

## Evaluation of Serum Copper and Lipid profile among Sudanese Patients with Type 2 Diabetes Mellitus

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### Abstract:

*Diabetes mellitus type 2 (t2DM) is an endocrine disorders which result from defective insulin resistance. It is a health problem affecting millions of individual worldwide and a major cause of mortality in developed countries.*

*Increase evidence suggests that low copper and HDL levels in diabetic patients play a role in arteriosclerosis as one of the complications of diabetes.*

*This is a case control study included 100 candidates, 50 medically assessed and diagnosed as diabetic patients(case) and 50 apparent healthy as control group. Serum copper samples were measured by using atomic absorption spectroscopy 210-VGP, estimation of lipid profile by mindrayBS-200. Independent analysis shows significant decrease in copper and HDL level in case with p-value (0.040 and 0.000) respectively. Copper is positively correlated with (TCH, TAG), and negatively correlated with LDL. No correlation between copper and duration of the disease.*

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**Key words:** Copper, Total cholesterol, Triglyceride, High density lipoprotein, Low density lipoprotein

**Abbreviations:** Cu: copper, DM: Diabetes mellitus

## 1. Introduction

Diabetes Mellitus type 2(t2DM) is an epidemic disease in most countries worldwide. It is estimated at 150 million people. This number is likely to reach 300 million by the year 2025 if successful strategies are not implemented for its prevention and control <sup>(1)</sup>

The incidence of type 2 Diabetes Mellitus (t2DM) is increasing at an alarming rate both nationally and internationally , with more than 1 million new cases per year diagnosed in the US alone <sup>(2)</sup>.

Data on the epidemiology of Diabetes Mellitus type 2(t2DM) in the Sudan is meagre. Recent small study indicated a prevalence of 3.4%, while another one estimated (t2DM) around one million (95%) <sup>(3)</sup>.

Type 2 diabetes mellitus (t2DM) is an endocrinological disorder associated with hyperglycaemia characterized by both insulin resistance and defective insulin secretion <sup>(4)</sup>. Patients with diabetes mellitus are at increased risk for cardiovascular diseases, thus cardiovascular complications are the leading cause of diabetes-related morbidity and mortality <sup>(5)</sup>.

Type 2 diabetes mellitus (t2DM) is associated with a cluster of interrelated plasma lipid and lipoprotein abnormalities <sup>(6)</sup>.Lipoprotein abnormalities commonly present in type 2 diabetes include an abnormally high level of triglycerides (TG), a high proportion of low density lipoprotein cholesterol (LDL), and low high density lipoprotein cholesterol (HDL) <sup>(7,8,9)</sup>. This pattern of lipid profile in diabetes mellitus type 2 is termed diabetic dyslipidemia. Dyslipidemia is a major

risk factor for coronary heart diseases (CHD) especially in women <sup>(10)</sup>. Several factors are likely to be responsible for diabetic dyslipidemia: insulin effects on liver Apo protein production, regulation of lipoprotein lipase (LpL), actions of cholesteryl ester transfer protein, and peripheral actions of insulin on adipose and muscle <sup>(11, 12)</sup>.

Early detection and treatment of hyperlipidemia in diabetic patients reduces the risk of cardiovascular and cerebrovascular diseases. Lifestyle changes such as diet and exercise are very important in improving diabetic dyslipidemia, but often pharmacological therapy is needed <sup>(13-14)</sup>.

Copper is the third most abundant mineral in the human body. Copper is present in the body combined with various enzymes to form metallic-enzymes such as ceruloplasmin, and superoxide dismutase (SOD). These enzymes play a major role in redox reactions, such as superoxide dismutase which plays key role in antioxidant defence. Copper is associated with altered glucose metabolism through the stimulation of glycation and release of copper ion enhancing the oxidative damage <sup>(15)</sup>. It is known that copper plays an important role in the development and maintenance of immune system functions <sup>(16)</sup>. Proposed mechanisms of enhancement of insulin action by trace elements include activation of insulin receptor sites, serving as cofactors or components for enzyme systems which are involved in glucose metabolism, increasing insulin sensitivity and acting as antioxidants for preventing tissue peroxidation <sup>(17)</sup>. Trace elements participate in production of reactive oxygen species (ROS), contribute to oxidative stress. Oxidative stress has an impact on the pathogenesis of many diseases including (t2DM) and arteriosclerosis. Previous studies have shown that copper causes oxidative stress. Copper acts as a prooxidant and may participate in metal catalysed formation of free radicals. The increased production of free radicals is likely to be associated

with development of DM type 2 <sup>(18)</sup>. it is also manifested that some reactive oxygen species (ROS) are produced during diabetes due to imbalance of essential metals. This oxidative stress might decrease the insulin gene promoter activity and mRNA expression in pancreatic islet cells due to hyperglycaemic effect. <sup>(19)</sup>.

