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An evaluation study of the trace element (Chromium) and it's severity in progression of diabetes mellitus type 1 and 2

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Abstract: The physiological functions of the human body depend on micronutrients called trace elements, which are essential in a number of metabolic pathways. Consequently, these deficiencies are associated with a number of chronic illnesses, such as diabetes mellitus. This study aimed to evaluate the relationship and severity of chromium in type 1 and type 2 diabetes, and to assess the correlations of chromium with some parameters in diabetes mellitus. There were 100 DM patients and 100 healthy controls in the current study. T1D affects people between the ages of 10 and 23 years, while T2D affects people between the ages of 40 and 70 years. The age of the controls and the patients was the same. The serum concentration of trace elements (chromium) was determined by a specific spectrophotometry flameless atomic absorption method utilizing an atomic absorption spectrophotometer. Chromium was determined at a wavelength of 357.9 nm, applying a slit width of 0.7 nm and a lamp current of 10 mA. To measure insulin and C-peptide, the Cobas Roche E411 was used, and to measure GAD antibodies, Magliume was utilized. Observations revealed that the mean concentration of Cr (0.6205 ± 0.40119) vs. (0.6775 ± 0.20316) (μ g/L) showed a non-significant p-value (0.387) in patients with type 1 diabetes when compared to the control group. In contrast, the mean level of concentration Cr (0.2614 ± 0.14735) vs. (0.6667 ± 0.20141) (μ g/L) significantly decreased (p-value = 0.0001) in patients with type 2 diabetes when compared to the healthy group. The findings of other parameters significantly decreased in patients with type 1 diabetes when compared to the healthy group (HOMA-IR, insulin, C-P) (P = 0.000, P = 0.000, P = 0.000). Meanwhile, GAD showed a significant increase in patients with type 1 diabetes when compared to the control group (p = 0.000). The results of other parameters in type 2 diabetes (HOMA-IR, insulin, C-P, GAD) showed a significant increase in patients with type 2 diabetes when compared to the control group (p = 0.0001, p = 0.0001, p = 0.0001, and P-value = 0.038). The current findings suggest that serum concentrations of the vital trace element chromium are connected to the existence of diabetes mellitus type 2 but not type 1. These findings contribute to the growing body of data showing the utility of chromium for proper glucose metabolism, creation, storage, and release of insulin, and help in normal insulin function. There are no correlations between chromium and other parameters in diabetes type 1 and type 2.

Keywords: *Atomic absorption spectrophotometer, Chromium, Diabetes mellitus type 1 and type 2.*

1. Introduction

Hyperglycemia linked to changes in the metabolism of fat, protein, and carbohydrates is a hallmark of diabetes mellitus, a metabolic disorder [1]. Type 2 diabetes is mainly caused by a combination of two main factors: defective insulin secretion and the inability of insulin-sensitive tissues to respond to insulin. Type 1 diabetes is characterized by insufficient insulin production due to beta cell destruction [2]. Gestational diabetes is the third major type of the disease [3]. Statistics show that diabetes is a serious global health concern. An estimated 463 million people between the ages of 20 and 79

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worldwide suffer with diabetes [4]. Trace elements are among the many factors that might cause diabetes or worsen its symptoms [5]. trace element, is necessary for human life. As a catalyst for enzymes, it aids in the organism's growth and development. helps with the metabolism of proteins, carbohydrates, and lipids [6]. Chromium produces over three hundred metalloenzymes and controls the synthesis and activation of several compounds [7]. Trace elements help regulate inflammation by reducing oxidative stress and changing pro-inflammatory cytokines. Deficits in trace elements impair human growth, reproduction, metabolism, and immunity [8]. Trace elements have an impact on insulin synthesis, storage, secretion, and metabolism in diabetes mellitus [9]. Deficits in trace elements are associated with insulin resistance [10]. Chromium is an essential metal for accelerating the metabolism of lipids, proteins, and carbohydrates [11]. Trivalent chromium can be found naturally in cereal grains, fruits, vegetables, nuts, meats, and spices. Numerous critical physiological processes in the body, most notably the metabolism of glucose, depend on chromium. It accomplishes this by activating insulin receptors with chromodulin oligopeptides, which raises sensitivity and facilitates the transmission of insulin signals [12]. A chromium shortage can have a number of metabolic effects, including hyperglycemia [13]. Elevated circulating insulin, impaired glucose tolerance, and developmental abnormalities [15]. Trivalent It has been demonstrated that chromium inhibits the release of cytokines and lowers oxidative stress. Chromium works similarly to insulin because it affects the phosphorylation-dephosphorylation pathways of proteins. The phosphorylation that leads to increased insulin sensitivity is partially caused by the enzyme insulin tyrosine kinase, which is activated by Cr. [14]. As a blood sugar modulator, chromium may help prevent elevated blood sugar levels [15]. Type 2 diabetes has been linked to low blood chromium levels, and there is growing evidence that diabetics have lower tissue chromium levels than healthy controls. Chromium may aid in the reduction of insulin resistance by boosting intracellular signaling, increasing the number of insulin receptor substrates, and improving receptor binding [16]. and improve insulin resistance by enhancing intracellular signaling [17]. This study aimed to evaluate the relationship and severity Chromium, in diabetes type 1 and type 2, and to assess Correlations of chromium to some parameters in diabetes mellitus.

