

An investigation of the relationship between HbA1c and blood zinc levels in diabetes patients, who attending to Boumansour Diabetes and Heart Center in the city of Derna, Libya

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Abstract:

Background: Diabetes is a chronic illness that develops when the body is unable to use insulin efficiently or when the pancreas is unable to produce insulin at all. Zinc (Zn) is a vital metal with several roles in cellular metabolism. They include insulin regulation and carbohydrate metabolism. Aims and Objective: The current study was aimed at analyzing serum zinc levels among diabetic patients and determining the correlation between serum zinc levels and HbA1c among diabetic patients. Materials and Methods: The study involved a total of one hundred patients. Estimation of blood glucose (Fasting). Glycated haemoglobin (HbA1c) and serum Zinc was done. Statistical Analysis: The data is collected and analyzed statistically to determine the significance of different parameters by using the SPSS package for Windows version 25.0. Results: Serum zinc and HbA1c levels have a slight negative correlation ($R=0.263$, P value = - 0.008). Conclusion: This study concluded that there is a mild negative correlation between serum Zn with HbA1c. It is important to estimate the level of ZN in diabetic patients to know their insulin status and prevent complications. It has been demonstrated that supplementing with zinc can improve lipids, haemoglobin A1c (HbA1c), and plasma glucose in prediabetics and diabetics. It may also enhance insulin sensitivity, lessen oxidative stress, and guard against kidney damage.

Keywords: Zinc level, Diabetes mellitus, HBA1C.

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تحقيق في العلاقة بين $HbA1c$ ومستويات الزنك في الدم لدى مرضى السكري الذين يترددون على مركز بومنصور للسكري والقلب في مدينة درنة بلبيبا

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الخلاصة:

الخلفية: مرض السكري هو مرض مزمن يتطور عندما يكون الجسم غير قادر على استخدام الأنسولين بكفاءة أو عندما يكون البنكرياس غير قادر على إنتاج الأنسولين على الإطلاق. الزنك (Zn) هو معدن حيوي له عدة أدوار في التمثيل الغذائي الخلوي. وهي تشمل تنظيم الأنسولين واستقلاب الكربوهيدرات. الأهداف: تهدف الدراسة الحالية إلى تحليل مستويات الزنك في المصل بين مرضى السكري وتحديد العلاقة بين مستويات الزنك في المصل و $HbA1c$ بين مرضى السكري. **المواد والطرق:** شملت الدراسة ما مجموعه مائة مريض. تقدير نسبة السكر في الدم (الصيام). تم عمل الهيموجلوبين السكري ($HbA1c$) ومصل الزنك. التحليل الإحصائي: يتم جمع البيانات وتحليلها إحصائيًا لتحديد أهمية البارامترات المختلفة باستخدام حزمة SPSS للنوافذ الإصدار 25.0. **النتائج:** الزنك المصل ومستوى $HbA1c$ لهما ارتباط سالب طفيف ($R = 0.263$ ، قيمة $P = -0.008$). **الاستنتاج:** خلصت هذه الدراسة إلى أن هناك علاقة سلبية خفيفة بين مصل Zn و $HbA1c$. من المهم تقدير مستوى Zn في مرضى السكري لمعرفة حالة الأنسولين ومنع المضاعفات. لقد ثبت أن المكملات مع الزنك يمكن أن تحسن الدهون، $A1c$ الهيموجلوبين ($HbA1c$)، وجلوكوز البلازما في مقدمات السكري ومرض السكري. قد يعزز أيضًا حساسية الأنسولين، ويقلل من الإجهاد التأكسدي، ويحمي من تلف الكلى. الكلمات المفتاحية: مستوى الزنك، داء السكري، $HbA1c$.

Introduction

A class of metabolic disorders known as diabetes is defined by elevated blood sugar levels brought on by deficiencies in insulin production, insulin action, or both. Diabetes's chronic hyperglycemia is linked to long-term harm, malfunction, and organ failure, particularly to the kidneys, eyes, heart, nerves, and blood vessels. [1]

According to the report of The International Diabetes Federation (IDF) , The report showed that 537 million adults in the world are affected with diabetes. This number is expected to rise to 643 million by 2030 and 783 million by 2045. [2]

IDF report about Libya, mentioned there are 399.200 People with diabetes in 2021. and this number will increase during the year 2030 to 513600 people and during the year 2045 to 673300 people. [2]

Zinc is a trace element that helps the pancreas synthesize, store, and secrete insulin. Hypozincemia, which can be caused by either decreased intestinal absorption of zinc or hyperzincuria, is the main consequence of diabetes on zinc homeostasis. [3]

The way both muscle and fat cells use glucose is significantly influenced by zinc. Intracellular enzymes require its cofactor to operate, some of which may be involved in the metabolism of proteins, fats, and carbohydrates. [4]

Insulin receptor production and the insulin receptor-initiated signal transduction process may be regulated by zinc. [4] Zinc is also essential for the production, release, and storage of insulin by pancreatic tissue. It also maintains the hexameric crystalline form of insulin's structure. [5]

Zinc may be an essential ingredient of several antioxidant enzymes.

