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**Original Research Article**

# Serum lipid profile and serum magnesium levels in newly diagnosed type 2 diabetic subjects and normal individuals: a case control study

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## ABSTRACT

**Background:** Hypomagnesaemia may be considered as one of the aggravating factors for insulin resistance. The kidneys lose their ability to maintain magnesium levels during periods of uncontrolled hyperglycaemia which may then result in lower blood levels of magnesium. Lipid profile and magnesium show significant variability in diabetes. The objective of the present study was to compare serum magnesium levels, lipid profile and HbA1c levels among patients newly diagnosed with type 2 diabetes mellitus and normoglycemic individuals.
**Methods:** The study was conducted during 60 patients (30 cases and 30 controls) attending to the diabetes clinic. Cases were 30 newly detected T2DM subjects, proved normotensives, not initiated on any oral- hypoglycaemic, anti-hypertensive or lipid lowering drugs, aged between 20 to 30 years. Controls were similar age and gender matched non-diabetics. The biochemical parameters like Mg levels, HbA1c and lipid profile were compared between cases and controls.
**Results:** The serum magnesium and HDL-C levels were significantly ($p<0.001$) lower among the diabetics compared to the healthy subjects. TG, total cholesterol, LDL-C showed significantly ($p<0.001$) higher mean levels in diabetics compared to the controls.
**Conclusions:** Serum magnesium levels and lipid profile were significantly different in diabetic patients compared to normal individuals.

**Keywords:** Lipid profile, Serum magnesium, Type 2 diabetes

## INTRODUCTION

Diabetes mellitus is now considered a giant killer disease of the 21st Century with its vicious prongs in the South-East Asian countries, especially India, which rightly is said to be the "diabetes Capital" of the world.[1]

Diabetes became more complicated with the advent of the concept of insulin resistance syndrome which includes dyslipidemia to be playing an important role in the development of atherosclerosis resulting in macro-vascular complications.[2] Diabetes mellitus is also associated with disturbances in electrolyte metabolism viz: $Na^+$ and $Mg^{2+}$ tend to decrease while $K^+$ increases. Among the electrolytes, only serum magnesium ($Mg^{2+}$) significantly correlate with the level of HbA1c and thus may be related to long-term control of diabetes.[3]

Hypomagnesaemia may be considered as one of the aggravating factors for insulin resistance.

The kidneys lose their ability to maintain magnesium levels during periods of uncontrolled hyperglycaemia. The increased loss of magnesium in urine may then result in lower blood levels of magnesium.[4] Thus serum magnesium and serum lipid profile are expected to show

marked differences in diabetic patients compared to normal individuals.

Hence this study aimed at determining the differences in serum magnesium levels and lipid profile among patients newly diagnosed with type 2 diabetes mellitus and normoglycemic individuals attending to a tertiary care hospital at Puducherry.

## METHODS

The study was conducted during January to April 2018 at Medicine OPD of Sri Venketeswaraa Medical College Hospital& Research Center, Ariyur, Puducherry, among 60 patients (30 cases and 30 controls) attending to the diabetes clinic.

Accordingly, 30 newly detected T2DM subjects, proved normotensives, not initiated on any oral- hypoglycaemic, anti-hypertensive or lipid lowering drugs, aged between 20 to 30 years were selected as cases.

A group of 30 age-and gender-matched healthy subjects viz: healthy relatives or attendants of the patients with normal blood glucose, with no family history of diabetes up to second generations were chosen as controls. All the subjects were included by purposive sampling.

The patients included in the study were informed about the study and written consent was obtained. A detailed history regarding socio-demographic variables and duration of disease was asked and clinical examination findings together were recorded in a proforma.

All the participants were then subjected to blood investigations like blood glucose levels measured using Glucose-oxidase method, Serum magnesium levels by Ion sensitive electrode method and lipid profile estimated using enzymatic calorimetric methods.

### *Statistical analysis*

Data entry and analysis was done using SPSS version 19. The mean difference between continuous variables was estimated using student t-test and correlated using Pearson Correlation test. A p-value of less than 0.05 was considered statistically significant.

## RESULTS

The mean age of the study participants was 26.4±4.3 years and majority were males (75%) (Table 1).

The serum magnesium levels were significantly ($p<0.001$) lower among the diabetics compared to the healthy subjects (Table 2).

TG, total cholesterol, LDL-C showed significantly ($p<0.001$) higher mean levels in diabetics compared to the controls. HDL-C was lower among the cases giving a clue about the unfavorable lipid derangements in diabetic patients compared to the non-diabetics.