2. Material and Methods

Shimadzu 7000f atomic absorption spectrophotometer for chromium measurement Japan. At a wavelength of 357.9 nm, chromium was measured with a lamp current of 8 mA and a slit width of 10 nm. Germany's Cobas Roche c111 for measurement ALT (alanine aminotransferase), AST (aspartate aminotransferase), fasting blood glucose, total cholesterol, triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C). blood creatinine and urea. Glycated hemoglobin (HBA1C) in human whole blood was measured using a BIO RAD D-10 HPLC company. United States

2.1. Subjects

There are 100 diabetics overall. 40 T1D with ages ranging from 10 to 23 years (22 men and 18 women) and 60 T2D with ages ranging from 40 to 70 years (26 men and 34 women) were enrolled in this study after the exclusion and inclusion criteria were rigorously applied. The person in question. were selected from among those who visited the Basra governorate's Al Fayha Teaching Hospital and Al Qurna General Hospital between August 2024 and February 2025.Direct patient interviews were used to gather data. While there were 100 healthy people (control), with a 50% female and 50% male ratio, each patient who took part in the trial gave written consent in compliance with international research ethics norms. T1D 40 samples are age-controlled (10–25) while T2D 60 samples are age-controlled (40–70).

2.2. Samples Collection and Separation

Every participant had five milliliters (ml) of whole blood extracted using a venous puncture. Two milliliters of collected blood were placed in an ethylene diamine-tetra-acetic acid (EDTA) tube for the

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HbA1c test, while the remaining blood was allowed to coagulate at room temperature in a gel vacuum tube. then centrifuged the serum at 3600 g for 10 minutes to separate it. The collected sera were frozen at -20 degrees Celsius (°C) for additional analysis. AST, ALT, lipid profile, chromium, and renal function test

2.3. Statistical Analysis

Any meaningful connections between the specified variables were examined using the Statistical Package for Social Sciences. A significant statistical relationship between qualitative factors was examined using the Chi-Square test, while parametric quantitative variables were examined using the Student t-test and non-parametric qualitative variables were examined using the Mann Whitney test." Pearson's test is used to examine correlations between parametric quantitative data, when analyzing correlations between non-parametric quantitative data, Spearman's test is employed. For association testing purposes, a threshold of probability value of less than 0.05 was considered significant.

3. Results

Patients with diabetes types 1 and 2 served as the basis for the current investigation. The levels of Cr in the blood samples, along with other parameters, were examined. Nonetheless, Table 1 compares the levels of chromium and other parameters in type 1 diabetics with controls. Compared to the control group (.6775±.20316), the chromium concentration in type 1 diabetic patients (.6205±.40119) had a non-significant p-value (.387). In comparison to the control group, the results of other measures (HOMA-IR, insulin, C-P,) were considerably significantly lessen in patients with type 1 diabetes (P=.000, P=.000 and P-value=.000). Compared to the control group, there is a substantial rise in individuals with type 1 diabetes during GAD (p=.000).

Table 1.
Comparison between chromium concentration and some parameters between type 1 diabetes and control.

