

Study Of Serum Magnesium Level And Their Correlation With Glycemic Control In Type-2 Diabetes Mellitus (T2dm) - A Cross Sectional Analysis

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ABSTRACT

Introduction: Type 2 diabetes mellitus (T2DM) is characterized by persistent hyperglycemia, which can lead to long-term damage, dysfunction, and end organ damage including the kidneys, heart, blood vessels, nerves, and eyes. T2DM is also associated with several electrolyte imbalances, particularly involving magnesium. In critically ill diabetic patients, low magnesium levels (hypomagnesemia) have been linked to increased mortality rates. However, further research is needed to better understand the relationship between magnesium levels and T2DM. This study aims to examine magnesium deficiency in T2DM patients and its effects on glycemic control.

Materials And Methods: Cross-sectional observational study

- Study period: 3 months
- Sample size: 60
- Study area: R. L. Jalappa Hospital
- Study population: Patients with type 2 DM, serum creatinine ≤ 1.2 mg/dL and without microalbuminuria
- Patients were categorized into 3 groups viz Group A (T2DM < 5 year duration), Group B (T2DM of 5-9 year duration), and Group C (T2DM > 10 year duration of disease).

Correlation analysis of Hypomagnesaemia with good glycemic control (HbA1C < 7), and poor glycemic control (HbA1C > 7) were done.

Results: Magnesium deficiency [Hypomagnesaemia] was found 44% in T2DM cases with mean serum Mg 1.14 ± 0.162 mg/dl with poor glycemic control of HbA1c of 9.6%. Serum Mg level in diabetics of HbA1c 7% was 1.382 ± 0.42170209 mg/dl. Mg in poor glycaemic group showed negative correlation with HbA1c ($r = -0.3244$, $p = 0.0012$). Mg shows negative correlation with FBS in poor glycaemic group ($r = 0.3365$, $p = 0.0152$). Mg in good glycaemic control group (HbA1c < 7%) shows negative correlation with HbA1c ($r = -0.2522$, $p < 0.05$). Hypomagnesaemia cases were significantly older aged (57.884 ± 6.595 years) and had higher HbA1C ($9.5636 \pm 2.753\%$).

Conclusion: Study results shows that Mg levels are decreased in T2DM and negative correlation of Mg with glycaemic control conveys that Mg may serve as a prognostic factor in T2DM. Patients with hypomagnesaemia were noted to have poorer glycaemic control and a longer mean duration of diabetes. Impaired magnesium metabolism may have a contributory role in the progression of diabetes and later development of secondary complications.

Keywords: Type 2 diabetes mellitus, diabetic control, SERUM magnesium

1. INTRODUCTION

Magnesium is a cofactor in more than 300 enzyme systems that regulates diverse biochemical reactions in the body, including protein synthesis, muscle and nerve function, blood glucose control, and blood pressure regulation. Magnesium is required for energy production, oxidative phosphorylation and glycolysis. It contributes to the structural development of bone and is required for the synthesis of DNA, RNA and the antioxidant glutathione. Magnesium also plays a role in the active transport of calcium and potassium ions across cell membranes, a process that is important to nerve impulse conduction, muscle contraction, and normal heart rhythm.¹ Magnesium is a cofactor of various enzymes in carbohydrate oxidation and plays an important role in glucose transporting mechanism of the cell membrane. It is also involved in insulin secretion, binding, and activity².

2. OBJECTIVES

1. To estimate serum Mg levels in patients of T2DM
2. To assess the correlation of hypomagnesaemia with glycemic status of diabetic individual.

3. MATERIALS AND METHODS

- **Study Design:** Cross-sectional observational study
- **Study period:** 3 months
- **Sample size:** 60
- **Reference article:** Odusan OO, Familoni OB, Odewabi AO, Idowu AO, Adekolade AS. Patterns and correlates of serum magnesium levels in subsets of type 2 diabetes mellitus patients in Nigeria. *Indian J Endocrinol Metabol* 2017;21:439-42.
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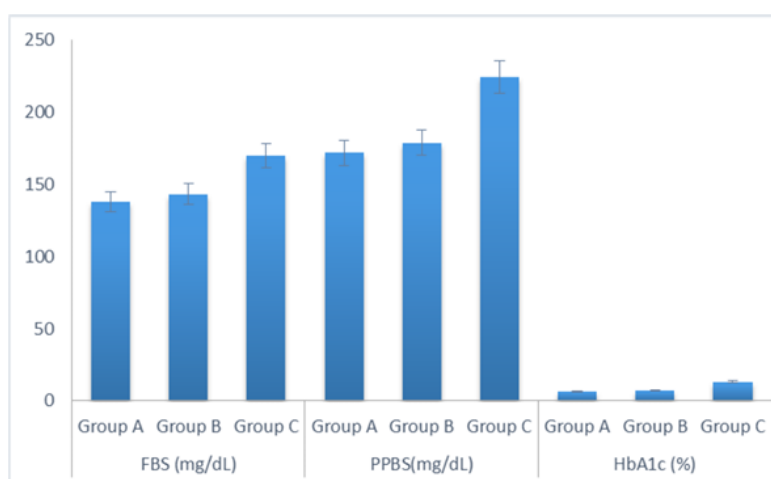
4. STATISTICAL ANALYSIS METHODS

