



# The Role Of Serum Zinc In Control Of Diabetes Type Two

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## Abstract

**Background :** Diabetes mellitus may cause the lowering of the level of Zn in the body by increasing its excretion and decreasing its absorption from intestines or by excretion from kidneys. The proposed mechanism of action of Zn is that it acts as cofactor for the synthesis of insulin, its storage, and probably its secretion from the pancreas.

In type 2 DM, the main factor is insulin resistance which may be increased by Zn deficiency.

**Aim of study :** The prevalence of Zn deficiency in diabetic patients and to discover the relationship of glycemic control with serum Zn levels.

**Patients and method:** A cross sectional study was enrolled 50 patients had diabetes type two to study glycemic parameters in relation to zinc level. The descriptive analysis was done to estimate the prevalence of poor control of blood glucose level, percentage of Zn deficiency.

**Result :** The mean age of our study  $49.1 \pm 12.3$ . Sixty five percent had bad glycemic control measured by high HbA1C. forty eight percent of patients had low serum zinc level. There is statically significant in relation of zinc to glycemic indicator patients with high HbA1C had

low serum zinc level

## Conclusion

Type two Diabetic patients had poor glycemic control is associated with low Zn levels.

**Key words:** Diabetes mellitus, Serum zinc, Glycemic indicator.

## Introduction

Diabetes mellitus was the 8th leading cause of death, accounting for 4% (1.5 million) of all deaths under the age of 70 in 2012 globally. The most recent data from WHO revealed that 422 million adults are living with diabetes mellitus. The disease is caused in most cases by a deficiency or complete lack of the hormone insulin, which is produced in the pancreas, or by an inability of the body to respond appropriately to insulin (i.e., insulin resistance). Both conditions can include chronically elevated blood glucose levels, excessive excretion of glucose in the urine, and the accumulation of certain acidic substances in the blood. If not prevented or treated properly, these changes can lead to coma and even death. Other adverse events associated with diabetes include the increased risks of associated complications e.g., heart disease, stroke, kidney failure, accounting for another 2.2million deaths worldwide.

Trace elements are accepted as essential substances for optimum human health because of their diverse metabolic characteristics and functions. They serve a variety of catalytic, structural, and regulatory functions in which they interact with macromolecules such as enzymes and pro hormones.

An alteration in the metabolism of these minerals and vitamins has been demonstrated. Some trace elements act as antioxidants; prevent membrane peroxidation while others act directly on glucose metabolism.

Zinc plays a relevant role in antioxidant defense in patients with type 2 diabetes mellitus. This mineral may act by different protection mechanisms by notably being an essential cofactor for more than 300 enzymes, such as superoxide dismutase. This mineral also facilitates reduction and neutralization of free radicals.

Considering changes in zinc metabolism and in superoxide dismutase enzyme activity present in type 2 diabetic patients simultaneously with the importance of these compounds in antioxidant defense.

In diabetic patients, chronic hyperglycemia increases oxidative stress by the production of free radicals (oxidants) and the reduction in antioxidant defense system. This leads to oxidative cellular injury resulting in cellular dysfunctions.

DM may cause the lowering of the level of Zn in the body by increasing its excretion and decreasing its absorption from intestines or by excretion from kidneys. The proposed mechanism of action of Zn is that it acts as cofactor for the synthesis of insulin, its storage, and probably its secretion from the pancreas.

In type 2 DM, the main factor is insulin resistance which may be increased by Zn deficiency. Zn has an important role in the utilization of glucose by muscle and fat cells. It is required as a cofactor for the function of intracellular enzymes that may be involved in protein, lipid, and glucose metabolism.

Zn may be involved in the regulation of insulin receptor-initiated signal transduction mechanism and insulin receptor synthesis.

The other proposed mechanism of importance of Zn is its role as an antioxidant for the improvement of metabolic control in type 2 DM.