This study is an attempt to Study aim to evaluate copper level and lipid profile in the serum of type2 DM patients in Sudan.

## **2. MATERIALS AND METHODS:**

A case control study was conducted at Khartoum state during the period from September to October 2015. A total of 100 samples ,50 samples were taken from patients diagnosed as having (t2DM),32 (64%) of them were males and 18(36%) were females. 50 samples taken from apparently healthy candidates 32 (64%) males and 18(36%) were females with no history of Diabetes Mellitus as a control group. Vein puncher Blood samples were collected from all participants, samples were left at room temperature and then plasma was obtained by centrifugation at 3000 rpm for 10 min. Plasma was used for measure of lipid and copper profile .

The study was approved by the local ethics committee of Al-Neelain University. All participants were informed by the aim of the study and they signed a written informed consent. Samples and clinical information were used anonymously.

Estimation of copper is measured by absorption spectroscopy 210-GVP, estimation of lipid profile is done by mindary BS-200.

Data from all patients were presented as percentage and (mean±SD), differences between means of patients and control group were considered statistically significant with p-value threshold <0.05 using independent T-test.

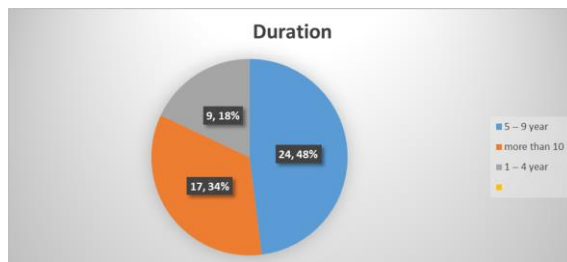
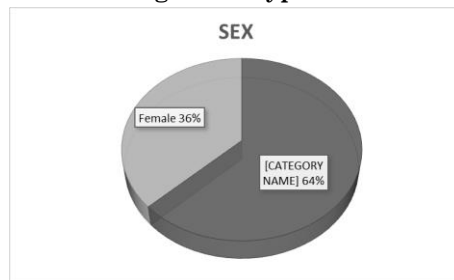
### **Ethical consideration**

The study has been approved by the local ethics committee of Al-Neelain University. The study participants give their written informed consent. Sample and clinical information were used anonymously.

### **3. RESULTS**

Fifty patients with Type 2 Diabetes Mellitus, and Fifty healthy persons selected as control were included in this study. The study had shown that levels of serum copper and HDL significantly decrease in case of comparison to control. But other lipid profile (T- cholesterol, TAG, LDL) were insignificant. The study revealed significant high HDL in male than female diabetic patients. Copper and HDL analysis were positively correlated only. Whereas no correlation was detected between copper and duration of the disease.

#### **3.1 Graf of Concentration of gender Type 2 Diabetes Mellitus**



**Table (1): Comparison between concentration of lipid profile and copper in type 2 diabetic patients**

Variable	Case	control	P.V
	Mean $\pm$ SD	Mean $\pm$ SD	
Total cholesterol	150 $\pm$ 35.62	151.2 $\pm$ 17.84	<b>0.832</b>
Triglyceride	105.14 $\pm$ 56.46	96.60 $\pm$ 13.18	<b>0.300</b>
HDL	49 $\pm$ 8.00	51.80 $\pm$ 5.08	<b>0.040</b>
LDL	84.52 $\pm$ 29.16	80.08 $\pm$ 20.05	<b>0.376</b>
Copper	0.31 $\pm$ 0.09	0.74 $\pm$ 0.03	<b>0.000</b>

- Result expressed as means  $\pm$  SD
- Significant different consider as p-value  $\leq$  0.05