The collected data entered into the Excel spread sheet and transferred to the SPSS 18.0 (SPSS Inc., Chicago, IL, USA) for windows version. Quantitative variables presented as mean and standard deviation. Descriptive statistics used to numeric variables as mean $\pm$ standard deviation and Qualitative categorical variables of data was expressed as count and percent. Independent sample t-test was used to compare the baseline and biochemical data between controlled and patients with T2DM. Analysis of variance (ANOVA) was used to compare the Mg level between controlled and uncontrolled T2DM. The relationship between the 2 numerical variables was analyzed using Spearman's correlation analysis. Spearman's correlation was applied to correlate serum Mg level with different markers for glycemic control such as HbA1c, FBS and PPBS respectively. Results were evaluated in 95% confidence interval, and P value for all tests were considered significant at < 0.05 and highly significant at < 0.001

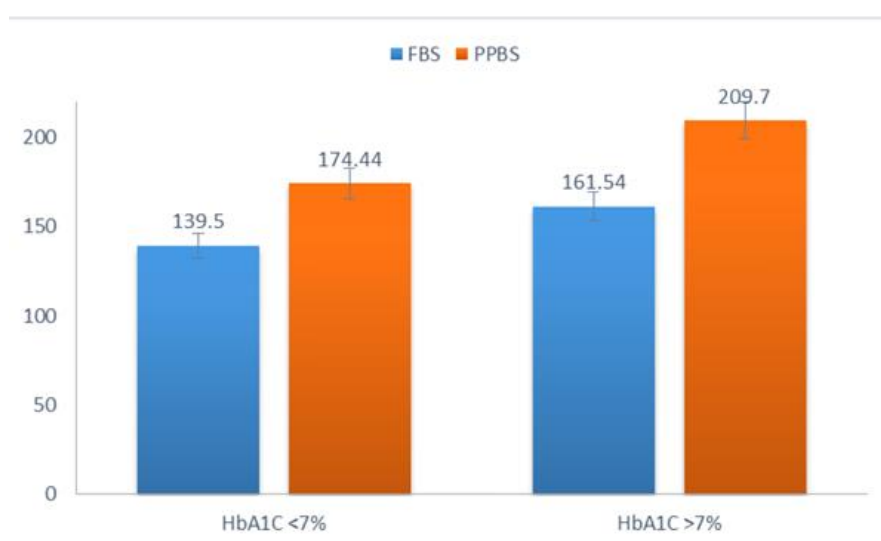
Sample size calculation Using the formula $Z^2 \times S^2 / d^2$ For, 95% confidence interval, Where, Z = 1.96, S = 17.23 and d as 5, 5% significance level, d = 0.05 = Allowable error. Therefore, required sample size, with $n = \{Z^2 \times S^2\} / d^2$ was 60.

5. RESULTS

43 were males and 17 were females, and 71% of patients were in the 4th to 6th decade with mean age of 53.68 ± 8.095 years. Mean FBS was significantly higher in Group C than Group B and Group A (170.1171 ± 26.126786 vs 143.242 ± 16.1497 vs 137.727 ± 5.334 mg/dl, $P < 0.001$). Mean PPBS was higher in Group C than Group B and Group A (224.38 ± 29.366 vs 179.0303 ± 18.63 vs 171.818 ± 11.0409 mg/dl, $p < 0.001$). Mean HbA1c levels in Group A was significantly lower than Group B and group C ($6.684 \pm 0.0972\%$, $7.454 \pm 1.148\%$ and $13.202 \pm 3.46217\%$, $p < 0.001$).

