

**ORIGINAL RESEARCH**

# Evaluation of serum magnesium levels among patients with type 2 diabetes

Dr. Anuradha Mahaur

Assistant Professor, Department of Biochemistry, National Capital Region Institute of Medical Sciences, Meerut, Uttar Pradesh, India

**Corresponding Author**

Dr. Anuradha Mahaur

Assistant Professor, Department of Biochemistry, National Capital Region Institute of Medical Sciences, Meerut, Uttar Pradesh, India

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**ABSTRACT**

**Background:** The present study was conducted for evaluating serum magnesium levels among patients with type 2 diabetes. **Materials & methods:** A total of 50 diabetic subjects and 50 healthy controls were enrolled. Complete demographic and clinical details of all the subjects was obtained. A Performa was made complete anthropometric variables were evaluated. physical examination was done and blood samples were obtained. All the samples were processed in an auto-analyzer for evaluation of serum magnesium levels. All the values thus obtained were then subjected to statistical analysis using SPSS software. Student t test was used for evaluation of level of significance. **Results:** Mean age of the controls and diabetic patients was 45.6 years and 48.9 years respectively. Mean serum magnesium levels among diabetic group and control group was 1.63 mg/dL and 2.21 mg/dL respectively. While comparing the results statistically, significant results were obtained. Among the 50 diabetic subjects, hypomagnesemia was seen in 19 subjects (38 percent). **Conclusion:** Serum magnesium levels are significantly altered in diabetic subjects demonstrating their role in the pathogenesis of the disease.

**Key words:** Magnesium, Diabetes

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**INTRODUCTION**

Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Type 2 diabetes mellitus (T2DM) constitutes 90% of all DM cases and is characterized by progressive insulin secretory defect on the background of insulin resistance. It is a growing public health burden across the world, particularly in the developing countries. India is almost in the grip of diabetes epidemic and warrants immediate corrective measures.<sup>1,2</sup> Magnesium (Mg) has a critical role in the actions of important enzymes and is the fourth most abundant cation in the human body. It is claimed that there is an inverse relationship between Mg intake and incidence of diabetes mellitus (DM). Mg deficiency is common in diabetic patients.<sup>3,4</sup> Magnesium deficiency is found to be commonly associated with endocrine and metabolic disorders, especially with Diabetes Mellitus. Magnesium ion plays a major role in carbohydrate metabolism and insulin action. Magnesium is a cofactor in the glucose transporting mechanism across the membrane and enzymes involved in carbohydrate oxidation and has a role in release of insulin.<sup>5</sup> Hence; the present study was

conducted for evaluating serum magnesium levels among patients with type 2 diabetes.

**MATERIALS & METHODS**

The present study was conducted for evaluating serum magnesium levels among patients with type 2 diabetes. A total of 50 diabetic subjects and 50 healthy controls were enrolled. Complete demographic and clinical details of all the subjects was obtained. A Performa was made complete anthropometric variables were evaluated. Patients with presence of any other systemic illness or any known drug allergy were excluded from the present study. Also, patients with history of hospitalization in the past two months of the study were also excluded from the present study. All the patients were instructed to keep overnight fasting and were recalled in the morning. General physical examination was done and blood samples were obtained. All the samples were processed in an auto-analyzer for evaluation of serum magnesium levels. All the values thus obtained were then subjected to statistical analysis using SPSS software. Student t test was used for evaluation of level of significance.

## RESULTS

Mean age of the controls and diabetic patients was 45.6 years and 48.9 years respectively. Among the control group, 32 subjects were males while remaining 18 subjects were females. Among the diabetic group, 37 subjects were males while remaining 13 subjects were females. Mean serum

magnesium levels among diabetic group and control group was 1.63 mg/dL and 2.21 mg/dL respectively. While comparing the results statistically, significant results were obtained. Among the 50 diabetic subjects, hypomagnesemia was seen in 19 subjects (38 percent).