**Table (2): Comparison between concentration of lipid profile and copper in control and type 2 diabetic patients**

Variable	Male	Female	P.V
	Mean $\pm$ SD	Mean $\pm$ SD	
Total cholesterol	155 $\pm$ 34.57	147.42 $\pm$ 36.40	<b>0.482</b>
Triglyceride	122 $\pm$ 84.32	96.45 $\pm$ 33.13	<b>0.131</b>
HDL	53.52 $\pm$ 12.08	46.66 $\pm$ 2.93	<b>0.003</b>
LDL	78.24 $\pm$ 29.26	87.76 $\pm$ 29.02	<b>0.279</b>
Copper	0.361 $\pm$ 0.067	0.293 $\pm$ 0. 932	<b>0.005</b>

- Result expressed as means  $\pm$  SD
- Significant different consider as p- value  $\leq$  0.05

**Table (3): Correlation of copper with lipid profile.**

Variable	R.V	P.V
Total cholesterol	<b>0.307</b>	<b>0.030</b>
Triglyceride	<b>0.344</b>	<b>0.014</b>
HDL	<b>- 0.046</b>	<b>0.749</b>
LDL	<b>0.255</b>	<b>0.073</b>

- Result present as mean  $\pm$  SD
- The value calculated using Test
- Significant different consider as P.value  $\leq$  0.05

**Table (4): Correlation of Duration with lipid profile and copper**

Variable	R.V	P.V
Total cholesterol	<b>0.057</b>	<b>0.695</b>
Triglyceride	<b>0.089</b>	<b>0.539</b>
HDL	<b>-0.120</b>	<b>0.204</b>
LDL	<b>0.053</b>	<b>0.714</b>
Copper	<b>0.277</b>	<b>0.051</b>

- Result present as mean  $\pm$  SD
- The P. value calculated using T. test
- Significant different consider as P. value  $\leq$  0.05

#### 4. DISCUSSIONS

Diabetes mellitus type 2(t2DM) is an endocrine disorders, which result from defective insulin resistance (who, 2016). It is a health problem affecting millions of individual worldwide and it is a major cause of morbidity in developed countries.

The present study provide experimental evidence that, mean concentration of HDL was significantly low in (t2DM) patients in comparison with control group with p-value 0.040(Table1). Our finding confirmed by pervious report that, Chinese had the highest HDL cholesterol than that of Malay and Indian ( $1.3 \pm 0.3$ ,  $1.2 \pm 0.3$  and  $1.1 \pm 0.4$ ) respectively. This might be due to different lifestyle among these races, including diet, exercise and other social habits. In Singapore a study showed that the differences in lipid profile between Malay, Chinese and Indians were due to differences in insulin sensitivity (20). While the results of other lipids profile showed insignificant differences in mean concentration of total cholesterol, TG and LDL-C with p-value (0.832), (0.300) and (0.376) respectively(Table1).

The results revealed that, mean copper level was significantly lower in (t2DM) patients versus control group with p-value 0.000(Table1). Thus, the essential antioxidant role of copper, is that its deficiency could lead to increase ROS formation and thus pathogenesis of CVD in (t2DM) patients.

The study provides experimental evidence that, mean concentration of HDL was significantly higher in male t2DM patients in comparison with gender group with p-value 0.003. Our finding disagreement by pervious report that women have higher production rates of Apo-I, the major HDL Apo protein, than do men, and that levels of Apo-I and production rates of Apo-I and Lp A-I can be increased with estrogen administration this make lowering HDL. Our finding might however be due to the menopause which affects the HDL (21)

The results revealed that, mean copper level was significantly lower in (t2DM) patients versus gender group with p-value 0.005. So essential antioxidant role of copper, deficiency could lead to increase ROS formation and thus pathogenesis of CVD in (t2DM) patients. .

Persons correlation analysis showed, there were positive significant correlation between copper and (T.ch and T.G) with p-value (0.014) and (0.030) respectively. Also there were positive insignificant correlation between copper and LDL with p-value (0.073). Likewise there were Negative insignificant correlation between copper and HDL with p-value (0.749).

Person's correlation analysis showed, there were positive insignificant correlation between Duration and (T.ch, T.G and LDL) with p-value (0.695), (0.539) and (0.714) respectively. There were Negative insignificant correlation between duration and HDL with p-value (0.204), and positive significant correlation between duration and copper with p-value (0.051).

## **CONCLUSION:**

HDL and copper are deficient in Sudanese (t2DM) patients. Essential role of copper as antioxidant factor and destructive effect which may lead to one of the complications in diabetic patients as arteriosclerosis. That is a main supplementation need.

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