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Internal Medicine

Zinc and Copper Status Among Egyptian Type 2 Diabetics and their Relationship to Glycemic Control and Micro Vascular Complications

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ABSTRACT

Background: Diabetes mellitus has been linked to altered Minirals and trace elements metabolism, which may play a unique role in the development and progression of this illness.

Aim of the work: To evaluate Zinc and Copper status among Egyptian Type 2 Diabetics and their relationship to glycemic control and micro vascular complications.

Patients and Methods: Cross-sectional research was conducted on A total of a hundred adult Egyptian patients of both sexes (33 males and 67 females) with T2DM, All procedures of this study were following Al-Azhar University committee regulations and standards.

Result: a significant correlation at the 0.05 level between serum CU and glycemic control evidenced by HbA1c level was noticed. The glycemic control indicated by the HbA1c level and serum Zn did not substantially correlate. There was also no substantial connection between serum Cu and serum Zn on one hand and the occurrence of diabetic micro vascular complications as evident by DR and its grades on the other hand.

Conclusion: The results denoting that glycemic status may affect the trace elements concentrations, also it confirms that some minerals and trace elements altered in diabetics may play a role in the development of diabetes or diabetic complications.

Keywords: *Diabetes; minerals; trace elements; free radicals; oxidative stress.*

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INTRODUCTION

Diabetes is spreading like an epidemic across the globe, with third world nations with growing economies seeing the most startling increases. The Middle East and North Africa (MENA) area, which has the greatest incidence of adult diabetes, is where this phenomenon is most noticeable.[1]

When the current number of 8.2 million people with diabetes doubles to 16.7 million by 2045, Egypt will move up to position 6 on the list of the top 10 nations in terms of this statistic. However, it's possible that Egypt's diabetes prevalence number is understated.[2]

Diabetes Mellitus (DM) is a metabolic condition that may cause both macro and microvascular issues. It has been discovered that this illness has an impact on the levels of trace elements (TEs), such as zinc (Zn) and copper (Cu). Cells are harmed as a result of this metabolic anomaly. Levels of TEs have been shown to be directly correlated with both health and sickness.[3]

In diabetic rats, Zn supplementation boosted glutathione peroxidase enzyme activity and lowered malondialdehyde and nitric oxide levels, demonstrating Zn's anti-oxidant defense against oxidative stress seen in T2DM. The scientists also noted that consuming Zn enhanced liver functioning and reduced diabetes-related pancreatic tissue damage.[4]

There is contradiction between the results of the different studies searching for the relationship between DM on one hand and Zn and Cu on the other hand. Where the result of one meta-analysis concluded that there is significant decrease in Zn and significant increase in Cu in patients with DM [5], there is another study concluded that both Zn and Cu are significantly decreased in patients with DM. [6]

PATIENTS AND METHODS

A total of a hundred adult Egyptian patients of both sexes (33 males and 67 females) with T2DM, their age ranges between 29 and 73 years, with their duration of suffering From T2DM ≥ 5 years irrespective to their glycemic control or the therapeutic agent(s) being used for that purpose.

Exclusion criteria include patients with T1DM, GDM i.e. DM which occur during pregnancy, patients who receive Zn and/or Cu supplementation or replacement for any reason, patients with history of bariatric surgery or any mal-absorption disorder; e.g. coeliac disease, IBD, etc, patients with any acute inflammatory conditions; e.g. Sepsis, collagen vascular diseases, etc, and finally, patients with chronic illnesses; e.g. chronic liver disease, chronic end stage kidney disease on renal replacement therapy (chronic peritoneal dialysis or hemodialysis), etc.

All procedures of this study were following Al-Azhar University committee regulations and standards.

Biochemical parameters: All participants were submitted to thorough medical history taking and physical examination focusing on optic fundi assessment for diabetic retinopathy and its grading using direct ophthalmoscope as well as laboratory tests including serum Cu level, serum Zn level, FPG and 2HPPPG levels, HbA1c, Serum creatinine and serum urea.

All samples (about 5 mL each) were collected using disposable syringes and were kept in the suitable tube for each test.

Samples for serum Zn and Serum Cu were collected in plain tubes, then after being left to clot for 30 minutes at room temperature, the serum was obtained by performing a 4,000×g centrifugation.