It is identified that zinc plays an important role in synthesis, storage and secretion of insulin in response to carbohydrate intake and plays an important role in energy production. It also maintains the structural integrity of insulin. The decreased zinc concentration in blood, affects the ability of the islet cells of pancreas to produce and secrete insulin that may lead to the development of insulin resistance responsible for incidence of type 2 diabetes.

Glycated hemoglobin percentage (HbA1C%) is one parameter which provides index of blood glucose control in collective sense. It is a reliable indicator of long-term hyperglycemia and the measurement of HbA1C% helps in identifying the risk of developing diabetic complications.

Zinc deficiency occurs in a subset of subjects with T2DM but is not related to diabetes control. Higher zinc intakes may be associated with a slightly lower risk of T2DM. It has been reported that oral zinc administration in the diabetic patients may be helpful in wound healing and in the prognosis of the complications of diabetes mellitus.

An inverse correlation between glycated hemoglobin (HbA1c) and serum zinc levels may be expected in diabetes mellitus.

Effective treatment with oral antidiabetic drugs should improve glycemic status, resulting in improved serum zinc levels.

Aim of study

The prevalence of Zn deficiency in diabetic patients and to discover the relationship of glycemic control with serum Zn levels.

Method

Study design

A cross sectional study conducted in Al-diwanaya teaching hospital since 6 months from April to November 2022, the study enrolled 50 patients have diabetes type two to study glycemic parameters in relation to zinc level.

### **Inclusion criteria**

Patients of T2DM for at least one year.

### **Exclusion criteria**

Pregnant and lactating women, cigarette smoking and chronic alcoholism, patient complaining of diarrhea, patient on hormonal therapy and/or drugs affecting serum zinc levels (Omeprazole/Proton pump inhibitors, H2-blockers, Chloroquine), patients with anemia, major systemic illnesses including hemoglobinopathies.

## Assay methods

For estimation of laboratory parameters fasting venous blood sample was collected. Blood glucose was estimated by Glucose-oxidase and peroxidase method using auto-analyser. HbA1c was measured using High performance liquid chromatography. Serum zinc was measured by Calorimetric method. Normal reference value of serum zinc was 60-70 mg/dL.

The reference value of serum

zinc was 70 mcg/dL to 120 mcg/dL. The groups were divided into normal zinc (>70 mcg/dL) and low zinc (<70 mcg/dL) levels.

The patients with type 2 diabetes presenting to the outpatient department were selected as cases, and signed informed consent if they agreed to participate.

Good glycemetic control was considered as glycated hemoglobin (HbA1c) 7 or less.

The age in years, gender height in meters (m), and weight in kilogram (kg) were recorded in patient's file Body mass index (BMI) was calculated by using formula;  $BMI = \text{Weight in kg} / \text{height in meter square}$ .

The descriptive analysis was done to estimate the prevalence of poor control of blood glucose level, percentage of Zn deficiency, and frequencies of different variables. For the analytical part of the study to discover the association of Zn and poor glucose control.

## Result

The mean age of our study  $49.1 \pm 12.3$ , male constituent 48% and female were 52%. Thirty eight percent had dyslipidemia. Sixty five percent had bad glycemetic control measured by high HbA1C. these result presented in table1. Table two show 48% of patients had low serum zinc level. There no statistically significant when comparison of age in according to serum zinc level group. The same manner to dyslipidemia.

Whereas there is statically significant in relation of zinc to glycemetic indicator patients with high HbA1C had low serum zinc level. As shown in table 3.

Table 1: patients characters

		No	Percent
Age	< 50	21	42%
	≥50	29	58%
Gender	Female	26	52%
	Male	24	48%

Dyslipidemia	Yes	19	38%
	No	31	62%
HbA1C	< 7%	22	44%
	≥7%	28	56%

Table 2: show serum level of zinc.

		Number	Percent
Zinc level	Low	24	48%
	Normal	26	52%
Total		50	

Table 3: show serum zinc level in relation to patients character.

