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## Study of serum magnesium level in patients of newly diagnosed type-2 diabetes mellitus and its effect on glycemic control

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### Abstract

Magnesium deficiency has been found to be associated with microvascular disease in diabetes. Hypomagnesemia has been demonstrated in patients with diabetic retinopathy, lower levels of magnesium predicting a greater risk for diabetic retinopathy. In this, Hospital based Observational Study, 106 newly diagnosed Type 2 diabetes mellitus patients who had attended Diabetic clinic, Medicine OPD and were admitted in Medicine ward, were selected as per the inclusion and exclusion criteria for the study. The data for the purpose of study were collected in a predesigned Proforma. The mean HbA1c among cases was  $(8.43 \pm 1.71)$ . Controlled diabetes were grouped under HbA1c level  $< 7$ . There were 16 patients who have their HbA1c level in controlled range with mean serum magnesium level  $2.17 \pm 0.09$  mg/dl. There were 90 patients in uncontrolled group with mean serum magnesium level  $1.86 \pm 0.17$  mg/dl. ( $p < .001$ ).

**Keywords:** Hypomagnesemia, HbA1c, magnesium deficiency

### Introduction

Hypomagnesemia is a common feature in patients with type 2 diabetes. Although diabetes can induce hypomagnesemia, magnesium deficiency has also been proposed as a risk factor for type 2 diabetes. Magnesium is a necessary cofactor for several enzymes that play an important role in glucose metabolism<sup>[1]</sup>. Low magnesium status has repeatedly been demonstrated in patients with type 2 diabetes. Magnesium deficiency appears to have a negative impact on glucose homeostasis and insulin sensitivity in patients with type 2 diabetes<sup>[2]</sup>.

Magnesium deficiency has been found to be associated with microvascular disease in diabetes. Hypomagnesemia has been demonstrated in patients with diabetic retinopathy, lower levels of magnesium predicting a greater risk for diabetic retinopathy. Magnesium depletion has also been associated with arrhythmogenesis, vasospasm, platelet activity and hypertension<sup>[3]</sup>.

Many studies have reported significantly lower serum magnesium levels in type 2 diabetics when compared with non – diabetic healthy controls<sup>[4]</sup>. Among diabetics, low serum magnesium values were reported in patients with retinopathy. In North-East India, there are related data available which are only restricted to few unpublished reports. Also, the comparative studies within diabetic population based on glycemic control are limited. With this background, we decided to study the level of serum magnesium. In newly diagnosed type – 2 diabetics and correlate with glycemic status.

### Aims and Objectives

To compare the levels of serum magnesium in patients with newly diagnosed Type 2 Diabetes Mellitus and normal healthy individuals (controls) To correlate the serum magnesium level with the glycaemic status in newly diagnosed Type 2 diabetes mellitus patients.

### Methodology

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**Methodology**

In this, Hospital based Observational Study, 106 newly diagnosed Type 2 diabetes mellitus patients who had attended Diabetic clinic, Medicine OPD and were admitted in Medicine ward, were selected as per the inclusion and exclusion criteria for the study. The data for the purpose of study were collected in a predesigned Proforma. Patients informed consent & Institutional Ethical clearance was obtained.

**Inclusion criteria:** Newly diagnosed Type 2 Diabetes mellitus (Newly diagnosed-arbitrary fixed at or < 6 months) [5], age at or above 20yrs [6].

**Exclusion criteria:** Patients' age less than 20 years, patients of Type 2 Diabetes Mellitus already diagnosed with or without treatment of > 6 months, diabetes mellitus other than Type 2 Diabetes mellitus, Impaired Renal Function Patients with hypertension Pregnant women Gastrointestinal disorders(chronic diarrhea), Alcoholism Pancreatitis, Those on diuretic therapy, aminoglycosides and iatrogenic administration.

**Specimen Collection:** Patient's plasma was collected in EDTA or heparinized vial. Plasma was collected in clean dry container. Plasma was separated from the cells at the earliest.

The estimation was done in a semi autoanalyser both Fasting (minimum 8 hrs of no calorie intake) and 2 hours postprandial was done by Glucose Oxidase and Peroxidase Method.HbA1c was measured by Ion Exchange Resin method. Magnesium was measured by Colorimetric method using calmagite dye. Normal serum magnesium (1.8mg/dl-3.0mg/dl).

**Statistical methods**

Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Unpaired Student's t test was used to compare means between two groups. p value was considered significant at a level of < 0.05.Statistical analysis was performed using Graph Pad Prism Version 6.05 software.