Variables	Control(N=40)		DM type1(N=40)		P-value
	mean ±SD	Median(min-max)	mean ±SD	Median(min-max)	
Chromium ug/l	.6775±.20316	.7000(.40-1.10)	.6205±.40119	.6000(.10-1.40)	.387
HOMA-IR	1.6125±.21023	1.6500(1.10-2.00)	1.1763±.90114	1.1000(.20-5.70)	.000
Insulin Ulu/ml	8.3258±1.06844	8.2700(6.00-10.10)	2.2205±1.64781	2.0500(.50-9.30)	.000
C-P ng/dl	1.9698±.63115	1.8250(1.00-3.00)	.4375±.67812	.2950(.10-4.30)	.000
GAD IU/ML	5.6762±3.19785	5.1150(1.30-13.97)	75.9575±77.08800	56.7000(2.36-280.0)	.000

Note: *Mann-Whitney U test.

Chromium levels and a few other characteristics are compared between type 2 diabetes and control in Table (2). the levels of chromium in individuals with type 2 diabetes. Compared to the control group, there is a substantial decrease (.2614±.14735). (.6667±.20141). (p=0.0001). In comparison to the control group, patients with type 2 diabetes showed significantly higher findings for other measures (HOMA-IR, insulin, C-P, and GAD). (p=0.0001, p=0.0001, p=0.0001, P=0.038).

Table 2.
Comparison between chromium concentration and some parameters between type 2 diabetes and control.

Variables	Control(N=60)		DM type2(N=60)		P-value
	mean ±SD	Median (min.-max.)	mean ±SD	Median (min.-max.)	
Chromium ug/l	0.6667±.20141	0.7000(.40-1.10)	0.2614±.14735	0.2355(.10-.81)	0.0001
HOMA-IR	1.7283±.15524	1.7000(1.40-2.00)	26.5708±13.40220	23.3000(8.80-72.30)	0.0001
Insulin Ulu/ml	8.9200±.95665	9.0000(7.10-10.60)	39.8670±19.92751	31.5900(23.90-110.80)	0.0001
C-P ng/dl	1.9007±.57299	1.7850(1.10-3.22)	6.4245±2.25430	5.5350(3.49-13.12)	0.0001
GAD IU/ML	5.5190±3.0480	5.1250(1.00-12.98)	6.5202±2.89099	6.3500(1.10-12.30)	0.038

Note: *Mann-Whitney U test.

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Table 3 Correlations of chromium to some parameters in DM1. The results showed that there are no correlations between chromium and other parameters in type 1 diabetes. (zinc, Mg, HOMA-IR, insulin, C-P, GAD). (P=0.517, P=0.187, P=0.447, P=0.551, C-P=0.927, P=0.822).

Table 3.
Correlations of chromium to some parameters in T1DM.

Correlations	Variable (N=40)						
Chromium in TIDM	R	Zinc	Mg	HOMA-IR	Insulin	C-P	GAD
		0.106	-0.213	-0.124	-0.097	0.015	-0.037
	P-value	0.517	0.187	0.447	0.551	0.927	0.822

Note: *Spearman's correlations.

Table 4 Correlations of chromium to some parameters in DM2. The results showed that there is no correlation between chromium and other parameters in type 2 diabetes. (zinc, Mg, HOMA-IR, insulin, C-P, GAD). (P=.670, P=.771, .341, P=.864, P=.635, P=.572).

Table 4.
Correlations of chromium to some parameters in T2DM.

Correlations	Variable (N=60)						
Chromium in T2DM	R	Zinc	Mg	HOMA-IR	Insulin	C-P	GAD
		0.056	0.038	0.125	0.023	0.063	-0.074-
	P-value	0.670	0.771	0.341	0.864	0.635	0.572

Note: *Spearman's correlations.

