

## RELATIONSHIP BETWEEN HYPOMAGNESEMIA AND DYSLIPIDEMIA IN TYPE 2 DIABETES MELLITUS

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**ABSTRACT:** Magnesium is an important macro mineral in the mammalian cells. It is a cofactor for many enzymes involved in lipid metabolism like lipoprotein lipase, pyrophosphatase etc. In magnesium deficiency, these enzymes are defective and leads to dyslipidemia in type 2 diabetic patients. Objective: To observe the association between hypomagnesemia and dyslipidemia in type 2 diabetic patients. Methodology: A case control South Indian population study consisted of control group (40 healthy individuals) and case group (203 patients who were diagnosed as type 2 diabetes). Serum magnesium and lipid profile was analyzed in blood samples using standard kits in fully automated analyzer. The data was analyzed using Student's 't' test and correlation coefficient. Result: In the present study, a significant low serum magnesium levels ( $p < 0.01$ ) in case group was observed when compared to control group. A significant decreased cholesterol levels ( $p < 0.05$ ) and serum HDL levels ( $p < 0.001$ ) was observed in case group when compared to control group. In case group, we found a significant increased triglycerides ( $p < 0.05$ ) and LDL levels ( $p < 0.001$ ) when compared to control group. A positive correlation was observed between magnesium and cholesterol ( $r = 0.195$ ,  $p < 0.01$ ), magnesium and LDL ( $r = 0.202$ ,  $p < 0.01$ ), magnesium and total cholesterol HDL ratio ( $r = 0.142$ ,  $p < 0.05$ ) in the case group. Conclusion: We observed hypomagnesemia in type 2 diabetes patients with dyslipidemia.

**KEYWORDS:** Hypomagnesemia, lipoprotein lipase and dyslipidemia.

## INTRODUCTION

Several studies had observed low serum magnesium levels in type 2 diabetes.<sup>[1,2]</sup> Atherosclerosis risk in community (ARIC) study shows an inverse association between serum magnesium and the risk for coronary heart disease among men with diabetes.<sup>[3]</sup> Chetan. P. Hans, et al provide evidence that magnesium deficiency affects lipid metabolism.<sup>[4]</sup> Magnesium play a salient role in lipoprotein lipase activity which involves in chylomicron and VLDL metabolism.<sup>[5]</sup> LCAT (lecithin cholesterol acyl transferase) requires magnesium for its activation. LCAT is a essential component in reverse cholesterol transport. Magnesium is also essential for apolipoprotein synthesis.<sup>[6]</sup> Magnesium is predominantly complexes with ATP. This ATP-Mg complex is the allosteric factor for the enzyme HMG CoA reductase in cholesterol synthesis. Hence magnesium is called as natural statin.<sup>[7,8]</sup> Pyrophosphatase plays a vital role in the first reaction of lipolysis.<sup>[9]</sup> In hypomagnesemia conditions, these enzymes are defective and leads to dyslipidemia. Therefore it is of interest, we decided to observe the association between hypomagnesemia and dyslipidemia in patients with type 2 diabetes mellitus.

## MATERIALS AND METHODS

The current study has been approved by Institutional Ethical Committee of Sri Ramachandra Medical College (CSP/12/JUL/24/110). Individuals informed consent was signed by the participants.

**Selection of participants:** The study comprises of two groups

Control group- Age matched apparently 40 (13 males and 27 females) individuals were selected among the staffs of Sri Ramachandra Medical College. Case group- 203 type 2 diabetes patients aged 30 and above of both genders ( 125 males and 78 females) were selected from out patients department of Sri Ramachandra hospital. Inclusion criteria are 30 years and above type

2 diabetes patients. Exclusion criteria are type 1 diabetes patients, hypertension, cancer, hyperthyroidism, pancreatitis, Cushing’s disease, renal disease, cardiovascular disease, smokers and alcoholics.

Sample collection: Blood samples were collected from 243 individuals in the fasting state using vacutainers without anticoagulant. These vacutainers were centrifuged at 3500rpm for 10 minutes. Serum were separated and stored at -20C until use.

