ORIGINAL RESEARCH

The study on the relationship between serum zinc, HbA1c, and microalbuminuria in type 2 diabetic patients at a tertiary centre: A case-control study

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ABSTRACT
Background: Diabetes currently affects more than 66.8 million people in India, which has become a major health care problem, representing the largest number of any country in the world. Reduced concomitant intake of Zinc has been proven to be associated with increased HbA1c percentages in individuals with Type 2 diabetes.
Aims and Objectives: The current study was designed to assess serum Zinc levels in Type 2 Diabetes patients and to find out the correlation between serum Zinc and HbA1c levels in Type 2 diabetes patients**.**
Materials and Methods: The present case-control study was conducted on Type 2 Diabetes mellitus patients attending the OPD of General Medicine in collaboration with the Department of Pharmacology at Bhagwan Mahavir Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India. The sample of the study was 80 old and new patients of Type 2 Diabetes Mellitus who were included in the study, consisting of Group I (45 patients): Type 2 Diabetic patients with HbA1c more than 7 percent and Group II (35 patients): Type 2 Diabetic patients with HbA1c less than 7 percent after taking informed consent.
Results: The mean age of study group was 52.64±12.36 years and control group was 56.72±10.28 years respectively. A case-control study was conducted with 80 type 2 diabetic patients who were divided into two groups consisting of 45 type 2 Diabetic patients with HbA1c >7 percent in Group I and 35 type 2 diabetic patients with HbA1c <7 percent in Group II. Serum Zinc has a strong negative correlation (r = -0.409) with HbA1c in the Type 2 diabetic patients with HbA1c >7 (p = 0.001).
Conclusion: By comparing the levels of HbA1c and serum zinc in Type 2 DM patients, it is possible to monitor glycaemic control and lower the risk of developing complications.
Key words: HbA1c; Serum Zinc; Microalbuminuria; Diabetes; Complications

Introduction

In recent years, it has been reported that diabetes patients tend to have lower zinc intake due to an unbalanced diet resulting from changes in lifestyle habits and an increased rate of eating disorders, especially among women.[1] Zinc is abundant in oysters, beef, liver, seafood, cereals, beans, nuts, and cheese[1], and is important as a cofactor for many enzymes, including the antioxidant enzymes catalase, peroxidase, and superoxide dismutase.[2] Although few reports have indicated a direct association between zinc deficiency and diabetes, a cohort study in the United States has shown that women with low zinc intake have an increased risk of developing diabetes.[3]Moreover, zinc deficiency exacerbates insulin resistance in non-insulin-dependent diabetics[4], and serum zinc levels are both inversely correlated with HbA1c levels in diabetic patients[5], and associated with diabetic peripheral neuropath.[6] Zinc deficiency can cause various disorders in diabetic

patients, such as anaemia, delayed wound healing, decreased reproductive function, decreased sense of taste, dermatitis, stomatitis, and hair loss.[7] In fact, a positive correlation was observed between the estimated glomerular filtration rate (eGFR) and serum zinc concentration in patients with chronic kidney disease (CKD)[8], and there is a possibility that diabetic renal failure is accompanied by a decreased serum zinc level.[9]Diabetes, which currently affects more than 66.8 million people in India, has become a major health care problem with the largest number of cases in the world.[10] A study suggests that several key glycemic indicators are significantly reduced in diabetic patients on zinc supplementation, and the findings support the notion that zinc supplementation has clinical potential for preventing or treating diabetes.[11] Several beneficial effects of Zinc supplementation in patients with diabetes mellitus, namely improved glycemic control, lipid parameters, and antioxidant status, have been identified. Additionally, it also causes significant reductions in FBG, PPBG, and HbA1c in patients with Type-2 diabetes due to its insulin mimetic and hypoglycemic properties.[12]

Aim And Objectives: To study the correlation between HbA1C, serum zinc levels, and micro albuminuria at a tertiary centre.

Methods and Materials

The present case-control study was conducted on Type 2 Diabetes mellitus patients attending the OPD of General Medicine in collaboration with the Department of Pharmacology at BhagwanMahavir Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India. The duration of the study was six months, from August 2022 to January 2023. The sample of the study was 80 old and new patients of Type 2 Diabetes Mellitus who were included in the study, consisting of Group I (45 patients): Type 2 Diabetic patients with HbA1c more than 7 percent and Group II (35 patients): Type 2 Diabetic patients with HbA1c less than 7 percent after taking informed consent. Aproformacontaining the general information of the patient like name, age, sex, socioeconomic status, and relevant history pertaining to diabetes mellitus like duration of the disease, complications if any, treatment taken, etc. was asked from the patient. Institutional Ethical Committee clearance was obtained before the commencement of the study.

Inclusion criteria

All cases of type 2 diabetes mellitus patients attending general medicine OPD with complications are included in the study.

