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Original Research Article

Study on Serum Magnesium Level in Type 2 Diabetes Mellitus in North Indian Population

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Abstract

Background: *Magnesium within the body has been associated with several disease such as Diabetes mellitus. Hypomagnesaemia has been reported to occur at an increased frequency among patients with type 2 diabetes compared with healthy non diabetic subjects.*

Methods: *125 patients of Type 2Diabetes Mellitus, who were diagnosed on the basis of WHO criteria, were included in this study and 100 healthy controls were also included. Detailed history and physical examination of all patients were done and all patients underwent laboratory tests for FBS, PPBS, HbA1c, Serum urea, Serum creatinine and magnesium level.*

Results: *The prevalence of hypomagnesaemia was quite higher in cases (29%) as compared to that of controls (6%)In this study, no statistically significant correlation was found between level of magnesium and age (p=0.063). In present study no statistically significant association was found between level of magnesium and serum creatinine level (p=0.792) and that of level of magnesium and serum urea (p=.481). The mean values of FBS, PPBS, HbA 1C in diabetic cases were found to be higher in cases then the healthy controls and was highly significant Pearson's correlation showed that serum magnesium correlated negatively to FBS ($r = -0.225$, $P < 0.002$),PPBS($r=-0.228$,$P < 0.016$) and HbA1C ($r = -0.203$, $P < 0.008$) and it was highly significant in cases). Both FBS and PPBS levels were higher in patient with hypomgnesemia as compared to that of patients having normal magnesium level and was statistically significant.*

Conclusions: *This study showed that hypomagnesaemia is common in Type 2 diabetes mellitus patients when compared to non diabetic controls. This study clearly depicts that in diabetes mellitus serum magnesium levels had a positive correlation with glycemic control.*

Keywords: *Type 2 diabetes mellitus, Hypomagnesaemia, Fasting blood sugar, Post prandial blood sugar, Creatinine, Glycosylated hemoglobin (HbA1c), Magnesium,.*

Introduction

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood sugar[(1)].

Prevalence of type 2 diabetes mellitus (T2DM) is increasing globally and has reached epidemic proportions in many countries. The number of people with diabetes has raised from 108 million in 1980 to 422 million in 2014[(2)]. The global prevalence of diabetes among adults over 18 years of age has risen from 4.7% in 1980 to 8.5% in 2014[(2)].

Several vitamins and minerals act as cofactors in enzyme reaction regulated by insulin. Deficiencies of certain vitamin and minerals such as vitamin E, potassium, magnesium zinc and chromium may aggravate carbohydrate intolerance out of all these, it is relatively easy to detect potassium or magnesium concentrations in serum and to replace them based on their low serum levels.[(3)]

Magnesium (Mg), is is the fourth most abundant cation in the human body and the second most abundant intracellular cation abundant intracel-lular ions with an essential role in fundamental biological reactions, whose deficiency provokes biochemical and symptomatic alterations in the human organism.[(4)]

Magnesium has a significant role in insulin secretion, insulin binding and its activity. Cellular deficiency of magnesium can alter the membrane bound Na^+ K^+ATPase which is involved in maintaining the gradient of sodium and potassium and also in glucose transport.[(5)]

The concentrations of magnesium in serum of healthy people are remarkably constant, whereas 25-39% of diabetics have low concentrations of serum magnesium.[(6)]

Hypomagnesaemia in the patient with diabetes may result from poor oral intake, poor gastrointestinal absorption, and enhanced renal Mg excretion.

Hypomagnesaemia has long been known to be associated with diabetes mellitus. Magnesium depletion is said to have a negative impact on glucose homeostasis and Insulin sensitivity. This association between diabetes mellitus and magnesium is said to have a wide range of impact on diabetic control and complications.[(7,8)]

The present study was undertaken with an aim to estimate level of magnesium in patients with type 2 diabetic and to correlate the serum magnesium concentrations with HbA1C, blood sugar fasting, blood sugar post prandial, Serum Urea and Serum Creatinine with that of healthy control subjects.

Material and Methods

The study was carried out in Department of Biochemistry, at Dr. Ram Manohar Lohia Institute of medical sciences and research. In this study, a total of 125 patients with type 2 diabetes mellitus who were attending medicine department of this institute for regular glycemic checkup were recruited. The study was approved by the Ethics committee; a written informed consent was obtained from all participants in this study. The diagnosis of type 2 diabetes mellitus was confirmed by biochemical investigations as per WHO criteria. Diabetic cases were selected with following inclusion and exclusion criteria.