**METHODOLOGY:** Serum magnesium, total cholesterol, LDL cholesterol, HDL cholesterol and triglyceride were processed in Dimension RxL automated clinical chemistry analyzer using standard kits. Total cholesterol HDL ratio was calculated using the formula

$$\text{Total cholesterol HDL ratio} = \frac{\text{Total cholesterol}}{\text{HDL}}$$

**Statistical analysis:** The results of all the parameters were expressed as Mean ± standard deviation. Student’s ‘t’ test was used to arrive the statistical significance (p value) between both groups. The association between magnesium and other parameters in the case group was assessed by the correlation coefficient .

**RESULT**

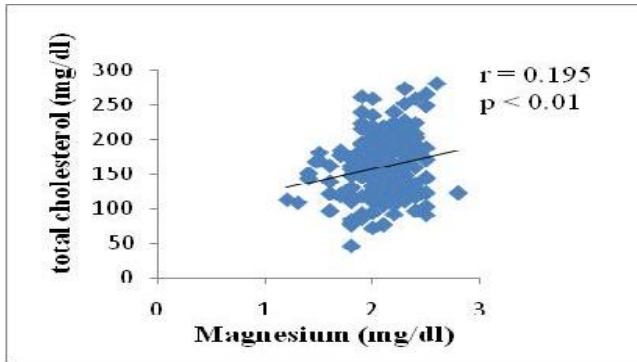
The results of the current study are shown below

Table 1 represents the mean and standard deviation of biochemical parameters in both groups

Groups	Age (years)	Magnesium (mg/dl)	Total Cholesterol (mg/dl)	LDL (mg/dl)	HDL (mg/dl)	Triglyceride (mg/dl)	Total cholesterol HDL ratio
<b>Control group</b> M : F 13 : 27	40.3 ± 8.8	2.19 ± 0.1	178.1 ± 37.4	85.0 ± 9.5	48.3 ± 8.1	124.8 ± 77.8	3.7 ± 1.1
<b>Case Group</b> M : F 125 : 78	55.7 ± 10.7	2.08 ± 0.2	160.5 ± 43	96.8 ± 35.4	34.4 ± 10.6	161.1 ± 120.9	5.1 ± 2.7
<b>p value</b>	-	<0.01	<0.05	<0.001	<0.001	<0.05	<0.001

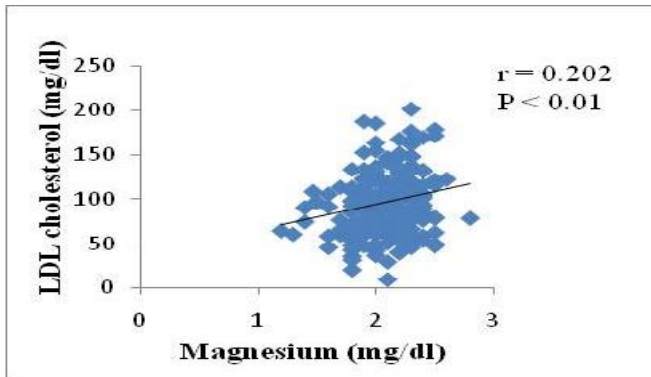
Table 1 shows a significantly low serum magnesium levels (p<0.01) in case group when compared to control group. In case group, there is a significant increased serum triglycerides levels (p<0.05) and serum LDL cholesterol levels (p<0.001) whereas significant decreased serum total cholesterol levels (p<0.05) and serum HDL cholesterol levels (p<0.001) in comparison with control group. A significantly increased total cholesterol HDL ratio (p<0.001) in case group when compared to control group.