Exclusion criteria

Patients with diabetes mellitus with chronic kidney disease(stage 3 onwards); Patients receiving magnesium supplements or magnesium-containing antacids, malabsorption or chronic diarrhoea. Patients with a history of alcohol abuse were excluded from the study.After identifying patients with type 2 diabetes mellitus, an appropriate questionnaire was used to collect patient data. During sample collection, 5 ml of venous blood was drawn under aseptic precautions in red-capped vacutainers, grey-capped vacutainers, and purple-capped vacutainers. Then, serum was separated by centrifugation and used for the analysis of serum zinc by the colorimetric method. Plasma was used for the analysis of blood glucose and whole blood for HbA1c estimation based on the immunoturbidity method. Urine analysis was done for microalbuminuria.

Statistical analysis

The data was collected, recorded, and analysed statistically to determine the significance of different parameters using the SPSS package for Windows version 22.0 and Microsoft Excel 15. P-values less than 0.05 were considered statistically significant. Spearman's correlation coefficient (r) and P-values are given for the univariate correlation of serum Zn with metabolic variables.

Results

A case-control study was conducted with 80 type 2 diabetic patients who were divided into two groups consisting of 45 type 2 Diabetic patients with HbA1c >7 percent in Group I and 35 type 2 diabetic patients with HbA1c < 7 percent in Group II.The mean age of study group was 52.64±12.36 years and control group was 56.72±10.28 years respectively (Table 1).

Table 1: Showing baseline parameters of the study and control groups

Parameters	Study group- T2 DM patients with HbA1c >7 (n = 45)	Control group -T2 DM patients with HbA1c <7 (n = 35)
Age of patients in year(Mean±SD)	52.64±12.36	56.72±10.28
Gender		
Male	29(64.44%)	21(60%)
Female	16(35.56%)	14(40%)
Blood Sugar in mg/dl (Mean±SD)		
Fasting blood sugar	180.5±16.92	112.50±26.71
Postprandial blood sugar	246±48.5	190±15.6
HbA1c (Mean±SD) in percentage	9.5 ± 3.25	5.6 ± 0.62

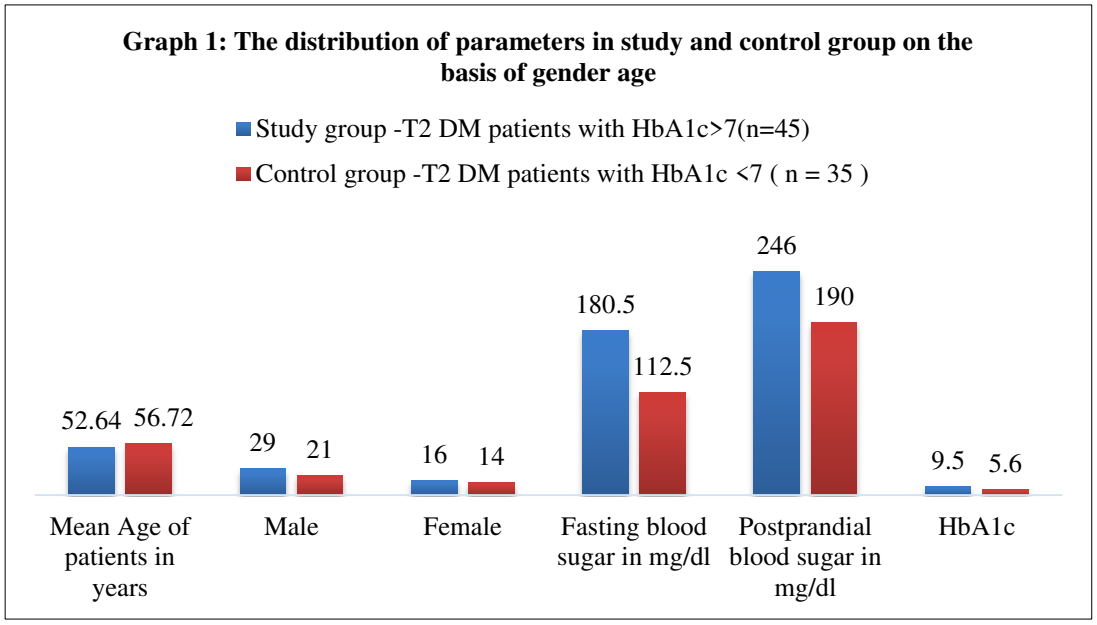

Table 2: Comparison the mean values of HbA1c with Serum Zinc and Microalbuminuria between the study and control groups

Parameters	Study group	Control group	P value
	Mean±SD		
HbA1c (%)	9.5 ± 3.25	5.6 ± 0.62	<0.005
Serum Zinc inµg/dL	42.50±18.46	64.91±14.63	<0.005
Microabluminuriain mg/dl	92.5±61.25	84.72±60.91	<0.005

