

# Serum Magnesium Levels in Type 2 Diabetes Mellitus

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## Abstract

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.

**Keywords:** Diabetes; Metabolism; Hypomagnesemia; Diabetes mellitus; Microvascular; Macrovascular

## Background

Diabetes mellitus is a clinical entity characterized by increased serum glucose levels and glycosuria due to absolute or relative deficiency in insulin secretion or insulin resistance which causes alterations in carbohydrate, lipid, protein metabolism and water and electrolyte homeostasis [1].

In India which is the diabetic capital of the world, total prevalence is expected to increase more than 2 times in the next few decades from 6% of the population in 2005 (19 million) to 12% in 2025 (57 million) where it is gaining the status of an epidemic [2]. Type 2 DM is characterized by a combination of insulin deficiency and insulin resistance. The general pathophysiological concept is that hyperglycaemia occurs when endogenous insulin secretion decreases and cannot match the increasing demand due to insulin resistance. Recently there has been an emerging research work regarding the important roles played by magnesium in various cellular metabolisms in the body. Magnesium is the 2<sup>nd</sup> most common intracellular cation and 4<sup>th</sup> most abundant cation in the body plays an important role in over 300 enzymatic reactions. Magnesium is a cofactor of various enzymes in carbohydrate oxidation and plays important role in glucose transport in the cell membrane. It also has a role in insulin secretion, binding, and activity. Long term magnesium deficiency has been associated with the development of insulin resistance. Hypomagnesemia has been proposed as an important factor implicated in the pathogenesis of poor glycaemic control and diabetic microvascular and macrovascular complications [3]. Other objectives of the study are to determine the association of hypomagnesemia with poor glycaemic control in patients with type 2 diabetes mellitus and to find the association between hypomagnesemia and diabetic comorbid conditions like hypertension and dyslipidemia [4].

- It was a cross-sectional descriptive study which included 250 type 2 diabetic patients admitted clinics in a tertiary care institute.
- The study was done from September 2018-March 2020.

The inclusion criteria used for selecting study subjects were.

- All patients diagnosed with Type 2 Diabetes mellitus according to the American Diabetes Association criteria.
- Duration of diabetes of  $\geq 2$  years.

- **Age:** 18-60years. Patients who were willing to give consent. The following patients were excluded from the study Patients on the following drugs like thiazide, loop diuretics, acetazolamide, aminoglycosides, Methotrexate, digoxin.
- Patients with renal disorders like acute tubular necrosis, Renal Tubular Acidosis, Chronic kidney disease due to other causes.
- Patients with other endocrine disorders like hyperparathyroidism, hyperthyroidism, hyperaldosteronism.
- GI loss-Persistent Diarrhoea and vomiting, pancreatitis, persistent nasogastric suctioning, short bowel syndrome and inflammatory bowel disease.
- Other conditions like alcohol withdrawal and dependence, protein calorie malnutrition.

Clinical history like demographic details, duration of diabetes mellitus, presence of associated comorbidities like hypertension, dyslipidemia was noted complete physical examination and evaluation for diabetic microangiopathic complications like retinopathy, neuropathy, nephropathy and macroangiopathic complications like coronary artery disease, peripheral vascular disease and cerebrovascular disease were done in all the patients with the help of appropriate diagnostic tools.

The collected data was coded and entered onto statistical package for social sciences (SPSS) version 20. The results were expressed as proportions and summary measures (mean with standard deviation) using appropriate tables and figures. For comparison across the group, Chi-square test and Student's unpaired T test was used. P value of  $<0.05$  was considered statistically significant [5,6].

