Derna University Journal of Medical Sciences (DUJMS)

UNIVERSITY OF DERNA

Volume 2 | Issue 1 | 2024 | Pages 88-94
ISSN: 2789-7389 (Online) | **DOI:** https://doi.org/10.58987/v8vd3h02

Original Research

A Comparative Study on Calcium Level among Diabetic and Non-Diabetic Children in Tripoli

Ambarka Eid.H Kreim[1*] and Amal Rajab Agila[2]

[1]Department of Nutrition, Faculty of Public Health, Benghazi University*
Department of Biochemistry, Faculty of Medicine, Derna University, Derna, Libya. E.mail: a.khalil@uod.edu/ly, amal_agela@yahoo.com
***Corresponding Author*:** Ambarka Eid.H Kreim. Email: ambarkakreim@duo.edu.ly*

Received: 04 March 2024 **Accepted:** 29 March 2024 **Published:** 30 June 2024

ABSTRACT

This paper is to investigate the prevalence of hypocalcaemia in comparative two groups of diabetic & non-diabetic children. A cross-sectional study was performed on 100 diabetic and non-diabetic children (6-18 years old), who admitted to diabetes and endocrinology in Salah al-din clinic & Alsafwa hospital in Tripoli City, Libya. A standard interviewed-based questionnaire was used, the questionnaire comprises from two sections. Section I includes personal information such as (age, sex), while section II contains some questions such as (are you diabetic or not? taking medications, laboratory investigations such as (serum calcium, HbAC1) and anthropometric measurements such as (weight, height and BMI). Data were entered and analyzed using the Statistical Package for Social Sciences (SPSS version 24). The prevalence rates of hypocalcaemia among diabetic and non-diabetic children, overall and by relevant variables, were obtained and assessed for statistical significance using the chi square test. The mean (SD) concentrations of serum calcium level by different levels of

relevant variables were derived and assessed for statistical significance using the independent t-test as appropriate. Relating to analysis, there was a high significant difference between diabetic and non-diabetic Libyan children in serum calcium (n=50, M= 9.3182 ±, Std = 78425) (P value = 0.000 < 0.05). According to data analysis of serum calcium for all subjects, low value was 4.4 and high value were 10.9 (M= 6.66256 ±, Std = 3.16707 ng/ml), HbA1C the low value was (3.80) and the high value (14.7) (M= 7.4730 ±, Std = - 2.91772) and the low value for BMI was 11.7 kg/m2 and high value was 27.7 kg/m2 (M= 19.3109 ± Std = 3.33293). For blood investigation of serum glucose (HbA1C), there was a strong correlation between HbA1C level and age. The higher level of HbA1C at age was from 10-14 years for diabetic children. The overall prevalence of hypocalcaemia in diabetic patients was significantly higher than non-diabetic children in Tripoli. Factors independently related to hypocalcaemia in diabetic patients included: male gender and poor glycemic control. The data also showed that patients with diabetes had significantly hypocalcaemia as compared to nondiabetic subjects. Further studies are needed to assess the exact relationship between hypocalcaemia and uncontrolled diabetes related to children age groups.

KEYWORDS: Calcium Level, Diabetic Non-Diabetic Children, Hypocalcaemia, Tripoli.

INTRODUCTION

Micronutrients are identified as vital nutrients that are required in trace amounts for homeostasis, enzyme regulation and functioning (Anbreen A.& Mohammad Zuber et.al.,2012). This trace element play specific roles in the pathogenesis and progression of type 2 diabetes mellitus (T2DM (Amina B.et.al.,2018). Diabetes mellitus was diagnosed according to ADA criteria, if the patient had FPG ≥126 mg/dL (7.0 mmol/L) in two occasions or if the patient had a random plasma glucose ≥200 mg/dL (11.1 mmol/L) in the presence of classical symptoms of hyperglycemia, or if he or she had HbA1c ≥ 6.5%. Moreover, diabetes was considered to be controlled if the patient had HbA1c < 7.0% according to the American Diabetes Association (ADA) 2018 guidelines (Berridge MJ.et.al.,2000).

