Assessment of Serum Zinc, Magnesium, Copper and HbA1c among Sudanese Diabetic Patients Type1

Intisar Alasha[a]*, Tarig Karar[b], Nuha Abubaker[c]

[a]Department of Clinical chemistry, College of Medical Laboratory Science, Sudan University of Science and Technology, Khartoum- Sudan

[b]King saud bin Abdul Aziz . University for Health Science .college of Applied Medical Sciences, Saudi Arabia

[c]Department of Clinical chemistry, College of Medical Laboratory Science, Sudan University of Science and Technology, Khartoum- Sudan .

[a]Email: intisaralasha@yahoo.com ; [b]Email: tarig.karar@yahoo.com; [c]Email: nuhabubkr@gmail.com

Abstract

Diabetes is the most common set of disorders of carbohydrate metabolism. Diabetes is a chronic disease in the land affecting many age groups. Children and adults, male and female, are one of the leading cause of death in the world. Responsible for significant morbidity and mortality.

Keywords: HbA1c; Diabetes.

1. Introduction

Diabetes mellitus (DM) is a group of diseases in which blood glucose levels are Elevated. Diabetes is the most common set of disorders of carbohydrate metabolism. This chronic disease is responsible for significant morbidity and mortality [1]. The most common type of diabetes is type I and type II.

----

* Corresponding author.

There are also other types and we are here in the first type, which is important in our research, where this type is characterized by the cracking of the beta cells in the pancreas and the patient always the need for insulin to help introduce sugar into cells.

The high level of make disturbance in most body function and may make in future some complication. It is characterized by metabolic disorders related to high blood glucose levels [2]. .Type 1 diabetes is Most commonly diagnosed in young people, although its onset can occur at any age (1).Type 1 DM develops as result of the synergistic effects of genetic, environmental and immunological factors that ultimately destroy the pancreatic beta-cells [3]. In the good quarter of the century, diabetes has become a health problem for people in developing regions, and there are disorders in a wide range of non-stereotypes. A survey of the published information on diabetes mellitus in African populations reveals that most groups include several children and a significant number of teenagers [4]. Trace elements are important for the functioning of the body these micronutrients serve a variety of functions including catalytic, structural and regulatory activities in which, they interact with macromolecules such as enzymes, pro hormones, presecretory granules and biological membranes [5]. There is accumulating evidence that the metabolism of several trace elements are altered in type-1 DM and that these nutrients might have specific roles in the pathogenesis and progression of this disease[6] A number of studies have documented the association of trace elements zinc, copper and magnesium .some of it reported that Serum Copper concentrations was significantly higher in patients with type 1 diabetes mellitus as compared with the controls(2) Some studies have shown that plasma levels of magnesium in diabetics are generally lower compared with the general population. This magnesium deficiency, which may take the form of a chronic latent magnesium deficit rather than clinical hypomagnesaemia, may have clinical importance because the magnesium ion is a crucial cofactor for many enzymatic reactions involved in metabolic processes [7]. The cumulative glucose analysis (HA1c) is used to determine the long-term effect of glycemic control. It is a measurement of the proportion of hemoglobin molecules in glycosyl binding. N-terminal value residue of the hemoglobin β-chain. HbA1c is usually expressed as % but more recently as mmol/mol.HbA1c [5]; Age of hemoglobin content on red blood cells about 120 days during this period is generated by association with non-hem dialysis glycosyl at a rate proportional to the concentration of blood glucose . Thus the HbA1cvalue reflects the average glycemic control of the past three months of patients with diabetes. The past month, however, may have a relatively larger impact on the HbA1cvalue. There is some evidence that also hereditary factors affect the HbA1c level in patients with type 1 diabetes [5].

2. Objective

This study was carried out to measure serum levels of HbA1c, copper, zinc and magnesium in diabetic patients.

3. Materials and Methods

Ninety six fasting blood samples were collected from patients in period between June to October 2016, chosen from Gaber abo Aleaze Center and Omdurman children hospital and fifty three normal subjects as control. Serum copper, zinc, magnesium and HA1c were measured by using atomic absorption spectrophotometer.

Data analysis was carried out, using SPSS version, 21.

