



## **ASSESSMENT OF HYPOMAGNESEMIA AND ITS CORRELATION WITH GLYCEMIC PARAMETERS IN TYPE 2 DIABETES MELLITUS IN A TERTIARY CARE HOSPITAL**

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### **ABSTRACT:**

**Introduction:** Diabetes mellitus represents a rapidly escalating global public health issue and is a principal cause of morbidity and mortality due to its acute and chronic complications. Alterations in mineral metabolism, particularly magnesium deficiency, have been implicated in the pathogenesis and progression of type 2 diabetes mellitus. Magnesium is integral to glucose metabolism and insulin action; however, studies investigating the relationship between serum magnesium levels and glycemic control in diabetes have yielded inconsistent results. **Aim:** To ascertain the prevalence of hypomagnesemia in patients with type 2 diabetes mellitus and to evaluate its association with glycemic control. **Methodology:** A cross-sectional observational study was conducted among 150 patients with type 2 diabetes mellitus attending the outpatient department, casualty, or admitted to various wards of the Department of General Medicine at Sree Mookambika Institute of Medical Sciences, Kanyakumari, Tamil Nadu, from March 2024 to September 2025. **Results:** Among the 150 diabetic patients, 39 cases (26%) exhibited hypomagnesemia. The hypomagnesemia and normomagnesaemia groups were comparable in terms of age and sex distribution. The mean HbA1c level was significantly higher in the hypomagnesemia group compared to the normomagnesaemia group. **Conclusion:** The prevalence of hypomagnesemia among Indian patients with type 2 diabetes mellitus is substantial. Hypomagnesemia is positively associated with poor glycemic control. **Keywords:** Diabetes mellitus; Glycemic control; Hypomagnesemia

### **Introduction:**

Type 2 diabetes mellitus (T2DM) constitutes nearly 90% of all diabetes cases globally and stands as one of the most pressing public health issues of the 21st century. The worldwide incidence of diabetes is rising at a concerning pace, fueled by rapid urbanization, inactive lifestyles, changes in diet, and an aging population. It is anticipated that by 2030, the number of people with diabetes will reach about 439 million. As reported by the International Diabetes Federation and the World Health Organization, the overall diabetes prevalence is estimated at around 10%, with individuals of Indian descent making up more than 19% of the global diabetic population, highlighting the unequal burden of the disease in India.[1,2] Magnesium



(Mg) ranks as the fourth most abundant cation in the human body and the second most common intracellular cation. It serves as a crucial cofactor in over 300 enzymatic processes, playing a vital role in carbohydrate metabolism, insulin secretion, insulin function, protein synthesis, nucleic acid stability, and cellular energy balance.

Magnesium is also essential for maintaining vascular tone, endothelial function, and neuromuscular conduction. A deficiency in magnesium has been shown to cause endothelial dysfunction, promote inflammatory pathways, and increase oxidative stress, all of which are key mechanisms in the development of atherosclerosis and cardiovascular disease, especially in individuals with diabetes mellitus.[3] In recent years, magnesium has garnered significant attention for its potential role in modulating insulin sensitivity and influencing glycemic control. Low magnesium levels may impair insulin-mediated glucose uptake and worsen insulin resistance, thereby contributing to poor metabolic control in T2DM patients. Additionally, hyperglycemia itself can lead to increased urinary magnesium loss, creating a vicious cycle between magnesium deficiency and worsening glycemic status. Several studies have shown a link between low serum magnesium levels and a higher prevalence of chronic microvascular and macrovascular complications of type 2 diabetes mellitus, including diabetic neuropathy, retinopathy, nephropathy, diabetic foot ulcers, and

Epidemiological studies conducted in different ethnic populations have yielded variable results regarding the relationship between hypomagnesemia and diabetic complications. Observations in Caucasian diabetic populations have identified hypomagnesemia as an independent risk factor for the development and progression of diabetic complications, whereas similar associations have not been consistently observed in Black African diabetic populations. The prevalence of hypomagnesemia among individuals with type 2 diabetes has been reported to range from 25% to 38% and has been linked to increased morbidity and mortality. Despite these findings, the available literature remains inconclusive, and hypomagnesemia is frequently under-recognized and under-treated in routine clinical practice.[4,5,6]

Given the high prevalence of diabetes in India and the limited data addressing magnesium status and its relationship with glycemic control in Indian patients with type 2 diabetes mellitus, there is a need for further research in this area. Understanding this association may have important clinical implications, as early identification and correction of hypomagnesemia could potentially improve glycemic control and reduce the risk of diabetes-related complications. Therefore, the present study was undertaken to evaluate the prevalence of hypomagnesemia and to assess its association with glycemic control in patients with type 2 diabetes mellitus in the Indian population.