Calcium homeostasis is impaired in diabetes and contributes to defective cell regulation in erythrocytes, cardiac muscles, platelets and skeletal muscles. The impaired homeostasis is concerning as it could be a significant contributory factor in the regulation of proper insulin secretion and action, also affecting various vascular complications independently]. (Cerezo de Ríos et.al.,2014**).** In 2007, Pittas et al. showed that changes in calcium and vitamin D levels appear to be involved in the development of T2DM. The study showed a moderately consistent association between low vitamin D status and calcium or dairy intake, and prevalence of T2DM or metabolic syndrome. (Diwan AA.et.al.,2006). The serum 25-hydroxyvitamin D (25-OHD) levels and prevalence of metabolic syndrome and T2DM were analyzed, showing inverse associations with incidence of T2DM or metabolic syndrome for the highest versus lowest combined vitamin D and calcium intake. Hyperglycemia produced an adverse influence with vitamin D and calcium deficiency, whereas supplementation with these two nutrients showed beneficial effects on glucose metabolism. In two small group studies, a contrast in the levels of serum calcium was reported.

One study with 30 subjects in Baghdad with an age range of 6–18years reported an increase in the amount of serum calcium with a substantial decrease in the parathyroid levels. Another training achieved in India reported significantly reduced levels of serum calcium in diabetic patients compared with the non-diabetic controls. Increased plasma blood glucose levels were negatively correlated with serum calcium levels. (Grupo de Trabajo et.al.,2010**).** Several studies in diabetic rats reported that the reduction in intestinal calcium absorption occurred concurrently with decreases

in the circulating 1,25(OH)2D3 level, intracellular vitamin D receptor number, and cytoplasmic calcium-binding protein calbindin-D9k in the enterocytes (Kisters K.et.al.2000). However, other investigators have reported a compensatory upregulation of transcellular and Para cellular calcium transporter expression in the intestinal epithelial cells of diabetic animals.

As demonstrated by Riviera and coworkers, the expressions of transient receptor potential vanillin family calcium channel-6 (TRPV6), plasma membrane calcium-ATPase-1b (PMCA1b), sodium-calcium exchanger-1 (NCX1), and claudin-2 were significantly increased in the intestinal epithelium of STZ-induced T1DM rats. (Magnesium. Am.,2002). Hypocalcaemia is state when serum calcium level is less than 7 mg/dl in preterm neonates and less than 8 mg/dl in term neonates and less than 8.5 mg/dl in older children. Various factors regulate the homeostasis of calcium. These include parathyroid hormone, vitamin D, hepatic function, renal function, phosphate level and magnesium levels. In newborns present with poor feeding, vomiting, cyanosis, seizures, apnea, or asymptomatic. In children present by lethargy, seizures, cramping, laryngospasm, tetany and signs of nerve irritability (Muños, M.et.al.,2008).

Patients with DM have an increased risk of developing acute renal failure due to volume depletion. Under conditions of renal failure, phosphorus cannot be excreted by the hypocalcaemia condition induces hypocalcaemia by interfering in phosphorus excretion in the malfunctioning kidney. In addition, phosphate binds ionized calcium and removes calcium from the bloodstream. hypocalcaemia, hypomagnesemia is another cause of hypocalcemia in diabetic patients. Mg2+ reduction leads to hypocalcemia through decreased secretion of parathyroid hormone (PTH) or via bone and renal tubular resistance to the action of PTH. Vitamin D deficiency and administration of diuretics such as furosemide administration may also induce hypocalcaemia. one main objective was to investigate the prevalence of hypocalcaemia in comparative two groups of diabetic & non-diabetic children. (Anbreen A.& Mohammad Zuber et.al.,2012), (Grupo de Trabajo et.al.,2010).

MATERIALS AND METHODS

Subjects

A cross-sectional study was performed on 100 type 2 diabetic & non-diabetic children (6-18 years old), who admitted in to diabetes and endocrinology in Tripoli University Hospital, Salah al-din clinic & Alsafwa hospital in Tripoli City, Libya.

Study Design

A standard interviewed-based questionnaire was used to get data on demography, clinical and family history. The questionnaire comprises from two sections, each section including many questions. Section I containing personal information such as (age, sex, family income level), section II containing some questions such as (do you have any disease? taking medications, laboratory investigations such as (serum calcium, F.B.S, HbAC1 and lipid profile) and anthropometric measurements such as (weight, height & BMI).

Statistical Analysis

Data were entered and analyzed using the Statistical Package for Social Sciences (SPSS version 24). The prevalence rates of hypocalcaemia among diabetic and non-diabetic children, overall and by relevant variables, were obtained and assessed for statistical significance using the chi square test.

The mean (SD) concentrations of serum calcium level by different levels of relevant variables were derived and assessed for statistical significance using the independent t-test as appropriate. Multivariate logistic regression was used to assess the independent effect of a given variable after adjusting for potential confounders. A P-value (< 0.05) off hypocalcaemia is significantly lower in diabetic patients as compared to the children sample of nondiabetics.