4. Results

Results of this study showed that, (15%) of patients at age range between (4- 8) Years, 66% of patients at age range between (9-13) years, while (19 %) of patients at age range between (14-18) years. The results showed that, 46 % of patients were male, while 54% of patients were female. Results of this study showed that, 15% of diabetic patients (control) at age range between (4-8) years, 71.7% at age range between (9-13%) years , 13.2% at age range between (14-18) years, while 14.6% of diabetic patients (un control) at age range between (4-8)years , 63.5% at age range between (9-13) years and 21.9% at age range between (14-18) years . Also in this study , the result showed that HbA1c , copper and Mg were significantly increased in diabetic patients compared to control group (10.6813 ± 1.659 vs 2.13 ± -- , p- value = 0.000)(1.489± 0.3066 vs 1.287 ±0.2535 p-value=0.01)(2.00 ± 0.1021 vs 1.962 ±0.1924 ,p –value =0.01) respectively and there was significant decreased in mean level of zinc in diabetic patients type 1 compared to control group(0.526 ± 0.1324 vs 0.626 ±0.1403 p, value =0.01) The results found , 50.4 % of patients under weight , 47.0% of patients with in normal range , 1.3% of patients over weight , while 1.3% of patients were obesity

5. Conclusion

The present finding concluded that, HbA1c, copper and mg were significantly increased, while zinc was significantly decreased in diabetic patients compared to control group.

6. Materials and Methods

Study Population: The study was carried out at College of Medical laboratory Sciences, and the subjects were recruited from Gaber abo Aleaze Center and Omdurman children hospital, in Khartoum (Sudan) from June to October 2016. A total of 149 children were enrolled in this study; divided into two groups, 96 diabetic patients (type 1) (case group) and 53 healthy children (Control group) ages and sex matched between two groups. The study was approved by hospital's ethics committee. Informed consent was obtained from patients before blood sampling.

- **Inclusion criteria**

    All children aged between 4 years to 14 with diabetes mellitus type l attending these refereed clinics as case group and healthy children serve as control group were included in this study.

- **Exclusion criteria**

    Newly discovered patients with diabetes (less than 6 months. patients aged less than 4 years and above l4years, diabetic patients with renal disease or any disease affect this parameters were excluded from the study.

- **Blood sample and Analysis**

About 4 ml of venous blood was collected by taking aseptic precautions. Care was taken to prevent venous stasis during the sample collection. The blood was allowed to clot and the serum was separated by centrifugation, heparin zed Container for serum zinc, copper and Magnesium, EDTA container for glycosylated hemoglobin the estimation of the parameters was carried out within 4-6 hrs. The samples were analyzed for serum zinc, copper and magnesium were measured by using atomic absorption method. Glycosylated hemoglobin (HbA1c) will be measured by Nycocard Company, read in Nycoerd reader II the internal control sera of two different levels were used to calibrate the instruments.

Data was analyzed using SPSS computer program, the mean and standard deviation were obtained and the independent test used for comparison (p value of ≤ 0.05) was considered significant.

7. Result

Results of this study showed that, (15%) of patients at age range between (4- 8) Years, 66% of patients at age range between (9-13) years, while (19 %) of patients at age range between (14-18) years as in figure (1).
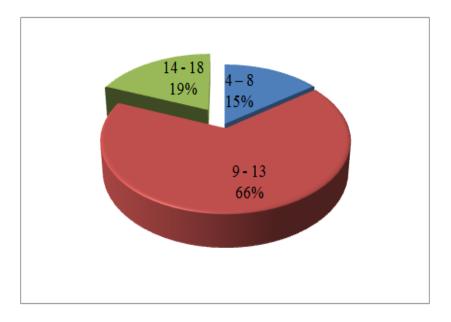

Figure 1: Age distribution among diabetic patients group

The results showed that, 46 % of patients were male, while 54% of patients were female as in figure (2)

Results of this study showed that, 15% of diabetic patients (control) at age range between (4-8) years, 71.7% at age range between (9-13%) years , 13.2% at age range between (14-18) years, while 14.6% of diabetic patients (un control) at age range between (4-8)years , 63.5% at age range between (9-13) years and 21.9% at age range between (14-18) years as in table (1)
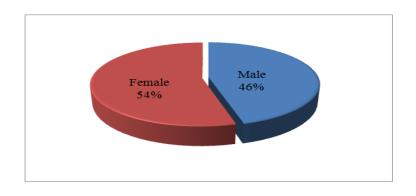
Figure 2: Gender distribution among patients group

