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Original article

Evaluation of Serum Calcium Element among Type 2 Diabetes Mellitus Patients at Al-Zawia Medical Centers, Western Libya

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Abstract
Diabetes mellitus is an endocrine condition marked by impaired carbohydrate metabolism. The objective of this study is to assess the status of serum calcium among type 2 diabetes mellitus patients attending Al-Zawia medical centers, western Libya. This is a descriptive-cross-sectional design study, among one hundred and forty (140) diagnosed type 2 diabetes mellitus patients, both genders (70 males and 70 females) were recruited during the period from December 2024 to April 2025. Demographic data were collected by a validated structured questionnaire, and analyzed by a medical statistician as frequency and percentage calculations. The frequency of low calcium was found in 52(37.1%) patients, 28 of them females, 24 males, and the normal calcium was found in 67(47.85%) of the total diabetes mellitus patients. On the other hand, the frequency of hypercalcemia was seen in 21(15%) of the patients. This study concluded that hypocalcemia 52 (37.1%) and hypercalcemia 21 (15%) were observed in a moderate proportion of patients with type 2 diabetes mellitus.
Keywords. Type 2 Diabetes Mellitus, Calcium, Zawia, Western Libya.

Introduction

Diabetes mellitus (DM) is a heterogeneous group of metabolic disorders characterized by increased blood glucose levels (hyperglycemia) due to relative or absolute deficiency of insulin, resulting in extreme changes in carbohydrates, lipids, proteins, water, and electrolyte metabolism [1,2]. Now, worldwide, the prevalence rate of DM has increased and has become a major pandemic and an alarming issue. According to the International Diabetes Federation (IDF), the number of patients affected by DM reached 463 million in 2019 and is expected to reach 578 million in 2030, and perhaps 700 million in the year 2045. In the Middle East and North Africa, the prevalence of diabetes mellitus in individuals aged 20 - 79 years is the highest rate in adulthood, whereas in Libya was estimated at around 9.7% [3-5]. From this study, it is hypothesized that alterations and fluctuations in calcium flux may adversely affect insulin secretion, as insulin secretion is a calcium-mediated process [1]. Serum Calcium, a critical electrolyte, plays a vital role in various physiological processes and is associated with an increased risk of Type 2 Diabetes mellitus [4]. Patients with DM are generally diagnosed with abnormal levels of serum trace elements, including calcium and other minerals, while these microelements are pathologically and homeostatically changed or internally reduced [6]. The elevation level of serum calcium is associated with an increased risk of type-2 DM independently of measured glucose, insulin secretion, and insulin resistance [7].

Calcium is one of the main components of the human body skeleton, which represents about 99% deposited and stored in bones and teeth (8). The fluctuations in calcium levels are associated with physiological diminished stimuli to the pancreatic islets and insulin target cells to respond appropriately, leading to a break on homeostatic hyperglycemia [9]. The secretion of insulin depends on Calcium, but some studies have suggested that high Calcium intake may affect the absorption of magnesium, which may predispose to some diseases. it has been reported that high levels of Calcium may lead to the development of T2DM in the long term, in which insulin usage is reduced, as well as adipose tissue receptor activity [6].

In recent research, calcium and vitamin D levels influence insulin resistance and secretion [10]. Therefore, the major goal of this study is to evaluate the status of serum calcium among type 2 diabetes mellitus patients at some medical centers in western Libya.

Methods

This was a descriptive cross-sectional study, conducted at Al–Zawia Medical Centers, Western Libya, during the period from December 2024 to March 2025. One hundred and forty (140) diagnosed type 2 diabetes mellitus patients were included in the study. The participants included males and females their aged between 20 -70 years. Serum calcium level was measured by using a fully automated chemistry analyzer (Integra 411). Three (3ml) of venous blood were obtained from each subject without applying a tourniquet around the arm above the elbow, using 70% alcohol as an antiseptic, then blood was obtained into a plain container without anticoagulant, then centrifuged at 1200 rpm for 3 minutes to obtain serum, which was stored in a plain bottle at -20°C until analyzed.

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Statistical analysis
Data was analyzed by a medical statistician as frequency and percentage.

Ethical consideration
Ethical permission was taken from the health institutions, and verbal informed consent was also taken from all participants before collecting the samples, and the information was used anonymously.

Results

Through the data in (Table 2), to evaluate the level of calcium in the blood serum of diabetic patients for both sexes, we find that a group of cases fall within the normal limits of calcium level between 8.5-10.5 mg/dL, which reached (67) cases, distributed as 38 cases in females, representing 27.14%, and as 29 cases in males, representing 20.71%While the number of cases occurring at levels below the normal calcium level was less than 8.5 mg/dL, with a number of (52) cases, for both sexes, with a number of 24 cases in males, representing 17.14%, and a number of 28 cases in females, representing 20%. As for the cases occurring at a level above the normal calcium level of 10.5 mg/dL, there were (21) cases for both sexes, with 9 cases for males and 12 cases for females, representing 6.42%8.6% respectively. This confirms that diabetes has an effect on calcium levels among cases.