Research examining various ethnic groups has shown differing outcomes concerning the link between low magnesium levels and diabetic complications. In Caucasian diabetic populations, low magnesium has been identified as an independent risk factor for both the onset and worsening of diabetic complications. However, this connection has not been consistently observed in Black African diabetic populations. Among those with type 2 diabetes, the occurrence of low magnesium levels is reported to be between 25% and 38%, and it is associated with higher rates of illness and death. Despite these findings, the current literature is not definitive, and low magnesium levels are often overlooked and inadequately treated in standard clinical settings.[4,5,6] Given the high incidence of diabetes in India and the scarcity of data on magnesium levels and their impact on blood sugar control in Indian patients with type 2 diabetes, further investigation is necessary. Understanding this relationship could have significant clinical benefits, as early detection and treatment of low magnesium levels might enhance blood sugar management and decrease the risk of diabetes-related complications.



Consequently, this study was initiated to determine the prevalence of low magnesium levels and to explore their connection with blood sugar control in Indian patients with type 2 diabetes.

## AIM AND OBJECTIVE OF THE STUDY

To evaluate the prevalence of hypomagnesemia in patients with type 2 diabetes mellitus and to assess its association with glycemic control.

### *Objectives*

1. To determine the prevalence of hypomagnesemia among patients with type 2 diabetes mellitus.
2. To estimate serum magnesium levels in patients with type 2 diabetes mellitus.

## MATERIALS AND METHODS

A cross-sectional observational study was conducted on 150 patients with type 2 diabetes mellitus attending the outpatient department Department of General Medicine at Sree Mookambika Institute of Medical Sciences, Kanyakumari, Tamil Nadu, between March 2024 and September 2025.. Patients aged between 18 and 75 years diagnosed with type 2 diabetes mellitus were included in the study. Patients with chronic diarrhea, malabsorption syndromes, renal failure, those receiving diuretics, magnesium supplements or magnesium-containing antacids, and pregnant

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS). Quantitative data were expressed as mean  $\pm$  standard deviation, while categorical variables were expressed as frequencies and percentages. Independent t-tests were used to compare continuous variables after verifying normal distribution. Chi-square tests were applied to analyze differences between categorical variables. Logistic regression models were used to adjust for age and estimate the independent effects of hypertension, ischemic heart disease, and diabetes mellitus. A p-value of less than 0.05 was considered statistically significant.

## Results:

Table 1: Age categorisation of cases as per Magnesium status

Parameter		Magnesium Status						P Value
		Low		Normal		Total		
		No.	%	No.	%	No.	%	
Age Category	<50 Years	6	22.2	21	77.8	27	18.0%	.711
	50-59 Years	10	23.3	33	76.7	43	28.7%	
	>=60 Years	23	28.7	57	71.3	80	53.3%	
	<b>Total</b>	39	26.0	111	74.0	150	100.0%	

Above table shows that the hypomagnesemia group and normo-magnesemia group was comparable on parameter of age distribution.