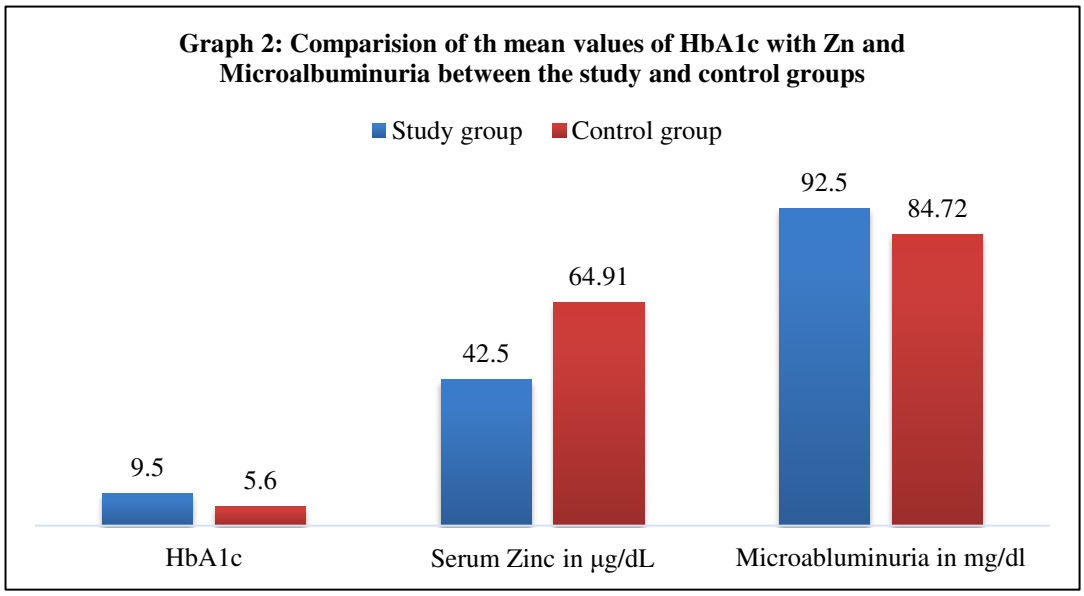

Table 2 and graph 2 shows that the mean values of HbA1c, serum zinc and microalbuminuria levels. Mean serum zinc was lower in the diabetic group whose HbA1c > 7 when compared to the diabetic group whose HbA1c < 7(p value <0.005). Mean microalbuminuria was higher in the diabetic group whose HbA1c > 7 when compared to the diabetic group whose HbA1c < 7(p value <0.005).

Table 3: Correlation between HbA1c and Serum Zinc in Type 2 diabetic patients

HbA1c	Serum Zinc- Correlation(r)	P value
Control group-HbA1c<7(n=35)	0.314	0.60
Study group-HbA1c>7(n=45)	-0.409	0.001

Table 3: Shows Serum Zinc has a strong negative correlation (r = -0.409) with HbA1c in the Type 2 diabetic patients with HbA1c >7 (p = 0.001).

Discussion

Zinc, an essential element, is useful in the synthesis, storage, and secretion of insulin. Estimating the level of serum zinc becomes important to know the status of insulin resistance in diabetic patients. Zinc supplementation for diabetic patients can help with better glycaemic control and prevent diabetes-related complications as well as bone ailments.The present study was conducted with the aim of correlating glycated haemoglobin with serum zinc levels and microalbuminuria in type 2 diabetic patients. The diabetic patients were divided into two groups.Group I consisted of type 2 diabetic patients with HbA1c levels >7 and consisted of 45 diabetic patients in total, with 35 male and 21 female patients. Group II consisted of type 2 diabetic patients whose HbA1c was less than 7, with 35 patients (50 male and 30 female).The mean values of serum zinc were significantly higher in Group II as compared to Group I (p value <0.005). It indicated a statistically significant negative correlation (r value = -0.409) in the present study group with HbA1c >7 (p value = 0.001). These findings were in accordance with the study done by Santosh K. Naiket al.[13] in 2019, where there was a significant negative correlation between serumzinc and HbA1c.According to a study by Jyothirmayi B et al.[14], type 2 diabetes patients in the study group had significantly lower serum zinc concentrations than people in the control group who were in good physical condition.Similar to this, in 2017 study by Ramesh Dasarathanet al.[15] found a considerable negative connection between zinc and HbA1c.It was found in a study conducted in South India by Sunthari K et al.[16] that individuals with Type 2 Diabetes Mellitus have significantly lower serum Zn levels when their HbA1c levels are high. A negative connection between the serum levels of zinc and magnesium and HbA1c in diabetics was shown in a study by Sunita Pujaret al.[17]In the present study, the mean microalbuminuria was higher in the diabetic group whose HbA1c was > 7 when compared to the diabetic group whose HbA1c was 7 (p value <0.005). Mitsunobu Kubota et al.[18] studied 227 diabetic patients and found that the serum zinc concentration was negatively correlated with age (r = -0.309, P < 0.001) and positively correlated with eGFR (r = 0.144, P = 0.030). They draw the conclusion that the serum zinc concentration tends to decline with advancing age and declining renal function. This study suggests that consideration of zinc deficiency is necessary in patients with overt albuminuria.

Limitation of study: The duration of study was short and small sample size.

Conclusion

By comparing the levels of HbA1c and serum zinc in Type 2 DM patients, it is possible to monitor glycaemic control and lower the risk of developing complications. Estimating the level of serum zinc becomes essential for understanding the status of insulin in diabetic patients. The degree ofglycemic control and disease duration are linked to microalbuminuria.

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