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A STUDY ON SERUM ZINC AND MAGNESIUM STATUS WITH GLYCATED HEMOGLOBIN OF TYPE-2 DIABETES MELLITUS PATIENTS AMONG ROHILKHAND POPULATION

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ABSTRACT:
Aim: This study looks at the relationship between glycemic markers and serum zinc and magnesium levels in patients with Type-2 Diabetes Mellitus (T2DM) in the Rohilkhand region. **Methods:** Serum separated from plain vial after centrifugation was used for estimation of serum zinc by colorimetric method, serum magnesium by Calmagite method; Plasma glucose estimation by GOD-POD Method, End Point, Glycated hemoglobin by Particle enhanced immune turbidimetric method on Automated Analyser ERBA EM360. **Results and conclusion:** Serum magnesium and zinc levels were found to be significantly lower in T2DM patients than in non-diabetic controls. Serum magnesium and zinc levels showed a positive correlation, pointing to a possible interaction or co-regulation of these micronutrients. Serum zinc levels and glycemic markers, such as HbA1c, fasting plasma glucose, and postprandial glucose, did not, however, show any discernible association. These results suggest that, while not directly affecting glycemic control, deficiencies in magnesium and zinc may play a part in the metabolic changes linked to type 2 diabetes. To fully comprehend the underlying mechanisms and possible clinical implications of these micronutrient deficiencies in the management of diabetes, more research is required.
Keywords: Diabetes, Zinc, magnesium, Glycated Hemoglobin

INTRODUCTION: Diabetes Mellitus (T2DM) is a prevalent and chronic metabolic disorder characterized by insulin resistance and impaired insulin secretion, leading to persistent hyperglycemia [1]. The prevalence of type 2 diabetes has been steadily increasing worldwide, with substantial ramifications for impacted people and healthcare systems [2]. Given the high prevalence of T2DM in India, especially in areas like Uttar Pradesh's Rohilkhand, this is a serious public health concern [3].

Effective management of type 2 diabetes necessitates not only pharmacological interventions but also a thorough comprehension of the underlying nutritional and biochemical factors. Among these, micronutrients that are essential for insulin function and glucose metabolism, like zinc and magnesium, have attracted a lot of attention. The synthesis, storage, and secretion of insulin, as well as the structural integrity of insulin molecules, all depend on zinc [4]. On the other hand, magnesium affects insulin receptor activity and glucose uptake in addition to acting as a cofactor for many enzymes involved in the metabolism of carbohydrates [5]. Deficiencies in zinc and magnesium have been associated with disrupted insulin action and glucose homeostasis, potentially exacerbating diabetic complications.

Glycated hemoglobin (HbA1c), which represents average blood glucose levels over the two to three months prior, is a trustworthy indicator of long-term glycemic control. Poor glycemic control is indicated by elevated HbA1c levels, which are linked to a higher risk of complications from diabetes [6].

Existing literature suggests a potential link between serum zinc and magnesium levels and glycemic control in T2DM patients [7-9]. However, there is limited research focusing specifically on the Rohilkhand population. On the other hand, not much research has been done especially on the people of Rohilkhand. A focused investigation is required to clarify the status of these micronutrients and their connection to HbA1c in local T2DM patients due to the region's distinct demographic and dietary patterns. By examining serum zinc and magnesium levels and their relationship to HbA1c in T2DM patients in the Rohilkhand region, the current study seeks to close this gap. Knowing this relationship may help to clarify how micronutrient management may help to improve glycemic control and lessen the burden of complications associated with diabetes in this population.

MATERIAL AND METHODS:

Subject selection: - The study was carried out in the Department of Biochemistry and the Department of Medicine in Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh. Ethical clearance was taken from Institutional Ethical Committee. Present study includes 70 clinically confirmed cases of diabetes mellitus of both sexes, age group ranges from 21-70 years.

Sample collection: - 5 ml venous blood after a fasting period of 10 hours was collected from cases.

Analysis of Sample: Serum separated from plain vial after centrifugation was used for estimation of serum zinc by colorimetric method, serum magnesium by Calmagite method; Plasma glucose estimation by GOD-POD Method, End Point, Glycated hemoglobin by Particle enhanced immune turbidimetric method on Automated Analyser ERBA EM360.

Statistical analysis: - Mean ± SD were calculated for all the parameters analyzed and compared by z test for each parameter. Pearson's Correlation analyses were used to estimate the correlation between serum Zinc & Magnesium levels with Glycated Hemoglobin. P-values considered significant were as follows:- $P < 0.05$ – As Significant, $P < 0.001$ – As Highly significant.

OBSERVATIONS AND RESULTS: Mean and standard deviations of the Age and Sex distribution in Diabetes Mellitus and Control Group of this study were summarized in Table 1. Similarly Mean and standard deviations of the Demographic characteristic of study population were summarized in Table 2. The mean comparison of variables between diabetic subject and controls reveals that the Serum Zinc and serum magnesium were significantly ($p< 0.001$) decreased in diabetic subject as compared to controls. Similarly Glycated hemoglobin, fasting plasma glucose and Postprandial plasma Glucose were significantly ($p< 0.001$) increased in diabetic subject as compared to controls. (Table no.: 3).