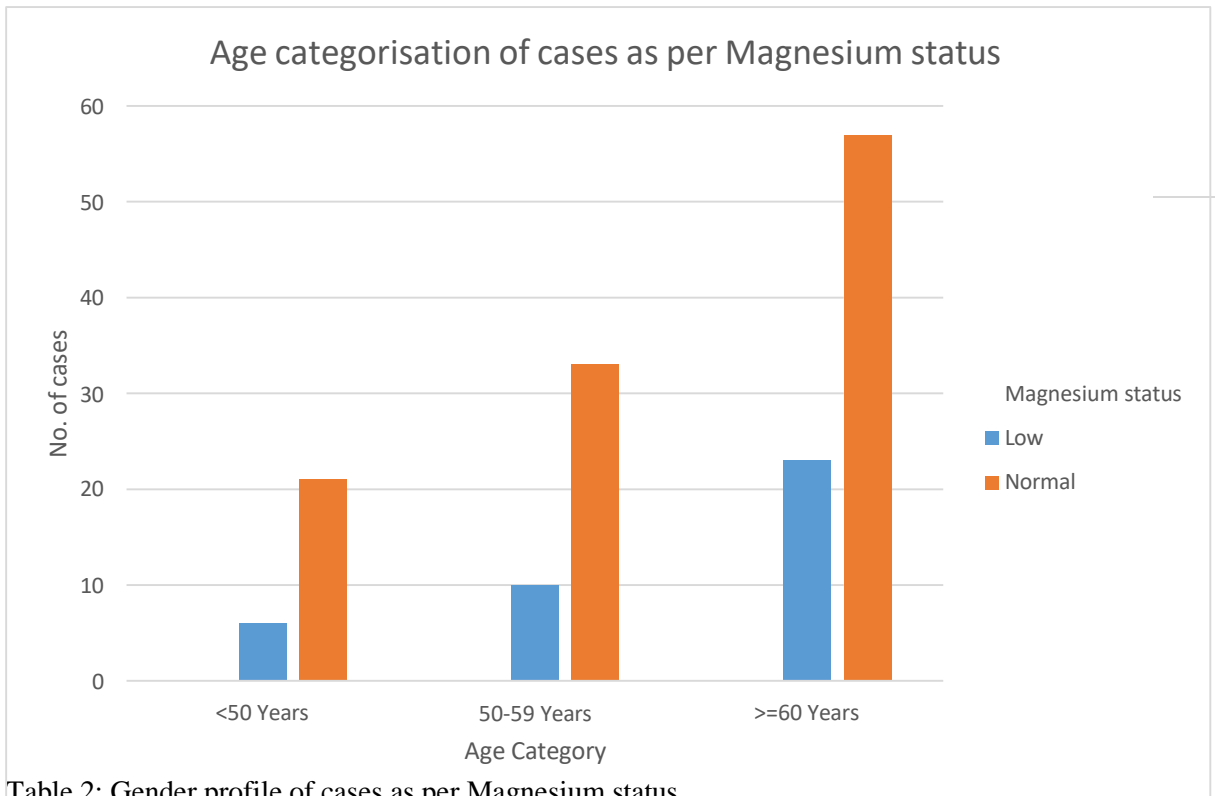


Table 2: Gender profile of cases as per Magnesium status

Parameter		Magnesium Status						P Value
		Low		Normal		Total		
		No.	%	No.	%	No.	%	
Gender	Female	3	13.0	20	87.0	23	15.3%	.124
	Male	36	28.3	91	71.7	127	84.7%	
	Total	39	26.0	111	74.0	150	100.0%	

Above table shows that out of 39 cases in hypomagnesemia group 36 cases belonged to male sex and 3 cases belonged to female sex whereas out of 111 cases in normal magnesium level group 91 cases belonged to male sex and 20 cases belonged to female sex and the two groups were comparable on parameter of sex distribution.



