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Evaluation of the Levels of Copper, Magnesium, Zinc and Selenium in Subjects with Diabetes Mellitus

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Abstract

Diabetes mellitus is characterized by impaired glucose metabolism and a resultant effect of persistent hyperglycaemia. The objective of this study is to evaluate the levels of copper, magnesium, zinc and selenium in subjects with diabetes mellitus in Edo South Senatorial district of Edo state. A total of 100 participants (50 subjects with diabetes mellitus and 50 apparently healthy individuals used as control) were recruited into this study. Participants were screened for trace elements; magnesium, zinc, selenium and copper were analyzed using atomic absorption spectrophotometry. The data were analyzed using statistical software for social science version 23 (IBM, Chicago IL, USA). The mean value of the trace elements, only magnesium showed a statistical decrease in the subject group when compared to the control group(P=0.007), with zinc, copper and selenium depicting no statistical significance. It has been established that there is hypomagnesemia in subjects with diabetes mellitus, with no significant effect on copper, zinc and selenium. Understanding these relationships may inform targeted therapeutic interventions to mitigate the complications associated with diabetes mellitus. Magnesium levels of diabetic patients should be routinely analyzed and derangement should be commensurately managed using necessary diets and/or supplementation.

Keywords: Copper; Magnesium; Zinc; Selenium; Diabetes Mellitus

Introduction

Diabetes has posed a serious public health challenge on a global scale, affecting indiscriminately the poor, middle income and rich countries alike. Although, its effect has been more severely felt by middle income and low-income countries due to obvious socioeconomic disadvantage. Diabetes mellitus is a metabolic disorder characterized by elevated blood glucose levels due to the body's inability to produce or effectively utilize insulin [1]. The coexistence of these conditions can exacerbate metabolic disturbances, leading to poor glycemic control and an increased risk of complications [2]. The underlying mechanisms involve alterations in insulin sensitivity, glucose metabolism, and thyroid hormone regulation [3]. Chronic low-grade inflammation is a hallmark of diabetes mellitus, contributing to the development and progression of the disease [4]. Trace elements like zinc and selenium, play a vital role in counteracting oxidative stress and mitigating its deleterious effects [5]. These cofactors act as scavengers of ROS, enhancing the body's antioxidant defense mechanisms and potentially reducing the risk of diabetic complications [5]. However, the efficacy of antioxidant supplementation in managing diabetes mellitus remains a subject of ongoing research and debate [5]. Understanding these intricate relationships is crucial for developing effective strategies to manage and prevent diabetic complications. The aetiology, pathophysiology, diagnosis and management of diabetes, cannot be clearly understood without elucidating on its association with some anti-oxidative co-factors, oxidative stress, inflammatory and thyroid markers. A detailed knowledge of these interactions could assist endocrinologists, in better management of diabetics, thereby relegating or curbing its economic, social and health burden imposed on sufferers and their dependants.

Research Methodology

Study Area and Population

This study will be carried out at Edo Specialist Hospital, Benin City, Edo State. The study population for this research is diabetic patients attending the endocrinology clinic of Edo Specialist Hospital, Benin City, Edo State. Apparently healthy male and female subjects; with a good glucose metabolism and no history of

testing positive to tuberculosis, HIV, Hepatitis B and C virus served as the control group. Therefore, a minimum of 100 test samples and 50 controls were used for this study.

Study Criteria

Adult male and female subjects with laboratory evidence of diabetes mellitus, adult male and female subjects who gave an informed consent to participate in this work and adult male and female subject with no laboratory evidence of reactivity to tuberculosis, HIV, Hepatitis B and C were included in the study. While, adult male and female subjects with no evidence of impaired glucose metabolism, adult male and female subjects who refused to grant informed consent for participation and adult male and female subjects who tested positive to tuberculosis, HIV, hepatitis B and C were excluded from the study.

Sample Collection

About five millilitres of blood was collected aseptically from the cubital fossa of each subject by an experienced phlebotomist using an aseptic collection procedure as described by Cheesbrough (2000), dispensed into plain sample container and allowed to clot. After clot retraction, samples are centrifuged and the supernatant was collected into another plain container. Sample was then stored at freezing temperature until analysis.

Laboratory Analyses

Determination of Copper, Zinc, Selenium and Magnesium using Atomic Absorption Spectrophotometry

Principle: Atomic absorption spectrophotometry (AAS) is a commonly used analytical technique for the quantitative analysis of trace elements in a wide range of samples, including environmental, clinical, and biological specimens. The principle of the AAS method involves the measurement of the absorbance of light by free atoms in a gaseous state.

Method: The sample was prepared by acid digestion, ashing, or other methods that convert the sample into a solution that can be aspirated into the AAS instrument. The solution containing the analyte was aspirated into a flame, usually a flame produced by burning acetylene and air, where the sample is vaporized and the atoms of the analyte was excited to higher energy levels. A beam of light, usually from a hollow cathode lamp that emits light at the specific wavelength corresponding to the element being analyzed, was passed through the flame. The atoms of the analyte in the flame absorb some of the light, resulting in a decrease in the intensity of the transmitted light. The amount of light absorbed by the analyte was measured by a detector, and the absorbance was converted to concentration using a calibration curve generated using standard solutions of known concentration.

