

## A Study of Serum Copper, Zinc and Magnesium in Type 2 Diabetes Mellitus with Complications and Without Complications

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In 21st century Type 2 diabetes mellitus is most challenging problem for human being. Trace elements are known as important substances for human health, because of metabolic characteristics and their functions. They have role in catalytic and regulatory functions. Trace elements interact with enzymes, pro hormones and pre secretory granules, biological membranes. Among the trace elements Copper (Co), Zinc (Zn) and magnesium (Mg) are most valuable. The present study has been planned to verify the role of these particular trace elements in diabetic complications and to find out the relation between these if there is any. copper, zinc and magnesium in relation to various complications of type 2 diabetes mellitus. This study was done in geetanjali medical college and hospital on 120 patients with healthy controls. Present study has shown increased Cu levels, and decreased level of Zinc and magnesium in comparison to control group. An adequate supply of particular substances in the diet of these diabetic patients can be effective in the management of diabetic patients.

**Keywords:** Fasting plasma glucose, Diabetic nephropathy, cardiovascular disease, trace elements.

A big health problem of present era is Type 2 diabetes mellitus<sup>1</sup>. The presence of metabolic imbalance lead to unchanged irreversible functional and structural alteration in body which lead towards “diabetic complications”, which affecting, cardiovascular, eye, renal and nervous system mostly<sup>2</sup> Chronic effect of type 2 diabetes could divided into vascular and nonvascular complications. Diabetic vascular complications are subdivided into micro and macro vascular complications<sup>3</sup> Few of them act as antioxidants. They prevent peroxidation of membrane Similarly

on glucose metabolism<sup>4</sup> Study regarding these elements has been continuously increasing during last two decades. they are known as essential for health of human being because of their various functions in metabolism and cell structure. They have an important role in functions of cell membrane, as enzymes and hormones.<sup>5</sup> In between Copper (Co), Zinc (Zn) and magnesium (Mg) are of Important<sup>6</sup> copper has insulin-like activity and increasing lipogenesis<sup>7</sup>

So many studies showed changes in serum copper level associated with diabetic

patients<sup>8</sup> Zn will be able to affect capability of islet cells of pancreas . Which are responsible for insulin production and secretion in type-2 diabetes<sup>9</sup>. Metabolism of glucose and transporting mechanisms are affected by magnesium as a cofactor by affecting enzyme involve in insulin secretion and their binding capacity.<sup>10</sup> We have planned this study to identify the role of trace elements in diabetic complications and to find out their relation.

### Material and methods

Cases were clinically diagnosed cases of type 2 DM with and without complications attending the biochemistry, ophthalmology, nephrology and cardiology department at Geetanjali Medical College & Hospital, Udaipur (Rajasthan).

The total sample of 120 patients including cases and control was taken in which equal division had done as 30 control and 30 in each complication. Group 1- Clinically diagnosed cases of DM type 2 without complications

Group 2- Clinically diagnosed cases of DM type 2 with retinopathy

Group 3- Clinically diagnosed cases of DM type 2 with nephropathy

Group 4- Clinically diagnosed cases of DM type 2 with coronary artery diseases

Informed consent was obtained from all subjects for participating in the study.

Blood sample was collected by vein puncture using an aseptic technique. Serum was Separated from the sample and was analyzed for following biochemical parameters- copper was estimated by Di-Br- PAESA method, serum zinc and magnesium by Calmagite method and 5-Brom-PAPS Johnsen and R.Eliasson method, respectively done Erba chem. V2 5 plus semi automated analyzer.

### RESULTS

Present study has shown increased Cu levels, and decreased level of Zinc and magnesium in comparison to control group.