Colorimetric method was used for measuring levels of both serum Zn (with 5-Bromo-PAPS method) and Serum Cu (Dibrom PAESA method) and were measured using the auto analyzer (Biotecnica BT1500 via Licenza, 18, 00156 Roma RM, Italy).

Statistical analysis: The Statistical Package of Social Sciences (SPSS), version 25, was used to examine the data employing Pearson Correlation.

RESULTS

		Frequency	Percent
Valid	20-30	1	1%
	31-40	9	9%
	41-50	26	26%
	51-60	32	32%
	61-70	31	31%
	71-80	1	1%
	Total	100	100%

Table 1: showing the variation of the age of the participants, where 1 participant only was in the second decade of life, 9 patients in the third decade of life, 26 participants were in the fourth decade of life, 32 participants were in the fifth decade of life, 31 participants were in the sixth decade of life and 1 participant only was in the seventh decade of life.

		Frequency	Percent
Valid	5-10	80	80%
	11-15	12	12%
	16-20	4	4%
	21-25	1	1%
	26-30	2	2%
	31-35	1	1%
	Total	100	100%

Table 2: showing the duration of suffering from T2DM among the patients of the study where 80 patients suffered from T2DM for 5-10 years, 12 patients suffered from T2DM for 11-15 years, 4 patients suffered from T2DM for 16-20 years, 1 patient suffered from T2DM for 21-25 years, 2 patients suffered from T2DM for 26-30 years, 1 patient suffered from T2DM for 31-35 years.

		S.Copper	HbA1c
S.Copper	Pearson Correlation	1	0.173*
	Sig. (1-tailed)		0.043
	N	100	100

*. Correlation is significant at the 0.05 level (1-tailed).

Table 3: correlation between serum Cu and glycemic control evidenced by HbA1c level. There is a significant correlation at the 0.05 level.

		S.Zinc	HbA1c
S.Zinc	Pearson Correlation	1	.121
	Sig. (1-tailed)		.116
	N	100	100

Table 4: correlation between serum Zn and glycemic control evidenced by HbA1c level. It was noted that there is no significant correlation.

		S. Copper	Retinopathy
Retinotathy	Pearson Correlation	1	-.113
	Sig. (1-tailed)		.132
	N	100	100

Table 5: correlation between serum Cu and DR. It was noted that there is no significant correlation.

		S. Zinc	Retinopathy
S.Zinc	Pearson Correlation	1	.041
	Sig. (1-tailed)		.344
	N	100	100

Table 6: correlation between serum Zn and DR. It was noted that there is no significant correlation.

DISCUSSION

According to the laboratory outcomes of the patients who were included in the current research, it was found that there is a significant correlation at the 0.05 level between serum Cu and glycemic control evidenced by HbA1c level as shown in table 8 (The P value is 0.043).

Because it is a part of the mitochondrial cytochrome oxidative phosphorylation system, copper (Cu) is a necessary element that is crucial for the creation of energy.[7] Therefore, it is hypothesized that Cu shortage would result in mitochondrial distortion, especially in metabolically active cells like pancreatic and liver cells.[8] Cu levels in T2DM and T1DM patients have been the subject of inconsistent findings in earlier investigations.[9] For example, elevated plasma levels in investigations from Taiwan, Brazil, and Egypt, copper levels were recorded.[10] while investigations from the USA [11], Germany [12], and Austria indicated a drop in Cu levels or no change at all. [13]

The gap may be explained by variations in food preferences and behaviors across various groups.

As demonstrated in table 8, there is a substantial correlation between serum Cu and glycemic management as shown by HbA1c levels.

There is no substantial correlation noted between the serum Zn and glycemic control evidenced by HbA1c level as shown in table 9 (The P value is 0.116)

It was also noticed that there is no substantial connection between serum Cu and serum Zn on one hand according to the laboratory results, and DR on the other hand using direct ophthalmoscope as shown in table 10 and table 11 (The P value is 0.132 and 0.344 respectively).

CONCLUSION

Among the sample of the Egyptian patients with T2DM whose results were discussed and analyzed in this study, a substantial connection at the 0.05 level between serum CU and glycemic control evidenced by HbA1c level was noticed. There was no substantial connection between serum Zn and the glycemic control evidenced by HbA1c level. There was also no substantial connection between serum Cu and serum Zn on one hand and the occurrence of diabetic micro vascular complications as evident by DR and its grades on the other hand.

Conflict of interest : none

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