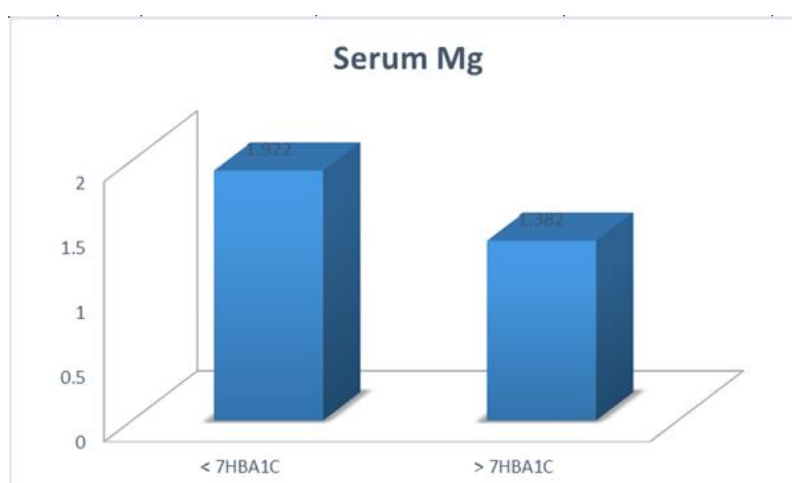


GYCEMIC VARIABLES IN SUBGROUPS

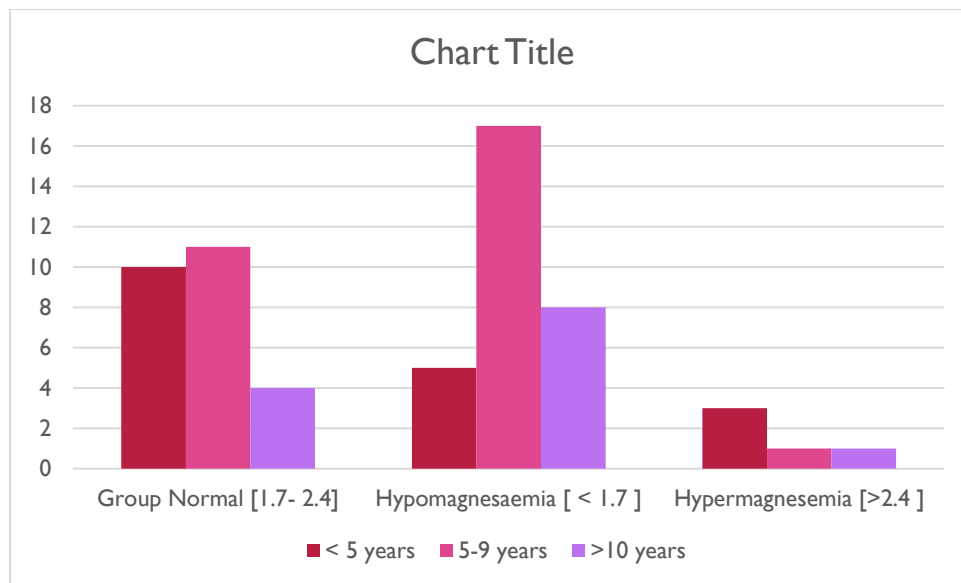


Relation between FBS,PPBS,HbA1C

Serum Mg significantly higher in Group C than Group B and Group A (1.2911771 ± 0.3808 vs 1.6939 ± 0.4278 vs 1.9818 ± 0.4496 mg/dl, $p < 0.001$). Study reported inverse correlation between Mg levels and duration of diabetes.



Relation between Mg,HbA1C



Association between magnesium levels and duration of diabetes mellitus

6. SUMMARY

Magnesium deficiency [Hypomagnesaemia] was found 44% in T2DM cases with mean serum Mg 1.14 ± 0.162 mg/dl with poor glycemic control of HbA1c of 9.6%. Serum Mg level in diabetics of HbA1c 7% was 1.382 ± 0.42170209 mg/dl. Mg in poor glycaemic group showed negative correlation with HbA1c ($r = -0.3244$, $p = 0.0012$). Mg shows negative correlation with FBS in poor glycaemic group ($r = 0.3365$, $p = 0.0152$). Mg in good glycaemic control group (HbA1c < 7%) shows negative correlation with HbA1c ($r = -0.2522$, $p < 0.05$). Hypomagnesaemia cases were significantly older aged (57.884 ± 6.595 years) and had higher HbA1C ($9.5636 \pm 2.753\%$).

DISCUSSION:

Study by [Olatunde O Odusan](#) also revealed similar results were the mean serum Mg of all patients was 2.06 ± 0.49 mg/dl, controls at 2.22 ± 0.48 mg/dl. About $\frac{1}{4}$ (23.2%) of the patients from the study had hypomagnesaemia which was significantly more than 12% of controls. Although the patients with diabetes and HT were older and more of females than those with DM alone, the mean serum Mg was comparable (2.03 ± 0.49 vs. 2.09 ± 0.50 mg/dl). 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 hypomagnesaemia and normal serum Mg, HbA1c was significantly higher in the hypomagnesaemia group (8.39 ± 0.98 vs. $6.75 \pm 1.22\%$, $P = 0.021$)⁴.

Study by Ramadass S concluded that Serum magnesium levels had inverse relation to HbA1c levels and with duration of Diabetes Mellitus type 2. Hypomagnesaemia is linked to poor control of Diabetes Mellitus type 2 and depletion of serum magnesium occurs exponentially with duration of disease⁶.

Limitations Of This Study

- Sample size of the study is small and requires large sample size to define the results to large population.

7. CONCLUSION

Study results shows that Mg levels are decreased in T2DM and negative correlation of Mg with glycaemic control conveys that Mg may serve as a prognostic factor in T2DM. Patients with hypomagnesaemia were noted to have poorer glycaemic control and a longer mean duration of diabetes. Impaired magnesium metabolism may have a contributory role in the progression of diabetes and later development of secondary complications. Age and poor glycemic control were significant predictors of low magnesium in T2DM patients. In addition to their regular anti-diabetic treatment, clinicians should consider Mg dietary supplementation in these patients to prevent further diabetes complications. Hence it was concluded that early detection and treatment of hypomagnesaemia may have an affirmative influence on glycaemic status and treatment of type 2 diabetes mellitus.

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