**Table 1.** Comparisons between the patients with diabetic complications and Control group for Copper

S.no.	Parameter	Types of complication	Mean±-SD(n=30)p value		
			Patients	Control	
1	Copper(µg/dl)	Diabetic neuropathy	125 ± 120.52	103 ± 7.08	<0.0001*
2		Cardiovascular disease	129 ± 12.52	103 ± 7.08	<0.0001*
3		Diabetic retinopathy	129 ± 14.3	103 ± 7.08	<0.0001*

**Table 2.** Comparisons between the patients with diabetic complications and Control group for Zinc

S.no.	Parameter	Types of complication	Mean±-SD(n=30)p value		
			Patients	Control	
1	Zinc(µg/dL)	Diabetic neuropathy	56 ± 6.7	67.6 ± 6.23	<0.0001*
2		Cardiovascular disease	56.8 ± 8.1	67.6 ± 6.23	<0.0001*
3		Diabetic retinopathy	54 ± 6.09	67.6 ± 6.23	<0.0001*

### DISCUSSION

Complications associated with diabetes mellitus are increasing during last two decades and increasing the rate of mortality in developing

and developed countries around the globe.<sup>11</sup> The role of trace elements are still not clear in diabetic patients, specially copper, Zinc and Magnesium.<sup>12,13</sup> We have determined the level of Copper, zinc and magnesium in the serum of all the patients as well

**Table 3.** Comparisons between the patients with diabetic complications and control group for magnesium

S.no.	Parameter	Types of complication	Mean±-SD(n=30)p value		
			Patients	Control	
1	Magnesium (µg/dL)	Diabetic neuropathy	1.6 ± 0.25	1.92 ± 0.37	0.0002*
2		Cardiovascular disease	1.7 ± 0.37	1.92 ± 0.37	0.0130*
3		Diabetic retinopathy	1.73 ± 0.30	1.92 ± 0.37	0.033*

as in controls and finally the results of cases were compared with that of controls. This study has shown increased Cu levels in diabetic patients with complication than without complication. The higher serum level of Cu in diabetic patients found in our research was similar with the study of Ghada A El-Zebda (2006), in their study Copper mean concentration was higher in diabetic hypertensive than control group and not significant, ( $P > 0.05$ ).<sup>14</sup> In contrast to our result M Prasad Naidu, Shiva Kumar *et al* in 2013 concluded that the mean blood copper levels in Diabetic Nephropathy cases were not significantly differed<sup>15</sup>.

We have found significantly low level of Zinc in patients in comparisons to control. Our study is similar with the study of Mohan Lal, Sudha K *et al* (KMC, Manipal) a significant decrease in, Zn and Mg.<sup>16</sup> which is similar to observations reported by Ghada A El-Zebda (2006), mean concentration of zinc was higher than control group and Significant ( $P < 0.05$ )<sup>(14)</sup>. Hyperglycemia will lead to low zinc level. Zn also has an important role as antioxidant and defense oxidative stress. Zinc deficiency lead to damage in cell and tissues because of oxidative stress in diabetic patients. (Chausmer 1998)<sup>17</sup>

In this study, magnesium levels in diabetics with complications were lower than the control group. Decrease level of serum magnesium commit to progression of diabetic Complications like retinopathy, abnormal functions of platelet, Cardiac functions, hypertension by decreasing the inositol transport pathway and later intracellular depletion<sup>(18)</sup>. Low level of magnesium in circulation lead to hypertension, abnormal lipid metabolism, increased inflammation, thickness of carotid wall, oxidative stress and heart disease<sup>19,20</sup>.

The kidney plays a major role in magnesium homeostasis and in maintenance of magnesium concentration. In addition to osmotic

action of glucosuria, hypomagnesemia may also occur following insulin therapy for diabetic ketoacidosis and may be related to the anabolic effects of insulin driving magnesium back into cells.<sup>21,22</sup>

This study suggests that zinc concentration may be considered a biochemical marker of oxidative stress associated with complications of diabetes. Deficiency of nutrients in developing countries can be a significant contributing factor in progression of chronic diseases, such as diabetes. The data of our study does not allow us to conclude whether zinc and magnesium deficiency and elevated serum copper level are the major causes of complication to occur. However, the elevated copper level and low zinc and magnesium levels in patients having diabetic complications as compared to the controls indicated there strong association in the Indian population.

## CONCLUSION

This is recommended that an ample of these elements in the diet of diabetic patients can be helpful in the management of diabetic patients in future. As well as antidiabetic therapy, zinc, magnesium supplementation and copper chelation can lessen Complications because of diabetes mellitus yet still more studies in this concern are Suggested. .

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