4. Discussion

Diabetes mellitus. (DM) is a long-term metabolic condition marked by hyperglycemia levels brought on by an inability or resistance to insulin [18]. A vital micronutrient for insulin sensitivity and glucose homeostasis is chromium [19]. The activation of pathways involved in the translocation of glucose transporter 4 increases glucose transport and improves insulin sensitivity [20]. Many bodily physiological functions, most notably the metabolism of glucose, depend on chromium [21]. It does this by using chromodulin oligopeptides to activate insulin receptors, which increases sensitivity and the transmission of insulin signals. Hyperglycemia, increased levels of circulating insulin, decreased glucose tolerance, and development deficits are just a few of the metabolic consequences that can result from a chromium deficiency [22]. There is evidence that trivalent chromium decreases oxidative stress and inhibits the production of cytokines. Protein phosphorylation-dephosphorylation processes are impacted by chromium, which is why it functions similarly to insulin [14]. Chronic illnesses including diabetes mellitus have been connected to chromium [23]. Clinical trials that showed deficient symptoms in patients receiving complete parenteral nutrition without chromium in the solution led to the conclusion that chromium is an essential dietary mineral [24]. Nevertheless, the findings indicated that the chromium levels in diabetes type 1 patients (.6205±.40119), non-significant p-value (.387). when compared to the control group. (.6775±.20316). Because autoimmune damage usually causes pancreatic β cells to stop generating insulin in Type 1 diabetes mellitus (T1DM), an endocrine condition [25]. While results showed that the levels of chromium in diabetes type 2 patients (.2614±.14735), significant decreased (.2614±.14735), when compared to control group. (.6667±.20141). (p=0.0001). because insulin resistance and high blood glucose levels are hallmarks of Type 2 diabetes, a metabolic, chronic illness [26]. A trace element found in all foods, chromium is included in the metabolism of carb and fats and helps to keep insulin functioning normally [27]. A key component for the action of insulin and the control of blood sugar is chromium. is required for both functions. It maintains insulin homeostasis by acting as a vital antioxidant. Type 2 diabetes mellitus (T2DM) causes an increase in the production of free radicals and a decrease in antioxidants, particularly chromium. Prior studies have indicated a connection between low serum chromium levels and inadequate glycemic control [28]. According to certain theories, chromium may reduce insulin resistance by increasing the number of insulin receptor

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substrates, improving intracellular signaling, and improving receptor binding [16]. Thus, research is being done on micronutrients like chromium compounds as possible treatments and preventative measures for diabetes [22]. The result of my investigation is match with numerous other studies. Research shows that Cr+3 is a cofactor for a physiologically active molecule that amplifies the effects of the hormone insulin, which affects how protein, fat, and carbs are metabolized [23]. Studies frequently examined the role of Cr+3, which improves the hormone's effectiveness with the receptor, in the pathophysiology of diabetes mellitus. Additionally, based on the literature, this study indicated that diabetics have lower Cr+3 levels in their plasma and erythrocytes than non-diabetics [29]. Research has indicated that the occurrence and progression of diabetes and its consequences are directly linked to deficiencies in specific trace elements. According to preliminary research, the risk of acquiring type 2 diabetes is linked to the levels of chromium in adipose tissue diabetes mellitus [30]. In other study found chromium levels in plasma and blood components were shown to be higher in T2DM patients than in the control group [31]. the results of (HOMA-IR, insulin, C-P,). (P=.000, P=.000, P=.000). were significant decreased in patients with type 1 diabetes, when compared to control group. while GAD there are significant increase in patients with T1DM when compared to the healthy group. (p=.000). Table 1. While the results of (HOMA-IR, Insulin, C-P, GAD). (p=.0001, p=.0001, p=.0001 and P-value=.038). were significant increase in patients with type 2 diabetes, when compared to control group. Table 2. The results showed that there are no correlations between chromium and other parameters in type 1 diabetes. (zinc, Mg, HOMA-IR, insulin, GAD). (P=0.517, P=0.187, P=0.447, P=0.551, C-P=0.927, P=0.822). Table 3. The results showed that there is no correlation between chromium and other parameters in type 2 diabetes. (zinc, Mg, HOMA-IR, insulin, C-P, GAD). (P=.670, P=.771, .341, P=.864, P=.635, P=.572). Table 4.

5. Conclusion

This study's findings are consistent with those of earlier research, indicating that diabetes mellitus type 2 but not type 1 may be influenced by deficiencies and inefficiencies in a certain vital trace element (chromium). There was an inverse relationship between the risk of type 2 diabetes and the Cr111 concentration. These findings contribute to the growing amount of data showing that Cr is necessary to the proper glucose metabolism. Creation, storage, and release insulin. And help in normal insulin function. found no association between other parameters and Cr111 in type 1 and type 2 diabetes.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Authors Contributions:

Mohammad Odeh. Jadoo (Single Author). drafted and approved the manuscript.

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