**Table 1: Demographic data**

Variable		Diabetic group	Control group
Mean age (years)		48.9	45.6
Gender	Males	37	32
	Females	13	18
Mean BMI (Kg/m <sup>2</sup> )		24.3	22.7
Residence	Rural	12	10
	Urban	38	40

**Table 2: Comparison of serum magnesium levels**

Serum magnesium levels (mg/dL)	Diabetic group	Control group
Mean	1.63	2.21
SD	0.73	0.85
p-value	0.001 (Significant)	

**Table 3: Incidence of Hypomagnesemia among diabetic patients**

Hypomagnesemia	Diabetic group	
	Number	Percentage
Present	19	38
Absent	31	62
Total	50	100

## DISCUSSION

Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Depending upon the etiology of the DM, factors contributing to hyperglycemia include reduced insulin secretion, decreased glucose utilization, and increased glucose production. The metabolic dysregulation associated with DM causes secondary pathophysiologic changes in multiple organ systems, leading to microvascular and macrovascular complications.<sup>5,6</sup>

Diabetes mellitus is one of the main threats to human health in the 21st century. Globally Diabetes is one of the most common non-communicable diseases, and is fourth or fifth leading cause of death in the developed countries. Diabetes mellitus has put an enormous socio-economic burden on developing countries like India. Although the prevalence of both type 1 and type 2 DM are increasing worldwide, the prevalence of type 2 DM is rising rapidly, mostly due to increasing obesity and physical inactivity with aging of the population.<sup>7,8</sup> Magnesium is the fourth most abundant mineral in the body and the most abundant intracellular divalent cation, with essential roles in many physiological functions. Hypomagnesemia is known to occur in diabetes. Hypomagnesemia has been reported to occur in 25-38% of patients with type 2 DM especially in those without good metabolic control.<sup>9</sup> Magnesium modulates glucose transport

through the membrane and it is a cofactor in several enzymatic reactions involving glucose oxidation. Its deficiency may increase insulin resistance. The reasons for magnesium deficiency in diabetes are not very clear. This could be due to higher urinary loss and lower dietary intake/impaired absorption.<sup>10-12</sup> Hence; the present study was conducted for evaluating serum magnesium levels among patients with type 2 diabetes.

In the present study, mean age of the controls and diabetic patients was 45.6 years and 48.9 years respectively. Among the control group, 32 subjects were males while remaining 18 subjects were females. Among the diabetic group, 37 subjects were males while remaining 13 subjects were females. Mean serum magnesium levels among diabetic group and control group was 1.63 mg/dL and 2.21 mg/dL respectively. In a similar study conducted by Badhe et al, authors evaluated 48 diagnosed cases of type II diabetes mellitus. The correlation between the two parameters was not found to be statistically significant. Serum magnesium does not bear a constant relationship with the diabetic control according to the findings of the current study and detailed studies including multi-parametric analysis along with duration of diabetes is required.<sup>13</sup> The patterns and correlates of serum Mg in cohorts of type 2 diabetic patients was assessed a study conducted by Odusan OO et al. Although the patients with diabetes

and HT were older and more of females than those with DM alone, the mean serum Mg was comparable. Twenty-seven percent (27%) of patients who had DM alone was more than 19.3% with HT and diabetes combined. Whereas the FBG was comparable in patients with hypomagnesemia and normal serum Mg, HbA1c was significantly higher in the hypomagnesemia group. Hypomagnesemia is common in T2DM outpatients occurring approximately one in four patients. It is associated with poor long-term control.<sup>14</sup>

In the present study, while comparing the serum magnesium levels statistically, significant results were obtained. Among the 50 diabetic subjects, hypomagnesemia was seen in 19 subjects (38 percent). Batar et al, estimated level of serum magnesium in the development and progression of DM Type 2 and its complications. In this study 50.4% of the patients were males and 49.6% were females. Overall, mean age of the study population was  $48 \pm 18$  years. The mean BMI of the study population was  $26.43 \pm 5.11 \text{ kg/m}^2$ . In their study majority of the patients with hypomagnesemia  $\text{Mg} < 1.7 \text{ mg/dl}$  were having diabetic complication, mainly microvascular complications. Patient with hypomagnesemia were showing significant association with nephropathy, neuropathy, retinopathy and cardiovascular disease. The study did not show significant correlation with hypertension and cerebrovascular events.<sup>15</sup> Khanna D et al, in another similar study, evaluated the prevalence of hypomagnesemia in patients with type 2 DM and their associations with diabetes microvascular complications such as retinopathy, nephropathy, neuropathy and macrovascular complications like ischemic heart disease, hypertension and cerebrovascular accident. Prevalence of hypomagnesemia was 42 percent in study subjects. Between hypomagnesemia and diabetic retinopathy, nephropathy, neuropathy, a major correlation was found. Co-morbidities such as ischemic heart disease, hypertension and cerebrovascular accident have not found any significant associations. Low concentrations of serum magnesium are common in type 2 DM. Hypomagnesemia is linked to diabetic retinopathy, nephropathy and neuropathy. Hypomagnesemia prevalence in type 2 diabetics is 42% which is significantly higher than non-diabetic controls.<sup>16</sup>