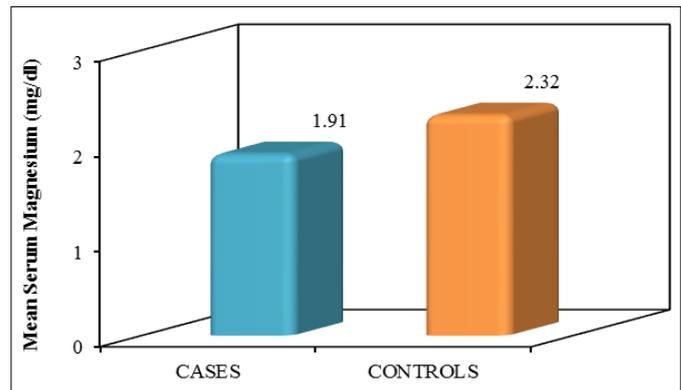
**Results**

A Comparative study consisting of 106 newly diagnosed Diabetic Mellitus patients and 106 controls was undertaken to investigate the change pattern of serum magnesium in DM cases when compared to controls. The mean age of the study group was 49.74 years with a standard deviation of 10.59. In the control group the mean age was 48.27 years with standard deviation of 10.43.Among the cases 69 (65.09%) patients were male and 37 (34.91%) of the patients were females. In the control group there were 70 (66.04%) male and 36(33.96%) female.

There is significant difference between levels of serum magnesium levels among diabetics and controls. The mean serum magnesium levels in cases and controls are 1.91 ± 0.2 mg/dl. and 2.32 ± 0.23 mg/dl. respectively (p< 0.001).

**Table 1:** Show the serum magnesium

Serum magnesium	Cases (mg/dl)	Controls (mg/dl)	p value
Range (Min-Max)	1.5—2.4	1.9—2.9	< 0.001
Mean ± SD	1.91 ± 0.20	2.32 ± 0.23	

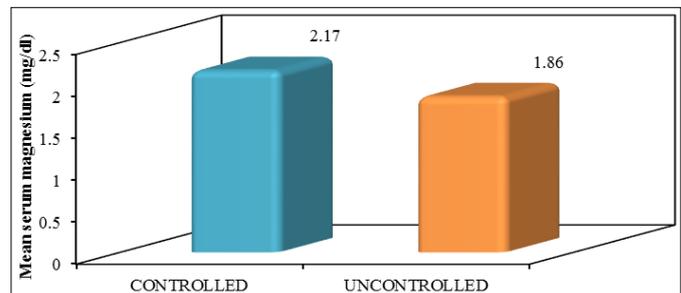


**Fig 1:** Effect of DM on serum magnesium among the cases and controls

The mean HbA1c among cases was (8.43 ± 1.71). Controlled diabetes were grouped under HbA1c level < 7. There were 16 patients who have their HbA1c level in controlled range with mean serum magnesium level 2.17 ± 0.09 mg/dl. There were 90 patients in uncontrolled group with mean serum magnesium level 1.86 ± 0.17 mg/dl. (p< .001).

**Table 2:** Correlation of serum magnesium among controlled and uncontrolled diabetics

Serum Magnesium	Controlled mg/dl	Uncontrolled mg/dl	p value
Mean ± SD	2.17 ± .09	1.86 ± 0.17	< 0.001
95% CI	1.8—2.4	1.5—2.2	



**Fig 2:** Correlation of serum magnesium among controlled and uncontrolled diabetics

**Discussion**

Of all the endocrine and metabolic disorders associated with magnesium deficiency, diabetes mellitus is the most common. Many studies have shown that plasma levels are lower in patients with type 2 diabetes mellitus compared with non diabetic control subjects. Inverse correlations between magnesium and, HbA1C [7, 8].

Initially the cause of hypomagnesemia was attributed to: (1) osmotic renal losses from glycosuria (2) decreased intestinal magnesium absorption and redistribution of magnesium from plasma into red blood cells caused by insulin effect. Recently a specific tubular magnesium defect in diabetes has been postulated. Hypermagnesuria results specifically from a reduction in tubular absorption of magnesium [9].

Hypomagnesemia may be a contributing factor for the long term complications particularly ischemic heart disease retinopathy, foot ulcer and peripheral neuropathy<sup>[10]</sup>.

In our study there was significant decrease in serum magnesium level in newly diagnosed type 2 DM as compared to controls. Similar such decreased in serum magnesium level in diabetic patients as compared to controls has been reported in other studies Ferdousi S et al. (2013)<sup>[11]</sup>, R Karim et al. (2014)<sup>[12]</sup>, Maula MG et al. (2012)<sup>[13]</sup>.

The magnesium level is also higher in diabetic patients having controlled level of HbA1c (<7) than those having uncontrolled levels (>7) ( $p < .001$ ) which is also shown in other studies Jain AP et al. (1979)<sup>[14]</sup>.

Sharma et al observed that those who had low serum magnesium levels were prone For diabetes related complications (hypertension, dyslipidaemia, and retinopathy). The study also showed lower levels in diabetics when Compared to healthy controls<sup>[15]</sup>. Diwan et al. had made similar observations about magnesium<sup>[16]</sup>.

### Conclusion

Serum magnesium level is reduced in Newly Diagnosed type 2 diabetes mellitus as compared to healthy non diabetic control. A lower magnesium level was related to poor glycemic control. Early detection of hypo-magnesemia by routine screening of serum magnesium in all newly diagnosed type 2 diabetic patients is required. If serum magnesium is low, a therapeutic correction of magnesium will be helpful in having a proper glycemic control to minimize complications.

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