Figure 1 represents the correlation between serum magnesium and total cholesterol



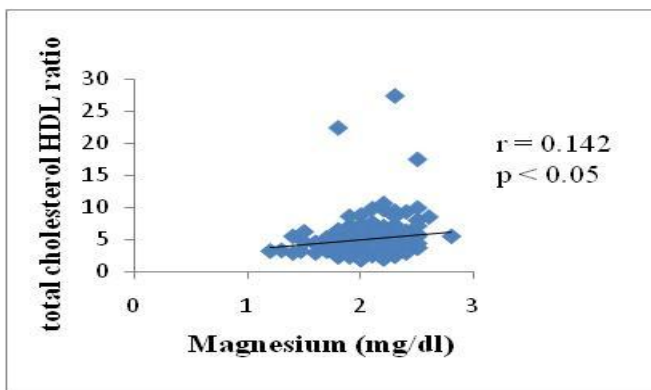
In the current study, a negligible positive correlation ( $r = 0.195$ ,  $p < 0.01$ ) between serum magnesium levels and total cholesterol levels was observed (Figure 1).

Figure 2 explains the correlation between serum magnesium and LDL cholesterol



We observed a weak positive correlation between serum magnesium levels and serum LDL cholesterol levels ( $r = 0.202$ ,  $p < 0.01$ ) in the case group (Figure 2).

Figure 3 shows a correlation between serum magnesium and total cholesterol HDL ratio



A negligible positive correlation ( $r = 0.142$ ,  $p < 0.05$ ) between serum magnesium and total cholesterol HDL ratio in the case group (Figure 3) No correlation was observed between serum magnesium and serum HDL cholesterol levels, serum magnesium and serum triglyceride levels in the case group.

## DISCUSSION

Several studies has observed association between lipid metabolism disturbance and magnesium deficiency in type 2 diabetes patients.<sup>[10,11,12]</sup> The current study observed a significant increase in serum triglyceride levels and serum total cholesterol levels in case group when compared to control group.<sup>[13,14]</sup> A significant increased serum LDL cholesterol levels was reported in case group when compared with control group. In comparison with control group, we observed a significant decreased serum HDL cholesterol levels in case group.<sup>[15]</sup> Our study shows a significant increased total cholesterol HDL ratio in the case group when compared to control group.<sup>[16]</sup>

In the present study, we found a positive correlation between serum magnesium and total cholesterol. S. Swaminathan, et al results are also in accordance with our study.<sup>[17]</sup> A positive correlation was observed between serum magnesium levels and serum LDL cholesterol levels. Similar results were reported by S. Swaminathan, et al study.<sup>[17]</sup> Our study shows a positive correlation between serum magnesium and total cholesterol HDL ratio in the case group. A significant increased total cholesterol HDL ratio in the case group implies that magnesium deficiency can contribute to dyslipidemia. The present study reports no correlation between serum magnesium and HDL cholesterol, serum triglycerides. Hamid Nasri, et al work also did not observe correlation between these parameters.<sup>[18]</sup> On one hand, magnesium deficiency causes lipid metabolism enzymes inactive which in turn leads to dyslipidemia. On the other hand, magnesium deficiency disturbs lipid metabolism through various mechanisms. Magnesium acts as a component of antioxidant system. Magnesium maintains glutathione concentration which is required for enzyme antioxidant like glutathione peroxidase, etc. Glutathione helps in the regeneration of other antioxidants like ascorbate and tocopherol. Decreased levels of these antioxidants contribute to lipid peroxidation.<sup>[19,20,21]</sup> In the intestine, magnesium forms insoluble complexes with fatty acids and prevents the dietary fat absorption.<sup>[19]</sup> An inverse relationship was observed between serum magnesium and glycemic control. Type 2 diabetic patients with poor glycemic control was found to be associated with hypomagnesemia. Poor glycemic control is responsible for the development of various complications like dyslipidemia, retinopathy, nephropathy, etc.<sup>[22,23]</sup> Oral magnesium administration had caused a fall in total cholesterol levels, LDL cholesterol levels, triglyceride levels and in HDL cholesterol levels.<sup>[24,25]</sup>

## CONCLUSION

The current study shows low serum magnesium levels and altered lipid metabolism in type 2 diabetic patients in comparison with healthy individuals. Hypomagnesemia may lead to dyslipidemia in type 2 diabetic patients. Our study suggests that oral magnesium supplementation to diabetic patients along with hypolipidemic drugs may improve the altered lipid metabolism status.

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## CONFLICTS OF INTEREST

No conflict of interest.

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