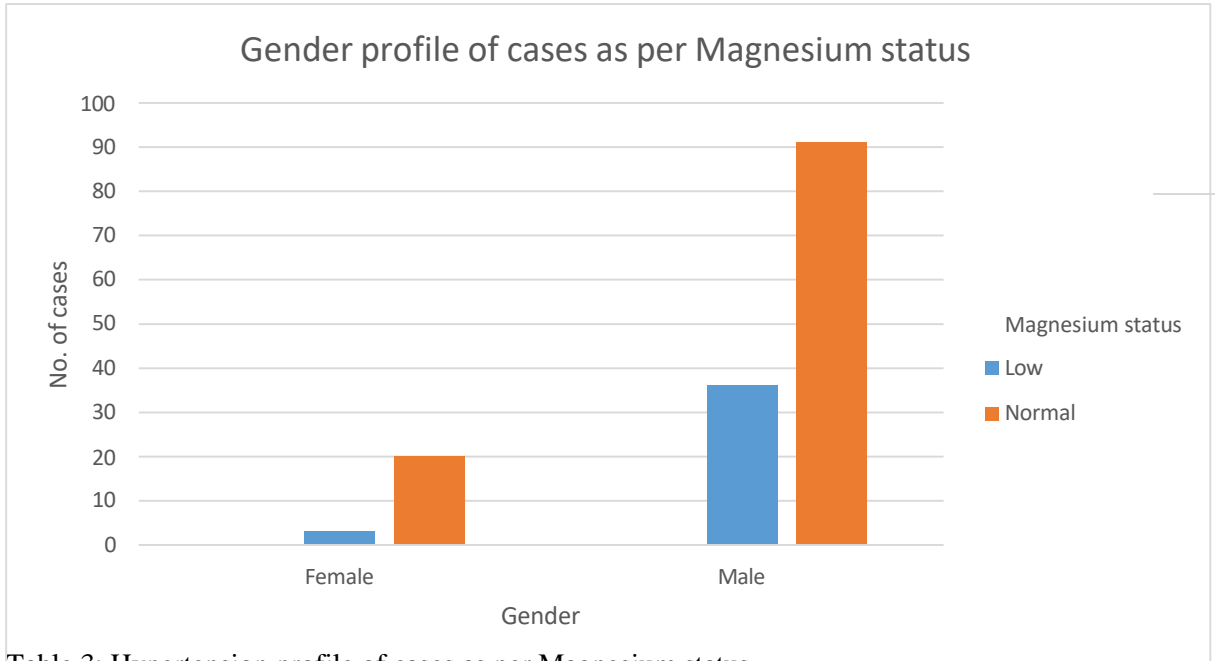


Table 3: Hypertension profile of cases as per Magnesium status

Parameter		Magnesium Status						P Value
		Low		Normal		Total		
		No.	%	No.	%	No.	%	
Hypertension	No	9	9.2	89	90.8	98	65.3%	<.001
	Yes	30	57.7	22	42.3	52	34.7%	
	Total	39	26.0	111	74.0	150	100.0%	

Above table shows that prevalence of hypertension was significantly higher in hypomagnesemia group as compared to normo- magnesemia group(76.9% versus 19.8% respectively).

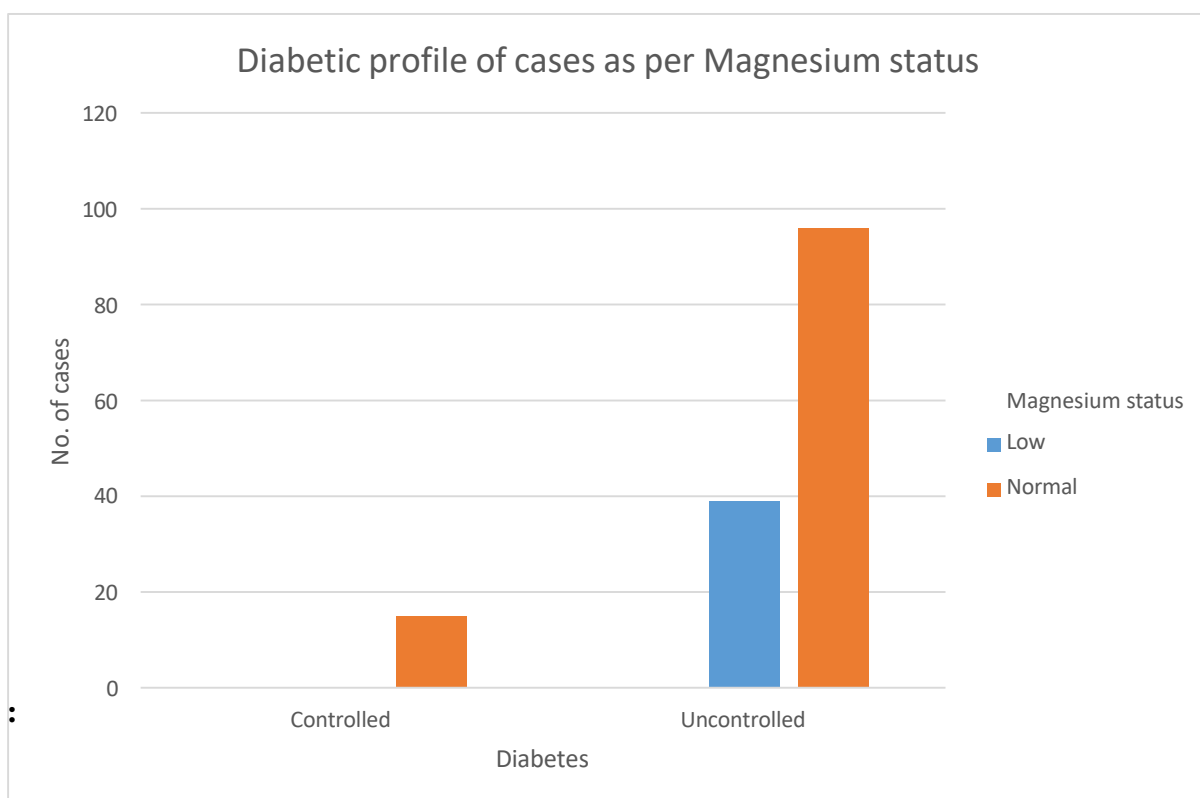
Table 4: Glycemic control profile of cases as per Magnesium status

Parameter		Magnesium Status						P Value
		Low		Normal		Total		
		No.	%	No.	%	No.	%	
Diabetes	Controlled (HBA1C<7)	0	.0	15	100.0	15	10.0%	0.016



	<b>Uncontrolled (HBA1C≥7)</b>	39	28.9	96	71.1	135	90.0%
	<b>Total</b>	39	26.0	111	74.0	150	100.0%

Above table shows that prevalence of uncontrolled Diabetes was significantly higher in hypomagnesemia group as compared to normo- magnesemia group(100% versus 86.5% respectively).