Inclusion criteria

1) Age between 30-80
2) Fasting blood sugar >126 mg/dl
3) Post Prandial blood sugar >200mg/dl

Exclusion criteria

1. Patients on diuretics
2. Gastrointestinal disorders
3. Impaired renal function
4. Alcoholism
5. History of acute MI
6. Patients receiving magnesium supplements

100 healthy individuals without diabetes were taken as controls.

5ml of fasting venous blood was collected, out of which 1ml was collected in fluoride vial for blood glucose estimation,2 ml was collected in EDTA vial for HbA1C estimation and 2 ml was collected in plain vial for estimation of serum magnesium,

urea, and creatinine and also 1ml of blood was collected in fluoride vial for PPBS estimation

Blood sugar estimation was done by using Hexokinase method.Serum creatinine by alkaline picrate method and serum urea by urease method on fully automated analyzer

Glycated hemoglobin was estimated by standard HPLC method using D-10 instrument from Bio-Rad.

Serum magnesium was estimated by Calmagite dye method on fully automated analyzer

Normal Value ;Adults: 1.7-2.2 mg/dl

Values below 1.7mg/dl were considered as hypomagnesaemia.

Statistical Analysis

Statistical Analysis of data was performed using SPSS (Version 15.0). Pearson correlation, Student t test has been used to find the significance of mean pattern of serum magnesium between cases/controls P value less than 0.05 was taken as statistically significant.

Results

In this study, a total of 125 patients with type 2 diabetes mellitus who were attending diabetic clinic for regular glycemic checkup were recruited. Among these patients, 53.6 % (n=67) were men, and 46.4% (n: 58) were women. Mean duration of diabetes was 81 ± 86.9 months.

The mean age (mean±SD) of the patients was 55.30±12.6 years and the median age was 57 years.

100 healthy subjects were taken as control. The mean age of the control was 58.16±10.35 years

The mean age of the diabetics was 55.30±12.6 years whereas it was 58.16±10.34 years in controls. The maximum number of patients was in the age group of 51-60 i.e. 32.8% (Figure 1)

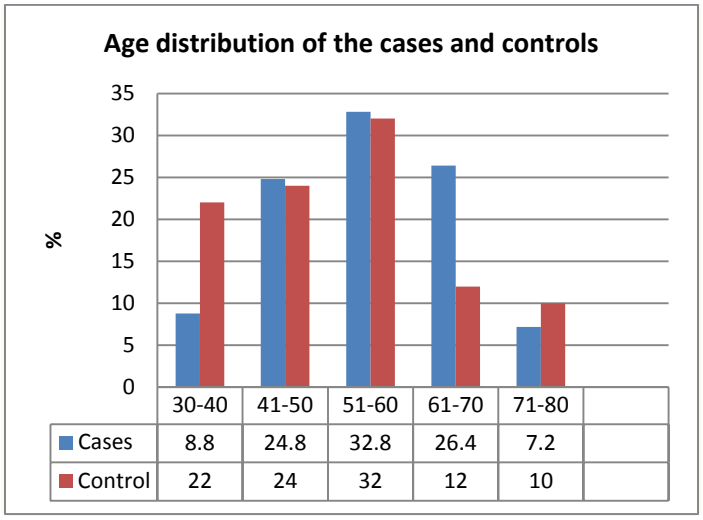

Figure 1: Age distribution of the cases and controls

In cases the number of males and females were 53.6% and 46.4% respectively whereas in control the numbers of males were 56% and females were 44% (Figure 2).

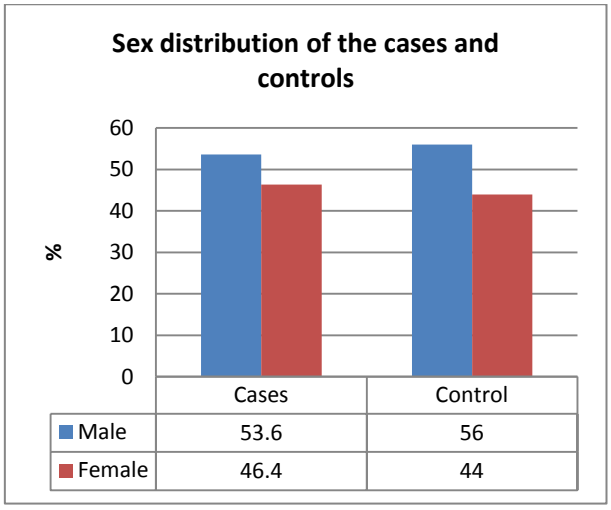

Figure 2: Sex distribution of the cases and controls

Table 1 Serum mg level in case and control groups

	Cases	Control	P value
Serum magnesium(mg/dl)	1.9265±0.35966	2.2850±0.3733	<0.001

There was significant difference in respect to serum magnesium levels between the cases and controls, with low value in the case group (1.9265±0.35966 versus 2.285±0.3733 (Figure 3)