Table 1. The classification of diabetes mellitus according to gender

Gender	Frequency	Percentage %
Male	70	50 %
Female	70	50%

Table 2. The frequency and percentage of serum calcium status among diabetes mellitus patient groups

Serum calcium level	Male frequency	Percentage	Female frequency	Percentage
< 8.5 mg/dl	24	17.14%%	28	20%
8.5 - 10.5 mg/dl	29	20.71%	38	27.14%
>10.5 mg/dl	9	6.42%	12	8.6%

While we note from the data in (Table 3), the levels of calcium in the blood of diabetic patients by age group for both sexes, we find that the age group between (51-65) years recorded levels lower than the normal rate of calcium in the number of (23) cases for both sexes, including 11 for males, 12 for females, which accounted for 7.92%, 8.5%, respectively, followed by the age group between (36-50) years with 10 cases in females, 8 cases in males, representing 7.1% and 5.71% respectively.
The lowest number was recorded in the age group of (20-35) years, with 11 cases for both sexes, representing 3.57% for males, and 4.28% for females, while the normal rates of calcium levels for diabetic patients in the age group of (20-35) years were recorded with (28) cases, representing 8.57% for males, and 11.41% for females followed by the age group between (36-50) years with 24 cases for both sexes, representing 7.17% and 10.0% for males and females, respectively. The age group between 51-65 years recorded 15 cases of diabetes for both sexes, representing 0.05% and 507% for males and females, respectively.
Higher levels of calcium were recorded in diabetic patients, who were in the age group between (20-35) years at a rate of 2.14% and 3.5% for males and females, respectively, followed by the age group between (36-50) years with 7 cases, representing 2.85% in males and 2.1% in females. As for the age group between (51-65) years, it recorded 6 cases, representing 1.42% and 2.85% for males and females, respectively We find that the age group between (36-65) years is the age group that suffers most from a deficiency in blood calcium levels for diabetics, and this is an indication that aging affects calcium levels, especially in diabetics.

Table 3. Frequency and percentage of diabetic patients according to age group/serum calcium status

Serum calcium status	Age groups (Years)	Frequency of males	Percentage	Frequency of females	Percentage
<8.5 mg/dl	20 – 35 y	5	3.5%	6	4.28%
	36 – 50 y	8	5.71%	10	7.14%
	51 – 65 y	11	7.92%	12	8.57%
8.5 – 10.5 mg/dl	20 – 35 y	12	8.57%	16	11.4%
	36 – 50 y	10	7.14%	14	10.0%
	51 – 65 y	7	5%	8	5.71%
>10.5 mg/dl	20 – 35 y	3	2.14%	5	3.57%
	36 – 50 y	4	2.85%	3	2.14%
	51 – 65 y	2	1.42%	4	2.85%

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Discussion

In this study, one hundred and forty known diabetic patients (70 males and 70 females) were enrolled. Serum calcium was measured for evaluation, where data were collected from different Al-Zawia medical centers in Western Libya. Serum calcium was found low in a considerable number; 52 (37.3%) of the type-2 MD patients below the normal range (8.5mg/dl), moreover 24(34.3%) represents males and 28(40%) females, while normal serum calcium was found in 29(41.4%) of males and 38(54.3%) of females, meanwhile frequency of high levels (>10.5 mg/dl) of serum calcium found in 9(12.5%), of males and in 12(17.1%) of females, respectively.

Collectively hypocalcemia 52(37.1%) in all study group, while 28 of them females and hypercalcemia 21(15%) was moderately related to our research study on type-2 DM. this finding justified that females concerning decreased serum calcium level less than 8.5mg/dl, there was 11 of the DM patients with frequency of only 5(7.1%) males, 6(8.6%) females according to age group (20-35 years), and 8(11.4%), 10(14.3%) for age group (36-50 years), respectively, whereas 11(15.7%), 12(17.1%) represents the frequency in the third group (51-70 years). Additionally, our results have revealed a significant increase in the frequency of hypocalcemia in females more than males in all age groups, which may be due to some physiological, lifestyle changes, and postmenopausal. Another study reported a higher percentage of low serum calcium in type 2 DM (11), which has highlighted that the hypocalcaemia (serum calcium level less than 2.15 mmol/L) was detected in 73.6% of patients with type 2 diabetes mellitus.

Fluctuation in serum calcium can sometimes be reduced due to Gastrointestinal Tract (GIT) disturbances, as (12) mentioned that alteration in serum mineral levels by gut microbiota alterations can affect the absorption of serum calcium, and it can play a role in both diabetes mellitus and osteopathogenesis, potentially contributing to bone health and diabetic osteopathy. In another circumstance study revealed that hypocalcaemia has shown that those with Type 2 Diabetes mellitus had impaired bone remodeling processes (13). Hypercalcemia detected in 21(15%) was shared between males 9(6.4%) and 12(8.6%) females. This finding may be attributed to prescribed medication or lifestyle changes, and females are more affected. Furthermore, the presence of disorders like hypercalcaemia is are warning risk of type 2 DM due to its complications.

As previously reported, detection of abnormal levels of calcium and phosphate in the serum can be an early warning for the onset of metabolic dysfunction among individuals who are at risk for diabetes. With this information, medical professionals (doctors, nurses, etc.) can prevent this from happening by making changes in lifestyles like diet or drugs that prevent or control diabetes [14,15]. This study aimed to assess the status of calcium fluctuations among established type-2 DM patients, and may give rise to further research studies into the mechanisms underlying disturbances in serum multiple minerals, together with calcium, phosphate, magnesium, and zinc levels in type-2 diabetes mellitus patients.

Conclusion

This study revealed that hypocalcaemia 52(37.1%) and hypercalcemia 21(15%) were observed in a moderate proportion of patients with type-2 diabetes Mellitus. Further research is needed to elucidate the mechanisms underlying disturbances in serum calcium with multiple other minerals as vitamin D, phosphate, and zinc levels, in type 2 diabetes mellitus patients.

Conflicts of Interest

The authors declare no conflicts of interest.

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