RESULTS AND DISCUSSION

Age and Sex

This study includes 100 participants, 50 diabetic children with hypocalcaemia, the analysis of collected data will be presented as following: Socio-demographic characteristics of the patients.

Table1: Distribution of Diabetic and Non-Diabetic Children according to Age Group

Age (Years)	Percentage (%)
6 to 9	39
10 to 14	39
15 to 18	22
Total	100%

The age of the patients with hypocalcaemia under this study ranged between 6-18 years (39%) of the patients were aged from 6-14 years and 22%% were aged 15-18 years. (table1) in comparing with a study in Pakistan by Anbreen Anjum & Mohammad Zuber et.al (2012) it was serum of diabetic males of all age groups are significantly lower than the values obtained for non-diabetic males of respective age groups.

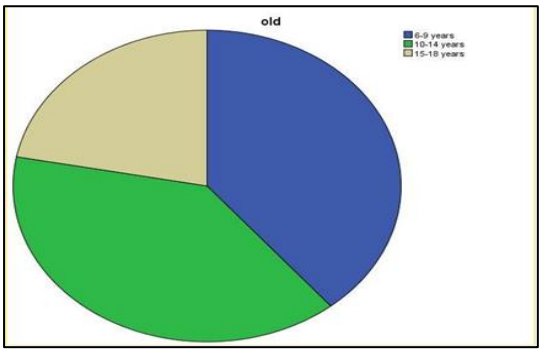

Figure 1: Relation between Age and HbA1C in Libyan Diabetic Children

More than half of the patients were males 55% and 45% were females for two groups diabetic and non-diabetic children. (figure 2). When comparing our results with study in Jourdan, by Rula Rashed & Dana Hyassat et.al (2022). There was multivariate logistic regression analysis showed that in diabetic: males, diabetic patients with HbA1c.

As well as a significantly decreased level of calcium was reported in serum of diabetic patients (Saniya and Demidov, 2007). Which were some of our results.

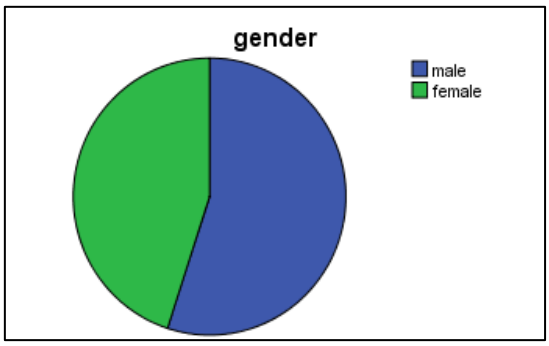

Figure 2: Distribution of Diabetic & Non-Diabetic Children Related to Gender.

According to data analysis serum calcium for all subjects, low value were 4.4 and high value were 10.9 (M= (6.66256 ± Std = 3.16707 ng/ml), HbA1C the low value were(3.80) & high value (14.7) (M= 7.4730 ± Std- 2.91772).

Also, the low value for BMI were 11.7 kg/m2 and high value were 27.7 kg/m2 (M= 19.3109 ± Std = 3.33293).as a comparing with study in pakistan by Pakistan by Anbreen Anjum & Mohammad Zuber et.al (2012).The concentration of Ca in the blood serum of diabetic and non-diabetic.

The mean of calcium serum level (ppm) was 119.93, in diabetic males of age groups 1-15 and while the level of Ca (ppm) in the blood serum of non-diabetic males of age matched groups was 170.77. which were not same as in this study.

Table 2: Serum Calcium, BMI and HbA1C for the Two Groups Diabetic and Non- Diabetic Children

Parameter	Low	High
Serum Calcium	4.4	10.91
HbA1C	3.80	14.7
BMI	11.83	27.7

Relations

Related to analysis, there a high significant difference between diabetic and non- diabetic Libyan children in serum calcium (n=50, M= 9.3182 ± Std = 78425) (P value = 0.000 < 0.05).

Table3: Statistical Comparison of Calcium Serum Values between Non-Diabetic and Diabetic Children

Patient State	**N**	**Mean**	Std. Deviation
Non-Diabetic	50	9.3182	0.78425
Diabetic	50	4.0068	2.2928
Non-Diabetic	50	1.96	0.755
Diabetic	50	1.70	0.763

Relation between Children Age and HbA1C in Diabetic Group

From blood investigation for serum glucose (HbA1C), there were a strong correlation between LHbA1C level age, it founded that a higher level of HbA1C at age from 10-14 years for diabetic children. (figure 2). In comparison with a research in Khartoum, North Sudan, the results showed that the diabetic group with increased Hb1Ac experienced a substantial decrease in serum calcium levels compared with the control group with normal levels of HbA1c. This negative correlation between the serum calcium levels and HbA1c in diabetic patients suggests that uncontrolled hyperglycemic diabetic patients are at risk of hypocalcaemia when compared with control patients, which is the same of our results.