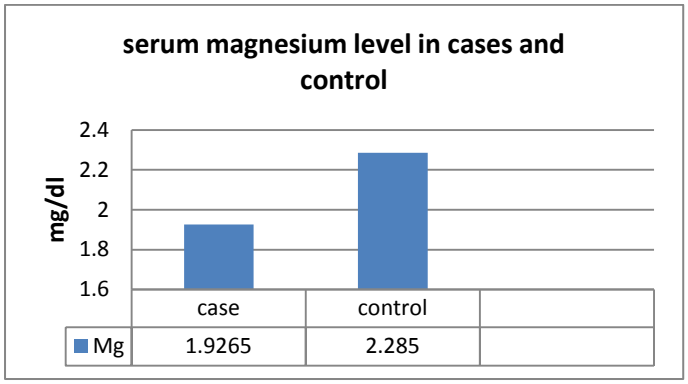

Figure 3- Mean serum magnesium level in cases and control

Table 2 Mean FBS, PPBS, HbA1c level in case and control groups

Parameters	Cases(n=125)	Control(n=100)	P value
FBS(mg/dl)	141.17 ±59.21	89.49± 12.34	<0.001
PPBS(mg/dl)	213.26 ±76.79	118.40 ±31.86	<0.001
HbA1C	8.73 ±2.11	5.30±.47	<0.001

The mean values of FBS, PPBS, HbA_{1C} in diabetic cases were found to be higher in cases then the healthy controls and was highly significant.

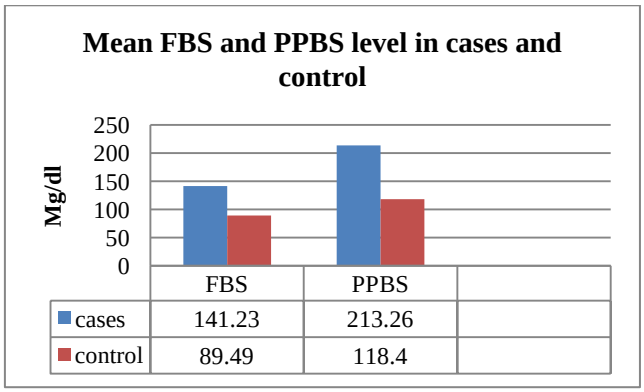

Figure 4- Mean FBS and PPBS level in cases and control

Table 3 Correlation of Magnesium with FBS, PPBS, and HbA1C

Magnesium		
	r value	P value
HbA1C	-0.203	0.008
FBS	-0.228	0.002
PPBS	-0.243	0.016

Pearson's correlation showed that serum magnesium correlated negatively to FBS ($r = -0.225$, $P < 0.002$), PPBS ($r=-0.228$, $P < 0.016$) and HbA_{1C} ($r = -0.203$, $P < 0.008$) and it was highly significant in cases

