



SERUM ZINC LEVELS IN TYPE 2 DIABETIC PATIENTS AND ITS WITH MICROVASCULAR COMPLICATIONS

Dr. Gayathri J*

Post Graduate, Department of General Medicine, Sree Mookambika Institute of Medical Sciences, Kulasekharam *Corresponding Author

Dr. R. Aashish

Post Graduate, Department of General Medicine, Sree Mookambika Institute of Medical Sciences, Kulasekharam

Dr. K.P. Selvarajan Chettiar

Professor, Department of General Medicine, Sree Mookambika Institute of Medical Sciences, Kulasekharam.

ABSTRACT

Background: Zinc is an essential trace element that has antioxidant effects. Oxidative stress is exacerbated by zinc deficiency, particularly in diabetes. However, it is still unclear how the zinc level in type 2 diabetes patients relates to all of the microvascular problems. A small percentage of people with type 2 diabetes mellitus (DM) experience zinc insufficiency, which is unrelated to diabetes management. It has been suggested that giving diabetic patients oral zinc may help with wound healing and the prognosis of DM complications. **Aim:** The purpose of this study was to analyse the relationship between zinc level and diabetic microvascular complication. **Materials and Method:** Present study was a cross sectional study conducted in Department of General Medicine, Sree Mookambika Institute of Medical Sciences, Kulasekharam for a period of 8 months. The study comprised type 2 diabetes patients between the ages of 40 and 65. The study involved a total of 80 patients. Age, gender, diabetes duration, and a thorough clinical examination were all considered clinical details. Blood glucose level was measured. Absorption spectrophotometer technology was used to measure the level of zinc. Unpaired t test and Chi square test were used to examine the results using SPSS 20.0 version. **Results:** In the current study, 68 (85%) patients had low serum zinc levels. Patients with diabetes had a mean serum zinc level that was much lower, 66.81 ± 10.32 g/dl. In comparison to patients without microvascular problems, patients with microvascular complications had lower mean zinc levels. Microvascular problems were statistically significant when compared to zinc levels, with p values less than 0.05. **Conclusion:** The mean serum zinc levels are considerably lower in diabetic patients. Increased frequency of diabetic microvascular problems was associated with lower serum zinc levels in type 2 diabetes patients.

KEYWORDS : Antioxidant, Blood sugar, Diabetes mellitus, Diabetic nephropathy, Zinc

INTRODUCTION:

Diabetes mellitus (DM) is a term given to a set of common metabolic diseases that all exhibit the hyperglycemia phenotype. Type 2 diabetes is quickly expanding, accounting for 90-95 percent of the entire diabetic population.¹

Diabetes is a chronic, life-threatening disease. Microvascular consequences from diabetes, such as diabetic nephropathy, diabetic retinopathy, and diabetic peripheral neuropathy, can be extremely burdensome for patients, their families, and society.²

Zinc is one of the fundamental trace elements required for all forms of life to function normally. Many different foods, both of animal and plant origin, contain zinc. Zinc is more easily accessible in animal products than it is in plant items.³ Zinc is crucial for healthy growth, reproduction, immune system, and glucose metabolism. It also has tight interactions with the endocrine system.⁴

Zinc plays a crucial function in the utilisation of glucose by fat and muscle cells. It is necessary as a co-factor for intracellular enzymes that could be involved in the metabolism of proteins, lipids, and glucose to function.⁵ The insulin receptor-initiated signal transduction process and the production of insulin receptors may be regulated by zinc. The synthesis, storage, and secretion of insulin by pancreatic tissue all depend on zinc, and this mineral is also responsible for maintaining the structural integrity of insulin in its hexameric crystalline structure. Several antioxidant enzymes may contain zinc as a key ingredient.⁶

An major factor in the emergence of diabetic microvascular problems is oxidative stress. In addition to having an antioxidative action, zinc is an essential part of numerous antioxidant enzymes. It promotes the removal of free radicals and prevents the harm caused by lipid peroxidation.^{7,8} These

results imply that low zinc levels may contribute to the emergence of diabetic microvascular problems.

Patients with microvascular difficulties exhibited significantly lower zinc levels than diabetic patients who did not have microvascular complications.⁹ However, the majority of such studies were limited in scope and focused on just one microvascular complication.

However, one problem may be an independent risk variable for another complication which is not being researched at the same time. Only few studies, particularly in Asian populations, examined the relationship between zinc levels and all microvascular problems.

AIMS AND OBJECTIVES:

- To analyze the relationship between zinc level and diabetic microvascular complication.

MATERIALS AND METHODS:

Present study was a cross sectional study conducted in Department of General Medicine, Sree Mookambika Institute of Medical Sciences, Kulasekharam for a period of 8 months from July 2022 to February 2023.

The study comprised type 2 diabetes patients between the ages of 40 and 65. The following conditions were eliminated from the study: hypertension, alcoholism, thyroid dysfunction, vitamin B12 insufficiency, auto immune illnesses, non-diabetic renal disease, chemotherapy, and individuals with macrovascular problems.