Table 1: Age distribution among diabetic patients (control and un control patients)

	Age			Total
	4-8	9-13	14-18	
Control	8	38	7	53
	15.1%	71.7%	13.2%	100.0%
Diabetic	14	61	21	96
	14.6%	63.5%	21.9%	100.0%
Total	22	99	28	149
	14.8%	66.4%	18.8%	100.0%
Pearson Chi-Square	1.713			
P-Value	0.42(Not Significant)			

Results of this study showed that HbA1c , copper and Mg were significantly increased in diabetic patients compared to control group (10.6813 ± 1.659 vs 2.13 ± -- , p- value = 0.000)(1.489± 0.3066 vs 1.287 ±0.2535 p-value=0.01)(2.00 ± 0.1021 vs 1.962 ±0.1924 ,p –value =0.01) respectively and there was significant decreased in mean level of zinc in diabetic patients type 1 compared to control group(0.526 ± 0.1324 vs 0.626 ±0.1403 p, value =0.01)as in table (2) .

Table 2: Means comparisons of serum zinc, magnesium, copper and HbA1c in diabetic patient's type 1 compared to control group

Parameters	Patients n=96 Mean ± SD	Control n=53 Mean± SD	P- value
HbA1c %	10.6813 ± 1.659	2.14 ±0.007	0.00
Zinc mg/ l	0.526 ± 0.1324	0.626 ±0.1403	0.01
Copper mg/ l	1.489± 0.3066	1.287 ±0.2535	0.01
Mg mg/dl	2.00 ± 0.1021	1.962 ±0.1924	0.01

Results of this study showed that, 50.4 % of patients under weight, 47.0% of patients with in normal range , 1.3% of patients over weight , while 1.3% of patients were obesity as in table (3)

Table 3: BMI in diabetic patients group

BMI	Frequency	Percent
< 18.5 (Underweight / slim)	75	50.4
18.5 – 24.9 (Normal weight)	70	47.0
25 – 29.9 (Overweight)	2	1.3
≥ 30 (Obesity)	2	1.3
Total	149	100.0

8. Discussion

Diabetes Mellitus is the most set common of disorder carbohydrate metabolism this chronic disease is responsible for significant morbidly and mortality [1]. Over the last 20 years, many wreaths have been acquired in the form of life in Sudan. Also happen changes in physical activity and dietary patterns have promoted the development of non communicable disease in Sudan, Such as diabetes mellitus [2]. Results of this study showed that, (15%) of patients at age range between (4- 8) Years, 66% of patients at age range between (9-13) years, while (19 %) of patients at age range between (14-18) years. This result agreed with another result, which finding confirmed that the majority of patients at age range between (9-13) years [3]. , Also the result is similar to another study on the pattern of insulin dependent DM (IDDM) in Sudanese children, showed that, the mean age at diagnosis was 8.8 years and peak incidence was in the mild and late child hood [4]. The result showed that, 46 % of patients were male, while 54% of patients were female. This result agreed with another result which showed diabetes distributed among female more than male [4]. Also in this study, the result showed that HbA1c, copper and Mg were significantly increased in diabetic patients compared to control group (p- value = 0.01).This result agreed with another result which showed, there is accumulating evidence that the metabolism of several trace element are altered in type 1 DM [5]. Also the result similar to another result, which finding confirmed that, these elements in oxidative stress. Increased level of copper and decreased level of zinc this are associated with increased value of HA1c and suggests that, the impaired metabolism of these minerals may have a contributory role in the progression of DM and later development of complications [9]. The result of this study showed that, there was significant decreased in mean level of serum zinc in type 1 diabetic patients compared to control group (p- value =0.01).This result agreed With study done by Salmono and his colleagues which showed that, decreased in zinc it may be to Oxidative stress in T1DM is accompanied by alterations in enzymatic activity and non-enzymatic mechanisms of antioxidant defense [7]. The decreased TAS levels noted in T1DM patients may impair the effectiveness of non-enzymatic antioxidant systems and also observed several complications of diabetes have been supposed to be related to increased intracellular oxidants and free radicals associated with decreases in intra cellular Zn and in Zn dependent antioxidant enzymes [8]. Also the result agreed with another result which showed, Zinc has insulin-mimetic and anti-diabetic effects and deficiency has been shown to aggravate1 diabetes-induced oxidative stress and tissue injury in diabetic subjects with diabetes. Zn is also an inducer 2 of metallothionein that plays important role in anti-oxidative stress and damage [9]. This result disagreed with another results carried out by Ahmed *etal* , which found significant increased in mean of zinc level compared to control group.(p- value= 0.001)[2]. Also the result disagreed with