Table No.4 shows the Pearson correlation and corresponding 'p' value of all variable parameters with serum zinc concentration in diabetes mellitus type II group. Significant correlation was not observed with fasting plasma glucose, post prandial plasma glucose, and HbA_{1C} when compared with varying serum zinc concentration. Serum magnesium was significantly positively correlated with 'r' value 0.591 when compared with varying serum zinc concentration.'P' value <0.05 was considered significant.

Table No. 1: Age and Sex distribution in Diabetes Mellitus and Control Group

Age (Years)	Diabetes Mellitus Group (n=70)		Control Group(n=70)	
	Males	Females	Males	Females
21-30	10	5	10	5
31-40	10	5	10	5
41-50	12	7	12	7
51-60	10	6	10	6
61-70	4	1	4	1
Total	46	24	46	24

Table No. 2: Demographic characteristic of study population

Parameters	Diabetes Mellitus Group (mean ± SD)	Control Group (mean ± SD)
Age (Yrs.)	44.49 ± 11.65	44.46 ± 11.73
Male	44.55 ± 11.73	44.52 ± 11.81
Female	45.36 ± 11.13	45.36 ± 11.16

Table No. 3: Serum Zinc, Magnesium, plasma glucose and Glycated hemoglobin levels in Diabetic patients and control group.

Parameter	Diabetes Mellitus Group (mean ± SD)	Control Group (mean ± SD)	P-value
Serum Zinc (µg/dL)	67.814 ± 21.044	82.657 ± 18.925	P <0.001
Serum Magnesium (Meq/L)	0.895 ± 0.446	1.843 ± 1.409	P <0.001
Glycated hemoglobin (%)	8.214 ± 1.965 %	5.3 – 14.0 %	P <0.001
Fasting plasma Glucose (mg/dL)	176.11 ± 23.49	85.21 ± 7.14	P <0.001
Postprandial plasma Glucose (mg/dL)	286.91 ± 70.0	132.35 ± 14.28	P <0.001

Table No. 4: Correlation of Serum Zinc with other parameters in Diabetes Mellitus

Parameters	Variables	Pearson Correlation (r)	'P' Value
Serum Zinc	Serum Magnesium	0.591	<0.001
	Fasting Plasma Glucose	-0.124	0.305
	Postprandial Plasma Glucose	-0.203	0.091
	HbA1c	-0.132	0.277

DISCUSSION:

This study examines the levels of magnesium and zinc in the serum and how they relate to glycated hemoglobin (HbA1c) in patients with type-2 diabetes mellitus (T2DM) in the Rohilkhand region. According to the results, diabetic patient's serum magnesium and zinc levels are significantly lower than those of healthy controls. Concurrently, the diabetic group exhibits a significant rise in HbA1c, fasting plasma glucose (FPG), and postprandial plasma glucose (PPG) levels.

Previous research linking hypozincemia and diabetes is consistent with the observed decrease in serum zinc levels in diabetic subjects [10,11]. Insulin production, storage, and secretion all depend on zinc. Its absence could hinder these functions and possibly add to the etiology and complications of diabetes. Nevertheless, there was no discernible relationship between serum zinc levels and glycemic markers (FPG, PPG, and HbA1c) in this investigation. The absence of correlation implies that although zinc deficiency is prevalent among patients with type 2 diabetes, it may not have a direct impact on the severity of hyperglycemia or HbA1c levels. Zinc appears to play a complex role in diabetes and may be influenced by a number of factors, such as genetics, dietary intake, and absorption rates [12].

Patients with diabetes have significantly lower serum magnesium levels, which is consistent with the established link between hypomagnesemia and diabetes [13, 14]. Because magnesium is essential for the metabolism of glucose, a lack of it can worsen insulin resistance and reduce the secretion of insulin. Serum magnesium, as measured by a 'r' value of 0.591, demonstrated a significant positive correlation with serum zinc levels, in contrast to zinc. This positive correlation suggests that the metabolism of magnesium and zinc in T2DM patients may be correlated. Understanding magnesium's function in regulating zinc's effects and vice versa may be essential to comprehending mineral homeostasis in diabetes [15].

The hallmark of diabetes management-poor glycemic control-is reflected in the significant increase in HbA1c, FPG, and PPG in patients with diabetes. A significant risk factor for the complications of diabetes is chronic hyperglycemia, which is indicated by elevated HbA1c levels. Serum zinc levels and glycemic markers do not correlate, indicating that although zinc deficiency is common in diabetics, it may not always have an easy effect on blood glucose levels and long-term glycemic control [16].

CONCLUSION: The study emphasizes how important it is for T2DM patients in the Rohilkhand population to have mineral imbalances, particularly deficiencies in zinc and magnesium. Although the levels of magnesium and zinc in the serum are considerably lower in diabetic subjects when compared to controls, only magnesium and zinc exhibited a positive correlation, suggesting a potential relationship between their metabolic pathways. The results point to the possibility of improving metabolic outcomes through regular monitoring and supplementation of these micronutrients in the comprehensive management of type 2 diabetes. It is necessary to conduct more research to determine the precise role that zinc and magnesium play in glycemic regulation and diabetes-related complications, as well as the mechanisms that underlie their interactions in diabetes.

CONFLICTS OF INTEREST: With regard to the publication of this study, the authors have disclosed no conflicts of interest. There have been no improper influences on the study from personal or financial relationships with other individuals or organizations.

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