The study involved a total of 80 patients. Age, gender, diabetes duration, and a thorough clinical examination were all considered in the clinical data. Blood sample was collected for blood glucose assessment and zinc level. The absorption spectrophotometer method was used to measure the zinc level.

The World Health Organization (WHO) criteria were used to identify diabetes: random plasma glucose 11.1 mmol/L (200 mg/dl); fasting plasma glucose 7.0 mmol/L (126 mg/dl); or 2h glucose level in an oral glucose tolerance test of 11.1 mmol/L (200 mg/dl). The established standard range for serum zinc concentration is 10.7–18.4 mmol/L, or 70–120 µg/dl.

Ophthalmological fundus examination was used to determine the presence of diabetic retinopathy. Blood creatinine levels and the urine protein/creatinine ratio (PCR) are used to identify diabetic nephropathy. Based on the findings of the physical examination as well as nerve conduction investigation, diabetic neuropathy was identified.

Statistical Analysis was carried out using SPSS 20.0 version. All data were subjected to descriptive statistics, which were presented as mean values and percentages. Appropriate statistical comparison tests were conducted. The unpaired t test and Chi-Square Test were used to assessed statistical significance. Statistical significance was considered when p value was less than 0.05.

OBSERVATION AND RESULTS:

Out of 80 patients, 49(61.25%) patients were male and 31(38.75%) patients were females. This distribution shows the predominance of males in type 2 DM. The mean age of the participants was 55.47 ± 4.83 years, and the mean duration of diabetes was 7.4 years. Among the 80 diabetic patients included in the present study, 22 (27.5%) had diabetic retinopathy, 18(22.5%) had diabetic neuropathy and 45(56.25%) patients had diabetic nephropathy. Microvascular complications when compared with duration of DM showed statistical significance.

The serum zinc level was low in 68(85%) patients in the present study. The mean value for serum zinc level was significantly lower in diabetic patients 66.81 ± 10.32 µg/dl.

Correlation between serum zinc levels and diabetic microvascular complications was described in table 1. The mean zinc levels were lower in patients with microvascular complication than those without microvascular complications. On comparison microvascular complications with zinc levels showed statistical significance with p values less than 0.05.

Table 1: Correlation between serum zinc levels and diabetic microvascular complications

	Frequency	Mean zinc level	p value
Diabetic retinopathy			
Present	22(27.5%)	54.32	0.012
Absent	58(72.5%)	68.5	
Diabetic neuropathy			
Present	18(22.5%)	57.53	0.001
Absent	62(77.5%)	86.34	
Diabetic nephropathy			
Present	45(56.25%)	43.67	0.039
Absent	35(43.75%)	63.58	

DISCUSSION:

The metabolism of humans depends on a variety of trace components. Numerous studies have shown the critical functions of trace elements such as zinc, magnesium, manganese, chromium, selenium and vanadium in insulin action and glucose metabolism. It is yet unknown how these trace components contribute to the development and pathophysiology of diabetes. Hyperglycemia as well as increased protein glycosylation associated with diabetes have been linked to the observed changes in the status of these components in diabetic patients.⁹

In the current study, 68 (85%) patients had low serum zinc levels. Patients with diabetes had a mean serum zinc level that

was much lower, 66.81 ± 10.32 µg/dl. According to a study by Farooq M et al.¹⁰ diabetes individuals had considerably lower mean serum zinc levels (66.54 ± 11.328 mcg/dL) than healthy people (82.63 ± 12.194 mcg/dL, $p < 0.001$). A comparable study was conducted by Saharia GK et al.¹¹ who found that diabetes individuals had lower zinc levels than their controls ($p < 0.001$). In their study, Al-Marouf RA et al.¹² found that the mean serum zinc levels in diabetes patients were considerably lower than those in healthy controls (83.4 ± 12.5 µg/dl for healthy controls against 64.2 ± 12.6 µg/dl for type 1 diabetics and 68.9 ± 11.9 µg/dl for type 2 diabetics).

In the study conducted by Masood N. et al.¹³ serum zinc levels were considerably decreased (mean 2.03 ± 0.39 mg/dL vs. 4.84 ± 4.217 mg/dL, $p < 0.001$) in diabetes patients. Age, gender, glycemic status, and the length of diabetes were not related to the serum levels of zinc in type-2 DM patients.

According to Al-Timimi DJ et al.¹⁴ diabetes patients had lower serum zinc levels ($p < 0.01$) than non-diabetic control subjects. Dasarathan R et al.¹⁵ in their study, it was found that all diabetics had considerably lower mean serum zinc levels than controls. Fasting blood glucose (FBG) and HbA1C serum levels were found to be considerably higher in the diabetic group compared to controls ($p < 0.001$).

In the present study, patients with microvascular complications, the mean zinc levels were lower, and a comparison revealed statistical significance with p values less than 0.05. Al-Timimi DJ et al.¹⁴ observed that diabetes patients with low blood zinc levels as compared to normal serum zinc levels had significantly lower levels of e-GFR ($p < 0.05$) and higher levels of microalbuminuria ($p < 0.001$). The study also found that lower serum zinc levels are related to advanced diabetic nephropathy, as seen by lowering GFR and increasing microalbuminuria.