A rise in the levels of intracellular oxidants and free radicals linked to a decrease in intracellular zinc and zinc-dependent antioxidant enzymes may be the cause of many of the issues associated with diabetes. [5]

According to Anderson et al., zinc deficiency was discovered in 30% of DM patients. Zinc deficiency in type 2 diabetes was observed by Tripathy et al. in 2004 [7]. Mumza et al. (2016) [8] on the other hand, showed elevated zinc levels in patients with type II diabetes.

Thus, the purpose of this investigation was to ascertain the serum zinc status in patients with diabetes mellitus (DM) and its correlation with glycosylated haemoglobin ($HbA1c$).

Material and methods

This cross-sectional study was done at Boumansour Diabetes and Heart Center, Health Services Administration, Derna City, Libya, from Jun to Aug 2023. 100 diabetic patients were included in the study.

All patients had laboratory tests such as fasting blood sugar (FBS), glycosylated hemoglobin ($HbA1c$), and blood Zn levels. Results were analyzed by using SPSS software version 25.

Results and discussion

Table 1 shows the Characteristics of the study subjects. A comparison of variables with zinc levels is shown in table 2.

Table 3 shows Serum Zinc has a mild negative correlation ($r = -0.263$) with HbA1c ($p = 0.008$).

Table 1: Characteristics of the study subjects.

Variable (Mean \pm St.D)	Frequency	Percentage
Age group (55.72 \pm 12.45)		
13- 51	32	32
52 – 60	36	36
< 60	36	32
Gender		
Male	53	53
Female	47	47
BMI (81.91 \pm 21.97)		
Normal <25	31	31
Overweight 25-30	46	46
Obese >30	23	23
Marital status		
Single	5	5
Married	95	95
Educational Level		
Primary	26	26
Secondary	29	29
Undergraduate	45	45
FBS (177.48 \pm 71.485)		
Normal 70-120mg/dl	24	24
Diabetic >120 mg/dl	76	76
HBA1C (8.5538 \pm 1.65088)		
Normal <6.5	6	6
Control diabetic >6.5	49	49
Poor control Diabetic >9	45	45
Zinc Level (51.5050 \pm 242.40595)		
Low <68	29	29
Normal 68- 107	62	62
High >107	9	9

Table 2: Comparison of variables with zinc levels.

Variable	Zinc Level	P Value	Notes
Gender			
Male	53(53%)	0.101	T. test *
Female	47(47%)		
Age			
13- 51	32(32%)	0.702	ANOVA **
52- 60	36(36%)		
>61	32(32%)		
Education			
Primary	26(26%)	0.606	ANOVA **
Secondary	29(29%)		
Undergraduate	45(45%)		
Marial State			
Single	5(5%)	0.976	T. test *
Married	95(95%)		
Diabetic Family			
Yes	63(63%)	0.352	T. test *
No	37(37%)		

BMI			
Normal <25	31(31%)	0.688	ANOVA **
Overweight 25-30	46(46%)		
Obese >30	23(23%)		
Diabetic Control			
Yes	(40%)40	0.771	T. test *
No	60(60%)		
Zinc Supp.			
Yes	9(9%)	0.189	T. test *
No	91(91%)		
FBS			
Normal 70-120mg/dl	24(24%)	0.909	T. test *
Diabetic >120 mg/dl	76(76%)		

* Independent T-test

** One-way ANOVA

Table 3: Correlation of serum ZN & HbA1c.

		HbA1c
S. ZN	Pearson's Correlation	R= 0.263 P= -0.008

Discussion:

The purpose of the current investigation was to establish a relationship between the glycosylated hemoglobin levels in diabetes individuals and blood zinc levels. The results showed a mild negative correlation (P value 0.008, $r = 0.263$). The results agreed with the research carried out by Santosh K. Naik et al., 2019 [9], which showed a negative relationship between serum ZN levels and HbA1c.

The concentrations of blood Zn in the study group (Diabetic patients) were significantly decreased, as determined by Jyothirmayi B et al. in 2015 [10].

Ramesh Dasarathan and colleagues in 2017[11] observe that a significant negative relation between ZN and HbA1c.

A significant decrease in ZN levels among patients with Type II diabetes and high HbA1c, as observed by

Sunthari K et al. 2018 [12].

Sunita Pujar et al., 2014 [13] found that serum zinc and magnesium were negatively correlated with HbA1c.

Conclusion:

This study concluded that there is a mild negative correlation between serum Zn with HbA1c. It is important to estimate the level of ZN in diabetic patients to know their insulin status and preventing complications. It has been demonstrated that supplementing with zinc can improve lipids, hemoglobin A1c (HbA1c), and plasma glucose in prediabetics and diabetics. It may also enhance insulin sensitivity, lessen oxidative stress, and guard against kidney damage.

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