**Table 1: Socio-demographic characteristics of cases and controls.**

| Variables | Cases (n=30) | Controls (n=30) |
|---|---|---|
| **Age** | | |
| 20-25 years | 11 (36.7) | 9 (30) |
| 26-30 years | 19 (63.3) | 21 (70) |
| **Gender** | | |
| Male | 21 (70) | 24 (80) |
| Female | 9 (30) | 6 (20) |
| **Dietary habits** | | |
| Vegetarian | 11 (36.7) | 10 (33.3) |
| Non-vegetarian | 19 (63.3) | 20 (66.7) |
| **BMI** | | |
| Obese (≥23) | 9 (30) | 12 (40) |
| Non-obese (<23) | 21 (70) | 18 (60) |

**Table 2: Lipid profile and serum magnesium levels compared between groups.**

| Biochemical parameters | Cases (n=30) | Controls (n=30) | p-value* |
|---|---|---|---|
| Mean HbA1c levels | 8.64±1.2 | 6.04±0.9 | <0.001 |
| $Mg^{2+}$ (mmol/l) | 0.42±0.05 | 0.79±0.02 | <0.001 |
| Triglycerides (mg/dl) | 221±18.9 | 132±22.3 | <0.001 |
| Total cholesterol (mg/dl) | 249±38.4 | 189±9.8 | <0.001 |
| HDL-C (mg/dl) | 42.8±6.8 | 54±8.2 | <0.001 |
| LDL-C (mg/dl) | 158±28.3 | 101±7.9 | <0.001 |

There was a significant inverse correlation ($r^2$= 0.714, $p<0.001$) between HbA1c levels and serum magnesium. As HbA1c (%) increased Mg levels showed decreasing trend (Figure 1).

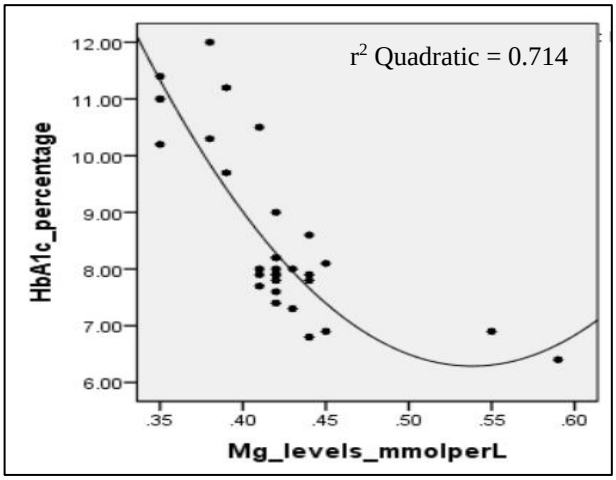


**Figure 1: Correlation scatter-plot of HbA1c levels against serum Mg levels.**

## DISCUSSION

Diabetes mellitus is a metabolic disease associated with derangements in electrolytes and lipids. It is expected that the electrolyte disturbances are more direct towards potassium balance than other ions. But magnesium levels have shown correlation with the severity of diabetes. In the present study, the serum magnesium levels were significantly ($p<0.001$) lower (mean $Mg^{2+}$ = 0.42±0.05 mmol/L) among the diabetics compared to the healthy subjects (mean $Mg^{2+}$= 0.79±0.02mmol/L). Similar results were reported in a study done by Karim et al which showed that the serum magnesium was found to be significantly lower ($p<0.001$) and in newly diagnosed normotensive type 2 diabetic patients compared to healthy controls.[5] The magnesium levels were still within the normal range in this study unlike there was real hypomagnesaemia reported in present study in diabetics. Sendhav et al in their study documented that lipid profile showed a significant rise ($p <0.01$) of triglycerides, total cholesterol, low-density lipoprotein-cholesterol (LDL-C), and very low-density lipoprotein-cholesterol (VLDL-C) along with increase in fasting blood glucose among diabetics in comparison with controls ($p < 0.01$).[6] In present study, author was able to document a significant increase in TGs, LDL-C, TC and drop in HDL-C among diabetics when compared to normal individuals. The increase or decrease in lipids did not find any essential correlation with magnesium levels as was documented in the study by Nasri where significant inverse correlations of serum Mg with serum cholesterol, LDL-C and serum HbA1c were reported.[7] However, in the present study, there was a significant inverse correlation ($r^2$= 0.714, $p<0.001$) between HbA1c levels and serum magnesium. The same was documented in other studies which showed inverse correlations.[8,9] Malnutrition related magnesium deficiency cannot be claimed as a confounder as it is evident from the study which shows magnesium deficiency is unlikely due to nutrition deficiency.[10] Thus the usage of magnesium as a marker of glycemic variability or any linear relationship models between magnesium and HbA1c levels are possible but there is a need for large scale prospective studies for authenticity. Similarly, correlation of Mg levels with lipids in diabetes may not be useful as the biological plausibility to establish any linear relationship between these parameters remains non-evidence-based.

## CONCLUSION

The serum magnesium levels are lower among diabetic subjects compared to healthy individuals. The lipid profile also shows higher triglycerides, LDL-C, Cholesterol levels and lower HDL-C levels in diabetics compared to healthy individuals. Thus, serum magnesium and lipid profile can be used as reliable parameters to predict severity of diabetes.

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