Individual characteristics like age, sex, duration of type 2 diabetes mellitus, glycated haemoglobin have been correlated with serum magnesium levels. The prevalence of hypomagnesemia, its correlation with microangiopathic complications like retinopathy, neuropathy, and nephropathy has been studied. The prevalence of hypomagnesemia and its correlation with macroangiopathic complications like Ischemic heart disease, peripheral vascular disease and cerebrovascular disease have been studied. Presence of diabetic comorbid conditions like Hypertension and dyslipidaemia and its correlation with magnesium levels have been studied. Results showed that among the study participants duration of diabetes mellitus ranged from 2 to 13 years. The mean duration of Type 2 DM was 5.2 (SD=2.2) years and there was significant difference in magnesium level due to duration of diabetes mellitus i.e. those who had more than 6 years of duration had more hypomagnesemia than others ( $p=0.001$ ). Serum HbA1C ranged from 6.1 to 14.3 with mean 8.92 (SD=1.53). Results showed that there was significant difference in mean blood glucose level between hypo and normomagnesemia group ( $p=0.0001$ ) which implies that those who belong to hypomagnesemia group had higher HbA1c and mean blood glucose levels. The mean Magnesium values were 1.97 (SD=0.29). The magnesium level was categorized into hypomagnesemia and normomagnesemia with the cut of value as 1.7 mg [7, 8] (Figure 1).

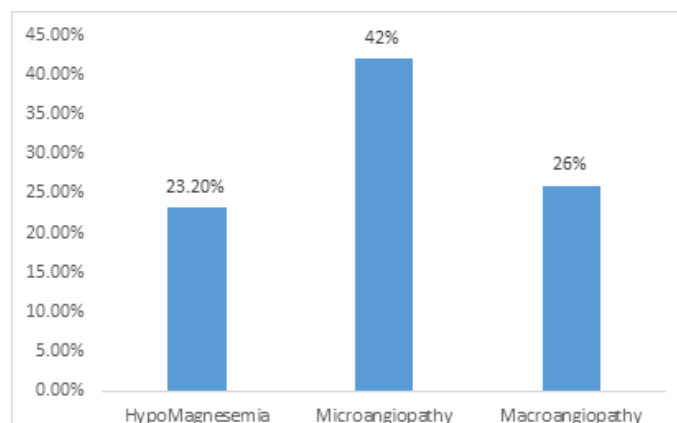


Figure 1: Prevalence of Hypomagnesemia, Microangiopathy, Macroangiopathy.

**Table 1:** Table shows that there was statistical significance with p value <0.001 between hypomagnesemia and microangiopathy with 50.4% of patients with diabetic microangiopathy having hypomagnesemia.

Microangiopathy	Hypomagnesemia	Normomagnesemia	Total	Chi sq	p
No Microangiopathy	5	140	145	72.98	0.001
Microangiopathy	53	52	105		
Total	58	192	250		

**Table 2:** Table shows that there was no statistical significance between hypomagnesemia and macroangiopathy with a 'p' value of 0.12 with 15.3% of patients with diabetic macroangiopathy having hypomagnesemia.

Microangiopathy	Hypomagnesemia	Normomagnesemia	Total	Chi sq	p
No Microangiopathy	48	137	185	2.45	0.12
Microangiopathy	10	55	65		
Total	58	192	250		

Results also showed that there was significant association between hypomagnesemia and diabetic patients with dyslipidaemia. 'p' value was significant <0.001 with 7.5% of these patients having hypomagnesemia. Our study also found that there was no significant association between low magnesium levels and macroangiopathic complications like Coronary artery disease, peripheral vascular disease and cerebrovascular accident (Table 1).

## Conclusion

The prevalence of hypomagnesemia in our study population of 250 type 2 diabetics was 23.2%. Hypomagnesemia had significant correlation with increased duration of type 2 DM. Patients having poor glycaemic control with microvascular complications had significant hypomagnesemia highlighting that magnesium also plays an important role in development of diabetic complications and insulin resistance. Patients with microvascular complications like retinopathy, sensory neuropathy, nephropathy, foot ulcer had significant association with hypomagnesemia. Patients with macrovascular complications like Coronary artery disease, Peripheral vascular disease, cerebrovascular disease did not have significant association with hypomagnesemia. Patients with diabetic dyslipidaemia had significant hypomagnesemia. Patients with both diabetes and hypertension did not have significant hypomagnesemia.

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