## CONCLUSION

Serum magnesium levels are significantly altered in diabetic subjects demonstrating their role in the pathogenesis of the disease.

## REFERENCES

1. Classification and Diagnosis of Diabetes. Diabetes Care. 2014;38(Suppl 1):S8–16.
2. International Diabetes Federation. IDF Diabetes Atlas. 6th ed. Brussels, Belgium: International Diabetes Federation; 2013. Available from: <http://www.idf.org/diabetesatlas>.
3. Xu J, Xu W, Yao H, Sun W, Zhou Q, Cai L. Associations of serum and urinary magnesium with the pre-diabetes, diabetes and diabetic complications in the Chinese Northeast population. PLoS One. 2013;8:e56750.
4. Kim DJ, Xun P, Liu K, Loria C, Yokota K, Jacobs DR, Jr, et al. Magnesium intake in relation to systemic inflammation, insulin resistance, and the incidence of diabetes. Diabetes Care. 2010;33:2604–2610.
5. Alvin C.P, Harrison's Principles of Internal Medicine, Vol. 19, 2015.
6. Nadler, Jerry L., et al. "Magnesium deficiency produces insulin resistance and increased thromboxane synthesis." Hypertension, Vol. 21, No. 6, 1993, pp.1024-29.
7. Arnaud MJ . Update on the assessment of magnesium status. Br J Nutr. 2008 Jun; 99 Suppl 3:S24-36.
8. de Lorde Lima M, Cruz T, Pousada JC, Rodrigues LE, Barbosa K, Canguçu V. The effect of magnesium supplementation in increasing doses on the control of Type 2 DM. Diabetes Care. 1998 May; 21(5):682-6.
9. Wälti MK, Zimmermann MB, Walczyk T, Spinaz GA, Hurrell RF. Measurement of magnesium absorption and retention in type 2 DM with use of stable isotopes. Am J Clin Nutr. 2003 Sep; 78(3):448-53.
10. Raheja BS, Kapur A, Bhoraskar A, Sathe SR, Jorgensen LN, Moorthi SR, Pendsey S, Sahay BK. Diabetes care Asia – India study: Diabetes care in India current status J Assoc Physicians India. 2001 Jul; 49:717-22.
11. Martha Rodriguez-Moran, Fernando Guerrero-Romero. Low serum magnesium levels and foot ulcers in subjects with type 2 diabetes. Arch Med Res. 2001 Jul – Aug; 32(4): 300-3.
12. Nadler JL, Malayan S, Luong H, Shaw S, Natarajan RD, Rude RK. Intracellular free magnesium deficiency plays a key role in decreased reactivity in type 2 diabetes mellitus. Diabetes Care. 1992 Jul; 15(7):835-41.
13. Badhe et al. Study of serum magnesium levels and its correlation with glycemic status in type II diabetes patients. International Journal of Clinical Biochemistry and Research 2021;8(4):294–296
14. Odusan, O. O., Familoni, O. B., Odewabi, A. O., Idowu, A. O., & Adekolade, A. S. (2017). Patterns and Correlates of Serum Magnesium Levels in Subsets of Type 2 Diabetes Mellitus Patients in Nigeria. Indian journal of endocrinology and metabolism, 21(3), 439–442.
15. Batar PK. Study of Serum Magnesium Level in Diabetes Mellitus and it's Correlation with Micro and Macro Complications. J Assoc Physicians India. 2022;70(4):11-12.
16. Khanna D, Bhatnagar M, Tayal S. Study of serum magnesium levels in type 2 diabetes mellitus. J. Evolution Med. Dent. Sci. 2020;9 (04):206-210