another study, which finding confirmed that, oxidative stress in diabetics cause destruction of β- cells release to amount of zinc from the cells into blood stream therefore increase in zinc levels in serum occurs [10].

Results of this study showed that, 71.7% of diabetic patients (control at age range between (9-13%) years, while 63.5% of diabetic patients (un control) at age range between (9-13) years.

Also results of this study showed that, 50.4 % of patients under weight, 47.0% of patients with in normal weight, 1.3% of patients over weight, while 1.3% of patients were obesity. This result disagreed with another result which finding that obesity is most risk factor for diabetes [7].

9. Recommendations

From the findings of this study it is recommended that:

1. Serum zinc and Copper and magnesium should be done as routine investigations in patient with type 1 diabetes to avoid serious complications of the disease.

2. Uptake of adequate zinc and copper rich nutrition is recommended.

3. More studies should be carried out on the effect of type1 diabetes mellitus on serum zinc ,copper and magnesium concentration with large sample size and to cover area with high population.

References

[1].Richard ,A., Matthew, R., HENRY'S Clinical Diagnosis and Management by Laboratory Methods, 22nd EDITION: Elsevier Saunders .2011 :226-240

[2].Ahmed ,H.A., EImanna,M.M., Mohammed N.B.,AbdeIrouf,M.B. Assessment of plasma copper, Zinc and glycated Hemoglobin among Sudanese patient with diabetes mellitus inKhartoumState.2016;2;91.

[3].Ozougwu, J., Obimba, K.C., Belonwu, C. D .The pathogenesis and path physiology of type 1 and type 2 diabetes mellitus: Journal of Physiology and Pathophysiology.2013; 4(4) : 46-56.

[4]. Elamin, A., Altahir, H ., Ismail, B .Clinical diabetes of child hood type 1 insulin dependent diabetes mellitus in Sudan , diabetes 1992(68):192-196.

[5].Qiu, Q., Zhang, F., Zhu, W., Wu, J., Liang, M. Copper in Diabetes Mellitus: a Meta-Analysis and Systematic Review of Plasma and Serum Studies. Biol Trace Elem Res. 2017;177(1):53-63.

[6]. Lowe,J., Taveira-da-Silva, R., Hilario-Souza, E. Dissecting copper homeostasis in diabetes mellitus. IUBMB Life. 2017;69(4):255-62

[7].Salmonowicz ,B., Krzystek-Korpacka, M., Noczynska, A. Trace elements, magnesium, and the efficacy of

antioxidant systems in children with type 1 diabetes mellitus and in their siblings. Adv Clin Exp Med. 2014;23(2):259-68.

[8].Ozturk ,N., Olgar y, Ozdemir, S. Trace elements in diabetic cardiomyopathy: An electrophysiological overview. World J Diabetes 2013 August 15; 4(4): 92-100

[9].Alghobashy ,A.A., Alkholy, U.M., Talat, M.A., Abdalmonem, N., Zaki, A., Ahmed, I.A. Trace elements and oxidative stress in children with type 1 diabetes mellitus. Diabetes Metab Syndr Obes. 2018;11:85-92.

[10]. Galli-Tsinopoulou, A., Maggana, I., Kyrgios, I., Mouzaki, K., Grammatikopoulou , M.G., Stylianou, C. Association between magnesium concentration and HbA1c in children and adolescents with type 1 diabetes mellitus. J Diabetes. 2014;6(4):369-77.