Quality control: AAS instruments include built-in quality control features to ensure the accuracy and precision of the analysis. These features include the use of blank solutions, reference standards, and control samples.

Result

Table 1 shows the results of the demographic characteristics of study participants.

Results for the trace elements, only magnesium showed a significant (P<0.05: P=0.007) decrease for the diabetic group when compared to the non-diabetic group while Cu, Zn and Selenium were not significant. This invariably implies that accompanied by impaired glucose metabolism as seen in diabetes mellitus is hypomagnesemia (Table 2).

Table 1: Demographic Characteristics of Study Participants.

Parameters	Diabetics	Control
No. of Sample	100	50
Age of Subject	6.25 ± 1.70	6.25 ± 1.52
Cu (Mg/L)	0.81 ± 0.03	0.86 ± 0.02
Zn (Mg/L)	1.08 ± 0.05	1.26 ± 0.06
Mg (Mg/L)	19.07 ± 0.47*	20.96 ± 0.49*
Se (Mg/L)	0.09 ± 0.01	0.11 ± 0.01
Catalase (u/mg)	7.57 ± 0.57*	16.89 ± 0.99*
GPx (u/mg)	4.72 ± 0.52*	11.49 ± 0.93*
MDA (µM/g)	0.54 ± 0.03*	0.44 ± 0.01*

Table 2: Comparison of anti-oxidative co-factors among study participants.

Variables	Diabetics (Test) n=100	Non-Diabetics (Control) n=50	t-value	P-value
Copper	0.8126±0.2219	0.8626±0.1950	1.197	0.234
Magnesium	19.0702±3.3523	20.9584±3.5065	2.752	0.007
Zinc	1.2318±0.4492	1.1140±0.4055	-1.377	0.172
Selenium	0.0986±0.0357	0.1118±0.0377	1.796	0.076

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Discussion

Results for the trace elements, only magnesium showed a significant (P<0.05: P=0.007) decrease for the diabetic group when compared to the non-diabetic group while Cu, Zn and Selenium were not significant. This invariably implies that accompanied by impaired glucose metabolism as seen in diabetes mellitus is hypomagnesemia. Studies have showed that in diabetic mellitus patients, trace elements like selenium, zinc, and copper play crucial roles in modulating redox parameters such as antioxidant enzyme activities and oxidative stress levels. Alterations in trace element status can disrupt the balance between oxidant and antioxidant defenses, contributing to increased oxidative stress and tissue damage observed in diabetes. Conversely, supplementation or optimization of trace element levels may help restore redox balance and mitigate complications associated with diabetes.

The results of this study regarding magnesium levels are consistent with those of Arpaci et al. [6], whose research on "Associations of serum Magnesium levels with diabetes mellitus and diabetic complications" identified a significant magnesium depletion. They suggest that hyperinsulinemia-related urinary magnesium excretion, insufficient nutrition, and possibly a particular renal defect might contribute to this occurrence. The results regarding magnesium in this study are consistent with those of Liamis et al., [7], who observed hypomagnesemia in patients with diabetes mellitus. They suggested that glomerular hyperfiltration might be responsible for this occurrence.

Conclusion

It has been established that there is hypomagnesemia in subjects with diabetes mellitus, with no significant effect on copper, zinc and selenium. Understanding these relationships may inform targeted therapeutic interventions to mitigate the complications associated with diabetes mellitus. Magnesium levels of diabetic patients should be routinely analyzed and derangement should be commensurately managed using necessary diets and/or supplementation.

Ethical Approval and Consent to Participate

The approval for this study was given by the ethical committee of Health Research Ethics Committee of Edo Specialist Hospital, Benin City, Edo State, Nigeria. Informed consent was obtained from each participant prior to specimen collection.

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References

1. American Diabetes Association (2023) Standards of medical care in diabetes-2023. Diabetes Care 46(1): 1-229.
2. Kuo IC, Lin HY, Shau WY, Huang CF, Lee PL, et al. (2019) Thyroid dysfunction in diabetic patients with metabolic syndrome. J Endocrinol Metabol 9(1-2): 22-29.
3. Kalra S, Sahay R (2022) Thyroid dysfunction in diabetes. J Pak Med Assoc 72(2): 449-453.
4. Esser N, Legrand-Poels S, Piette J, Scheen AJ, Paquot N (2014) Inflammation as a link between obesity, metabolic syndrome and type 2 diabetes. Diabet Res Clin Practice 105(2): 141-150.
5. Asemi Z, Karamali M, Esmaillzadeh A (2015) Effects of calcium-vitamin D co-supplementation on glycaemic control, inflammation and oxidative stress in gestational diabetes: A randomised placebo-controlled trial. Diabetologia 58(9): 1919-1928.
6. Arpaci D, Tocoglu AG, Ergenc H, Korkmaz S, Ucar A, et al. (2015) Associations of serum Magnesium levels with diabetes mellitus and diabetic complications. Hippokratia 19(2): 153.
7. Liamis G, Liberopoulos E, Barkas F, Elisaf M (2014) Diabetes mellitus and electrolyte disorders. World Journal of Clinical Cases: WJCC 2(10): 488.

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