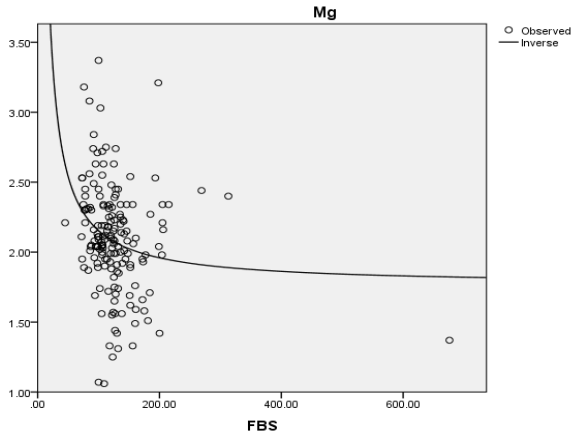

Figure 5 Correlation between serum magnesium and FBS in cases

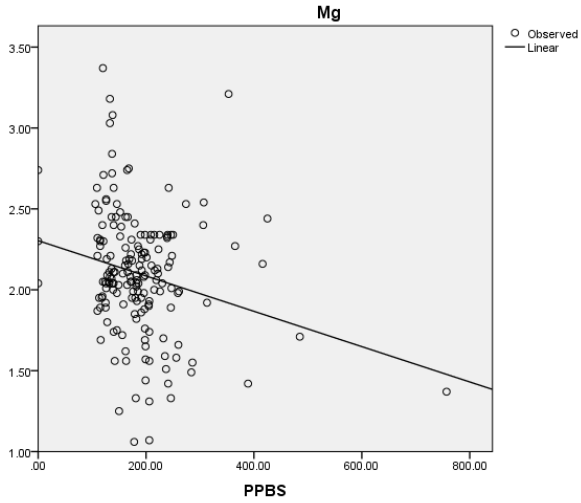

Figure 6 Correlation between serum magnesium and PPBS in cases

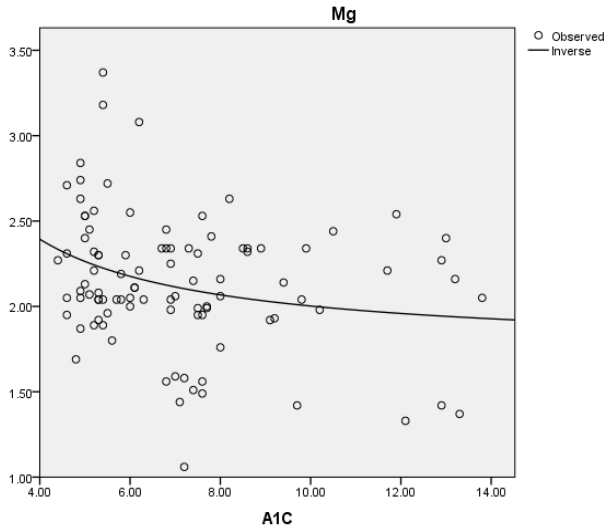

Figure 7 Correlation between serum magnesium and HbA_{1c} (%) in cases

Diabetic cases were further classified into two group as having normal magnesium level and diabetic having low magnesium level

In cases high magnesium level (≥1.7) was found in mean age 54.18 ± 12.63years whereas mean age 59±9.6 years was associated with low magnesium level (<1.7) and this difference was statistically significant (p=0.007).

According to the serum level of Mg, cases and control were classified into two groups: low Mg (<1.7) as hypomagnesemic and normal Mg group (≥1, 7) as normomagnesmic.

Table 4 Distribution of cases and control according to level of Magnesium

Group	Group 1	Group 2
Magnesium level	<1.7(hypomagnesemia)	≥1.7(normomagnesemia
No. of cases	36(29%)	89(71%)
No.of control	6(6%)	92(92%)

The prevalence of hypomagnesaemia was quite higher in cases (29%) as compared to that of controls (6%) (Figure 8).

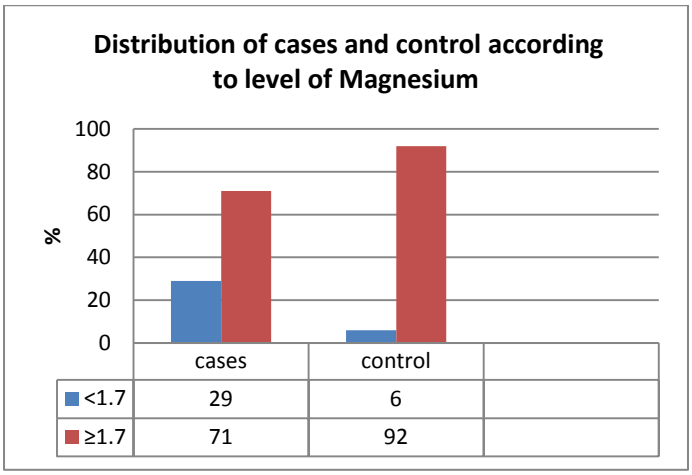

Figure 8- Distribution of cases and control according to level of Magnesium

Both FBS and PPBS levels were higher in patient with hypomgnesemia as compared to that of patients having normal magnesiumlevel and was statistically significant.

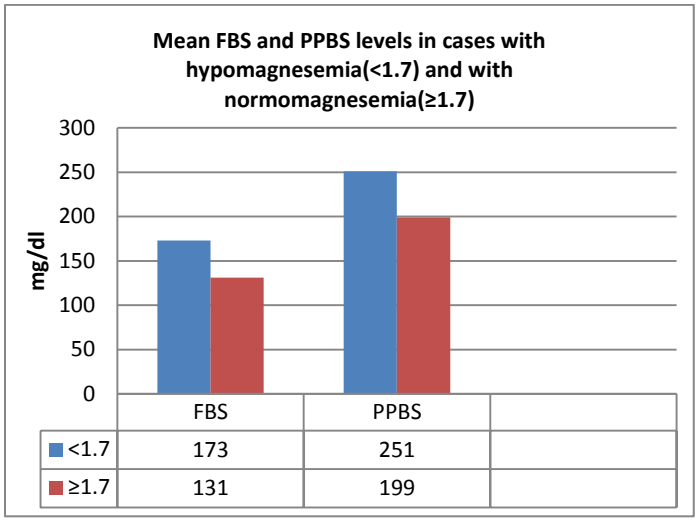

Figure 9- Mean FBS, PPBS, HbA1c level in cases with hypomagnesemia and with normomagnesemia magnesium level <1.7 was associated in patients with HbA1C 9.12 ±1.53whereas magnesium level ≥1.7 was seen in patients with HbA1C 8.432±1.23which was statistically significant