		Low (24)	Normal (26)	p-value
Age	< 50	9	12	0.4
	≥50	15	14	
Gender	Female	16	10	0.055
	Male	8	16	
Dyslipidemia	Yes	12	7	0.6
	No	16	15	
HbA1C	< 7%	7	15	0.04
	≥7%	17	11	

## Discussion

Numerous studies have demonstrated the essential roles of trace elements as chromium, zinc, magnesium, selenium, vanadium, molybdenum, and manganese in insulin action and carbohydrate metabolism.

Our study presented the patients with bad diabetes control had low serum zinc level. These result are consistence with study of **Zanco** et al.

The National Health and Nutrition Examination Survey for Koreans conducted in 2005 showed that the prevalence of diabetes was 9.0% for male adults and 7.2% for female adults. The study indicated that marginal Zn deficiency was more prevalent among diabetic adults than the normal adult population.

The reduced concentration of Zn in type 2 DM was demonstrated by Saharia and Goswami Al-Marroof and Al-Sharbatti also reported that Zn levels were lower in diabetic patients compared to their controls,

and they found a strong negative relationship between glycosylated hemoglobin levels of diabetic patients with their serum Zn levels. Anderson et al. reported that 30% patients with DM were found to be Zn deficient

Tripathy et al. also reported Zn depletion in type 2 DM. However, Mamza et al. reported high Zn levels in type 2 DM patients.

Refaat A et al. have compared effect of zinc supplementation on glycemic control in T2DM patients. The authors have reported reduced serum zinc levels in the patients as compared to the control group. The baseline mean serum value of zinc in their study was  $68.9 \pm 11.9$  mg/dL. Kanchana et al. have reported that, the mean serum zinc level in diabetic patients as compared to the control group (nondiabetic) was lesser ( $69.65 \pm 5.6$  v/s  $86.54 \pm 9.3$  □g/dL) and the mean HbA1c level was higher in the patients as compared to control group ( $7.03 \pm 0.67$  v/s  $5 \pm 0.29\%$ ). As compared to the present study the mean zinc level is higher and mean HbA1c level is lower.

The authors have explained the reason for decreased serum zinc in diabetics may be due to impaired absorption, increased urinary excretion due to altered renal function, or genetic factors or during infections in which zinc has a role.

The positive correlation between serum zinc and higher level of HbA1c can be explained on the basis- that in T2DM patients as the severity of the disease advances, poor control of blood sugar may result in enhanced secretion of insulin and pancreatic zinc release, hence the positive

correlation between serum zinc and HbA1c. It is possible that higher Hb1Ac is because of advanced disease which may also involve pancreatic beta cell destruction releasing zinc in blood. These observations are suggestive of complexity of metabolism and derangement of zinc levels

in T2DM patients. Ahmed HA et al. have reported higher levels of zinc in diabetic patients as compared to nondiabetic controls ( $132 \pm 89.6$  v/s  $103.7 \pm 82.5$  mg/dL). The writers have explained increased zinc levels in diabetic patients on the basis of oxidative stress leading to destruction of beta cells releasing zinc into blood stream. A significant positive correlation between serum zinc and PPBG was observed at higher HbA1c levels in monotherapy group .

These may be because of enhanced insulin release to cope up with increased PPBG and associated release of zinc in the blood.

In combination group at lower HbA1c, the inverse correlation between serum zinc and HbA1c was persistent

The actual role of these trace elements in the pathogenesis and progress of diabetes is still unclear. The observed alterations in the status of these elements in diabetics have been attributed to hyperglycemia and increased protein glycosylation seen in this condition.

There are evidences that hyperglycemia interferes with the active transport of zinc back into the renal tubular cells leading to more urinary excretion of zinc. Moreover, zinc also increases insulin sensitivity by increasing the binding ability of insulin to its receptors.

## Conclusion

Type two Diabetic patients had poor glycemic control is associated with low Zn levels.

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