Limitations

The main strength of our study its relatively collecting sample size and the fact that it was the first study conducted in Tripoli to assess the prevalence of hypocalcaemia among type 2 diabetic children. One of the anther limitations of our study was no previous study in Tripoli among relation between serum calcium in blood and diabetic children.

RECOMMENDATIONS

The present work recommends the following advices:

1-A1C or HbA1C should be measured in all children and adolescents who has family history with type 2 diabetes at 3-month intervals to assess their overall glycemic control.

2- Increasing use of CGM (continuous Glucose Monitoring) devices, outcomes other than A1C, such as time with glucose in target range and frequency of hypoglycemia, should be considered in the overall assessment of glycemic control.

3-Diabetic children who have hypocalcaemia should follow a nutritionist to give them a food items rich in calcium.

CONCLUSION

The overall prevalence of hypocalcaemia in diabetic patients was significantly higher than non-diabetic children in Tripoli. Factors independently related to hypocalcaemia in diabetic patients included: male gender poor glycemic control. Our data also showed that patients with diabetes had significantly h hypocalcaemia as compared to non-diabetic subjects. Further studies are needed to assess the exact relationship between hypocalcaemia and uncontrolled diabetes related to children age groups.

ACKNOWLEDGEMENT

We thank everyone helps to complete this research.

ETHICS

We have ethical approval from the research studies office of Tripoli University.

REFERENCES

1-Anbreen Anjum & Mohammad Zuber et.al (2012).Comparative study on calcium and cobalt in diabetic & non-diabetic patients in Punjab, Pakistan.

AFRICAN JOURNAL OF BIOTECHNOLOGY 11(28):7258-7262.

2-Amina Bouziani & Naima Saeid . Dietary Calcium Intake in Sample of School Age Children in City of Rabat, Morocco. Journal of Nutrition and Metabolism Volume 2018, Article ID 8084623, 7 pages https://doi.org/10.1155/2018/8084623.

3. UNICEF. 2019. Available online: https://www.unicef.org/media/60806/file/SOWC-2019.pdf (accessed on 12 November 2021).

4-Berridge MJ, Lipp P, Bootman MD (2000). The versatility and universality of Ca signaling. Nat. Rev. Mol. Cell. Biol. 1: 11-21.

5-Cerezo de Ríos, S.; Ríos-Castillo, I.; Brito, A.; López de Romaña, D. Nutritional counseling increases consumption of calcium-rich foods, but mean intake remains below the daily requirement. Rev. Chil. Nutr. 2014, 41, 131–138. [CrossRef]

6-Diwan AA, Pradhan AB, Lingojwar D, Krishna KK, Singh P, Almelkar SI (2006). Serum Zinc, chromium and magnesium levels in type-2 diabetes. Int. J. Diab. 26: 122-123. Fogh-Andersen N, Mcnair P, Moller-Petersen J, Madsbad S (1983). Lowered Serum Ionized Calcium In Insulin Treated Diabetic Subjects. Scand. J. Clin. Lab. Invest. 43: 93-97.

7-Grupo de Trabajo de la Guía de Práctica Clínica Sobre Osteoporosis y Prevención de Fracturas por Fragilidad. Guía de Práctica Clínica Sobre Osteoporosis y Prevención de Fracturas por Fragilidad. Plan de Calidad Para el Sistema Nacional de Salud del Ministerio de Sanidad, Política Social e Igualdad. Agència d'Informació, Avaluació I Qualitat en Salut (AIAQS) de Cataluña. 2010. Available online: http://aquas.gencat.cat/web/.content/minisite/aquas/publicacions/2010/pdf/gpc_osteoporosis_aiaqs2010_pcsns_vcompl_es.pdf (accessed on 12 November 2021).

8-Kisters K, Schildheuer M, Koneke J (2000). Magnesium Deficiency And Increased Fractional Magnesium Excretion In Insulin Dependent Diabetes Mellitus, Magnesium Loading Test And Blood Pressure. Trace Elem. Electro. 17: 67-70. Liu J, Zhu Z, Hua R, Liu X , Liu X (2000). Determination of trace elements Fe, Cr, Co and Ni in serum of middle-aged and aged people with slight and severe diabetes.