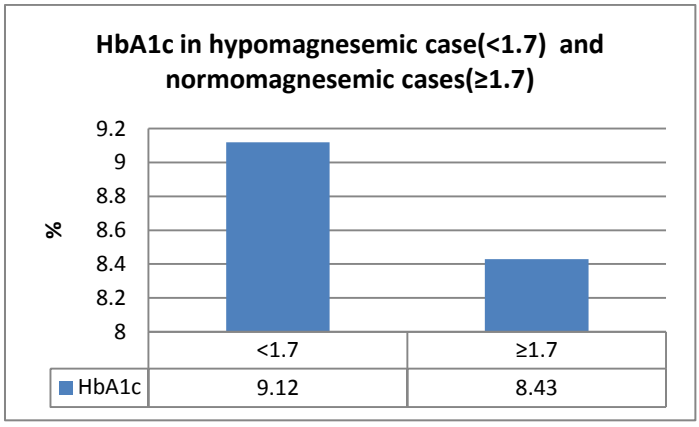

Figure 10- HbA1C in hypomagnesemic cases and normomagnesemic cases

Discussion

This study was conducted in department of biochemistry at Dr.Ram Manohar lohia institute of Medical sciences, Lucknow, a tertiary health care center. After taking informed consent 125 diabetic patients and 100 age and sex matched healthy controls were enrolled .In this study we focused to determine Serum magnesium level, fasting blood glucose, post prandial blood glucose, HbA1c in both groups.

The present study revealed lower levels of serum magnesium in diabetic patients; the present study included 125 type 2 diabetic patients and 100

control subjects. Serum magnesium levels were determined in all these subjects.

The present study had diabetic patients ranging from 30-80 years with average age of 55.3years. The average age of controls in the present study was 58.76 years. Hypomagnesemia, has been reported to occur in 13.5 – 47.7% of non-hospitalized patients with type 2 diabetes compared with 2.5 – 15% among their counterparts without diabetes.[9] In our study Hypomagnesaemia was seen in 29% of the cases where as only 6% of the controls had Hypomagnesemia which was in accordance with the above studies..

In our study serum magnesium levels were recorded in controls 2.2850±0.37, in various other studies levels in controls varied from 2.07±0.27 to 2.30±0.32 [10,11,12]. In diabetics patients in our study it is 1.9265±0.35 in other studies it varied from 1.8±0.22 to 1.94±0.05 [10,11,12], which was statically significant and was similar to our study.

In our study there was significant decrease in serum magnesium level in 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.

There was no significant difference between cases and controls with respect to serum creatinine levels and urea levels. The mean serum creatinine levels among cases and controls were 0.93±0.27 and 0.96±0.25 mg/dl respectively. Pearson's correlation showed that serum magnesium correlated negatively to FBS ($r = -0.225$, $P < 0.002$), PPBS($r=-0.228$,$P < 0.016$) and HbA1C ($r = -0.203$, $P < 0.008$) and it was highly significant in cases which was similar to the finding of Schlienger et al who studied the influence of glycemic control on various trace elements and reported significantly reduced plasma magnesium levels in patients with poor control of diabetes.[13]

Jain AP, et al study also establish positive correlation between magnesium levels with glycemic control in diabetics similar to our study, [14]

Conclusion

The present study suggested that magnesium deficient state is one of the causes of insulin resistance. Low magnesium status is common in type 2 diabetes mellitus patients when compared to non diabetic controls Because Mg2+ depletion reduces insulin sensitivity and may increase risk of secondary complications, like retinopathy, hypertension it may be prudent in clinical practice to periodically monitor plasma Mg2+ concentrations in diabetic patients. If plasma Mg2+ is low, an intervention to increase dietary intake of magnesium may be beneficial.A magnesium rich diet consisting of whole grains legumes, fruits and vegetables such as spinach, okra, dry apricots may be recommended. Further studies on the role of magnesium in diabetes are recommended.

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