**Discussion**

Type 2 diabetes mellitus (T2DM) has shown a rapid and sustained increase in prevalence worldwide over recent years, contributing substantially to the global disease burden. Beyond chronic disturbances in glucose metabolism, growing attention has been directed toward abnormalities in micronutrient balance, particularly reduced serum magnesium levels, among individuals with T2DM. Evidence from multiple studies indicates that hypomagnesemia occurs more frequently in people with type 2 diabetes than in the general population. According to Pham et al.[7], reported rates of hypomagnesemia among patients with T2DM range from 13.5% to 47.7%, a variability likely influenced by differences in dietary intake, metabolic control, population characteristics, and laboratory assessment techniques.

In the current investigation, low serum magnesium levels were detected in 26% of participants with type 2 diabetes, a finding that aligns with previously published data. Earlier studies by Ram Kumar S et al.[8] and Mohammed et al.[9] documented prevalence rates of 19.1% and 15.7%, respectively. The comparatively higher proportion observed in the present cohort may be attributed to factors such as regional nutritional practices, socioeconomic conditions, duration and severity of diabetes, and degree of

glycaemic dysregulation. Moreover, persistent hyperglycaemia and insulin resistance are known to increase renal magnesium excretion, which may further predispose individuals with poorly controlled diabetes to magnesium deficiency.

Analysis of glycaemic indices in this study revealed that patients with hypomagnesemia had significantly elevated mean HbA1c levels when compared with those maintaining normal magnesium concentrations. This observation supports a close association between magnesium depletion and suboptimal glycaemic control. Magnesium is essential for several physiological processes related to glucose homeostasis, including insulin release, receptor binding, and intracellular signal transduction. Inadequate magnesium availability may impair insulin action, heighten insulin resistance, and ultimately lead to poorer long-term glycaemic outcomes.

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The association identified in this study is consistent with reports from earlier research. Investigations conducted by Rao and Shariff et al.[10], Arpacı D et al.[11], and Moradiya K and Muley et al.[12] have similarly demonstrated higher HbA1c levels among hypomagnesemic patients with T2DM. Comparable findings were also described by Wahid et al.[13] and Kumar et al.[14], who observed statistically significant differences in HbA1c values between individuals with low and normal serum magnesium concentrations. Collectively, these observations strengthen the evidence for an inverse relationship between serum magnesium status and glycaemic control.

The interplay between magnesium deficiency and hyperglycaemia appears to be reciprocal in nature. While reduced magnesium levels may worsen insulin sensitivity and glucose regulation, sustained hyperglycaemia can, in turn, promote urinary magnesium loss, further aggravating hypomagnesemia. This cyclical interaction may accelerate disease progression and increase the likelihood of both microvascular and macrovascular complications associated with diabetes.

Despite mounting evidence linking hypomagnesemia to adverse metabolic outcomes, routine measurement of serum magnesium is not commonly incorporated into standard diabetic care. The findings of this study emphasize the potential clinical value of assessing magnesium status in patients with type 2 diabetes mellitus, particularly in those with inadequate glycaemic control. Identifying and correcting magnesium deficiency at an early stage may offer a simple and economical adjunctive approach to improve metabolic outcomes and possibly reduce long-term complications.

It is important to acknowledge certain limitations of this study. The cross-sectional design limits the ability to infer causality between magnesium deficiency and poor glycaemic control. Additionally, factors such as dietary magnesium intake, renal magnesium excretion, and the therapeutic impact of magnesium supplementation were not evaluated. Future prospective and interventional studies are necessary to determine whether magnesium repletion can produce sustained improvements in glycaemic parameters, including HbA1c, among individuals with type 2 diabetes mellitus.

### **Conclusion:**

The prevalence of hypomagnesaemia in Indian Diabetic patients is high. Hypomagnesaemia was positively associated with poor glycaemic control. Periodic magnesium level testing and effective magnesium replacement therapy are recommended to help control diabetes and minimize the risk of long-term complications. A larger prospective study is required to observe the effect of magnesium deficiency on clinical outcomes.

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### **Conflict of interest statement:**

There is no conflict of interest among the authors.

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