9-Magnesium. Am. J. Clin. Nutr. 45: 1305-1312. Wokoma FS (2002). Diabetes and Hypertension in Africa- an overview. Diabet. Int.12: 36-40. Xiao-fang Shen, Yong Zhang, Xue-mie Oin (2006). Spectroscopy and Spectral Analysis, 26: p. 187.

10- Muños, M.; Salas, J.; Bonanda, A.; Trallero, R. Dietadurante la infancia y la adolescencia. In Nutricion y Dietética Clínica; Elsevier: Amsterdam, The Netherlands, 2008; Volume 8, p. 83.

الملخص

تهدف هذه الدراسة إلى بحث مدى انتشار نقص كالسيوم الدم لدى مجموعتين مقارنتين من الأطفال، إحداهما مصابة بداء السكري والأخرى غير مصابة به. أُجريت دراسة مقطعية على 100 طفل (تتراوح أعمارهم بين 6 و18 عامًا)، مصابين بداء السكري وغير مصابين به، والذين راجعوا قسم السكري والغدد الصماء في عيادة صلاح الدين ومستشفى الصفوة بمدينة طرابلس، ليبيا. استُخدم استبيان معياري قائم على المقابلة، ويتألف من قسمين. يتضمن القسم الأول معلومات شخصية مثل (العمر، الجنس)، بينما يحتوي القسم الثاني على بعض الأسئلة مثل (هل أنت مصاب بالسكري أم لا؟، هل تتناول أدوية؟)، وفحوصات مخبرية مثل (مستوى الكالسيوم في الدم، والهيموجلوبين السكري HbA1c)، وقياسات أنثروبومترية مثل (الوزن، الطول، ومؤشر كتلة الجسم). تم إدخال البيانات وتحليلها باستخدام برنامج SPSS (الإصدار 24). تم الحصول على معدلات انتشار نقص كالسيوم الدم بين الأطفال المصابين وغير المصابين بالسكري، بشكل عام وحسب المتغيرات ذات الصلة، وتم تقييم دلالتها الإحصائية باستخدام اختبارَ Chi Square. تم حساب متوسط (الانحراف المعياري) تركيزات مستوى الكالسيوم في الدم حسب مستويات المتغيرات ذات الصلة المختلفة، وتم تقييم دلالتها الإحصائية باستخدام اختبار t المستقل عند الاقتضاء. أظهر التحليل وجود فرق دال إحصائيًا بين الأطفال الليبيين المصابين وغير المصابين بالسكري في مستوى الكالسيوم في الدم (ن = 50، م = 9.3182 ±، الانحراف المعياري = 78425) (قيمة 0.000 = P < 0.05). وفقًا لتحليل بيانات مستوى الكالسيوم في الدم لجميع المشاركين. في الدراسة، كانت أدنى قيمة لمستوى الهيموجلوبين السكري 4.4، وأعلى قيمة 10.9 (المتوسط = 6.66256 ± الانحراف المعياري = 3.16707 نانوغرام/مل). أما بالنسبة للهيموجلوبين السكري، فكانت أدنى قيمة 3.80، وأعلى قيمة 14.7 (المتوسط = 7.4730 ± الانحراف المعياري = -2.91772). وبالنسبة لمؤشر كتلة الجسم، كانت أدنى قيمة 11.7 كجم/م²، وأعلى قيمة 27.7 كجم/م² (المتوسط = 19.3109 ± الانحراف المعياري = 3.33293). أظهر فحص مستوى الهيموجلوبين السكري (HbA1c) في الدم ارتباطًا قويًا بين مستواه والعمر. وسُجلت أعلى مستويات الهيموجلوبين السكري لدى الأطفال المصابين بالسكري في الفئة العمرية من 10 إلى 14 عامًا. وكان معدل انتشار نقص كالسيوم الدم لدى مرضى السكري

في طرابلس أعلى بكثير منه لدى الأطفال غير المصابين بالسكري. كما تم تحديد عوامل مرتبطة بشكل مستقل بنقص كالسيوم الدم. شملت العوامل المؤثرة في مرضى السكري: الجنس الذكري وضعف السيطرة على مستوى السكر في الدم. كما أظهرت البيانات أن مرضى السكري يعانون من نقص كالسيوم الدم بشكل ملحوظ مقارنةً بالأفراد غير المصابين بالسكري. هناك حاجة إلى مزيد من الدراسات لتقييم العلاقة الدقيقة بين نقص كالسيوم الدم ومرض السكري غير المنضبط لدى الأطفال.

الكلمات المفتاحية: مستوى الكالسيوم، مرضى السكري، الأطفال غير المصابين بالسكري، نقص كالسيوم الدم، طرابلس.