According to a study by Luo YY et al.¹⁶ patients with Type 2 diabetes had a higher incidence of microvascular complications and lower serum zinc levels. There were 141 patients without any microvascular issues and 271 patients with microvascular difficulties among the 412 patients. Patients with diabetes retinopathy ($p < 0.001$), diabetic nephropathy ($p < 0.001$), or diabetic peripheral neuropathy ($p = 0.002$) had significantly lower serum zinc levels than patients without those particular complications. This was comparable to the present study.

CONCLUSION:

In conclusion, the present study provided evidence that type 2 DM patients with lower serum zinc levels had a high prevalence of diabetic microvascular problems. Patients were more likely to have diabetes for a longer period if their serum zinc levels were lower. For type 2 diabetics, zinc supplementation is advised in the early stages of the disease to reduce the risk of developing both microvascular and macrovascular problems. In order to supplement zinc in type 2 DM and support its use in blood glucose management, large-scale research will be required.

Financial Support And Sponsorship:

Nil.

Conflicts Of Interest:

There are no conflicts of interest

REFERENCES:

- Glovaci D, Fan W, Wong ND. Epidemiology of diabetes mellitus and cardiovascular disease. *Current cardiology reports*. 2019 Apr;21:1-8.
- Gosak L, Martinović K, Lorber M, Stiglic G. Artificial intelligence based prediction models for individuals at risk of multiple diabetic complications: A systematic review of the literature. *Journal of Nursing Management*. 2022 Nov;30(8):3765-76.
- Islam MR, Akash S, Jony MH, Nowrin FT, Rahman MM, Rauf A et al. Exploring the potential function of trace elements in human health: a therapeutic perspective. *Molecular and Cellular Biochemistry*. 2023 Jan 13:1-31.

4. Ruz M, Carrasco F, Rojas P, Basfi-Fer K, Hernández MC, Pérez A. Nutritional effects of zinc on metabolic syndrome and type 2 diabetes: mechanisms and main findings in human studies. *Biological trace element research*. 2019 Mar 15;188:177-88.
5. Tamura Y. The role of zinc homeostasis in the prevention of diabetes mellitus and cardiovascular diseases. *Journal of Atherosclerosis and Thrombosis*. 2021 Nov 1;28(11):1109-22.
6. Fukunaka A, Fujitani Y. Role of zinc homeostasis in the pathogenesis of diabetes and obesity. *International journal of molecular sciences*. 2018 Feb 6;19(2):476.
7. Giugliano D, Ceriello A, Paolisso G. Oxidative stress and diabetic vascular complications. *Diabetes care*. 1996 Mar 1;19(3):257-67.
8. Folli F, Corradi D, Fanti P, Davalli A, Paez A, Giaccari A et al. The role of oxidative stress in the pathogenesis of type 2 diabetes mellitus micro- and macrovascular complications: avenues for a mechanistic-based therapeutic approach. *Current diabetes reviews*. 2011 Sep 1;7(5):313-24.
9. Zargar AH, Bashir MI, Masoodi SR, Laway BA, Wani AI, Khan AR, et al. Copper, zinc and magnesium levels in type-1 diabetes mellitus. *Saudi Med J* 2002; 23:539-42.
10. Farooq M. Zinc deficiency is associated with poor glycemic control. *J. Coll. Physicians Surg. Pak*. 2019 Mar 1;29:253-7.
11. Saharia GK, Goswami RK. Evaluation of serum zinc status and glycated hemoglobin of type 2 diabetes mellitus patients in a tertiary care hospital of Assam. *J Lab Physicians* 2013; 5:30-3.
12. Al-Marouf RA, Al-Sharbatti SS. Serum zinc levels in diabetic patients and effect of zinc supplementation on glycemic control of type 2 diabetics. *Saudi medical journal*. 2006 Mar 1;27(3):344.
13. Masood N, Baloch GH, Ghori RA, Memon IA, Memon MA, Memon MS. Serum zinc and magnesium in type-2 diabetic patients. *J Coll Physicians Surg Pak*. 2009 Aug 1;19(8):483-6.
14. Al-Timimi DJ, Sulieyman DM, Hussen KR. Zinc status in type 2 diabetic patients: relation to the progression of diabetic nephropathy. *Journal of Clinical and Diagnostic Research: JCDR*. 2014 Nov;8(11):CC04.
15. Dasarathan R, Kumar S, Ganesh V, Chenthil KS. Study of serum Zinc status among type 2 diabetes mellitus patients. *IJAM*. 2017 Sep;4(5):1344-7.
16. Luo YY, Zhao J, Han XY, Zhou XH, Wu J, Ji LN. Relationship between serum zinc level and microvascular complications in patients with type 2 diabetes. *Chinese medical journal*. 2015 Dec 20;128(24):3276-82.