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Original Article

Comparison of Serum Magnesium and Vitamin B12 in Healthy Pregnancy and Gestational Diabetes Mellitus (GDM) in a Tertiary Care Hospital

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ABSTRACT

Background: Gestational diabetes mellitus (GDM) is a common metabolic disorder during pregnancy associated with adverse maternal and fetal outcomes. Micronutrients such as vitamin B12 and magnesium play an essential role in glucose metabolism and insulin function. Deficiencies in these nutrients may contribute to impaired glycaemic control and the development of GDM.
Objectives: To compare serum vitamin B12 and magnesium levels between pregnant women with GDM and healthy pregnant controls, and to assess their variation across gestational age.
Methods: This analytical cross–sectional study was conducted on 100 pregnant women (50 with GDM and 50 healthy pregnant controls) attending a tertiary care hospital. Participants aged between 20 to 40 years in the second and third trimesters were included. Women with pre-existing diabetes or those on vitamin B12 or magnesium supplementation were excluded. Serum vitamin B12 and magnesium levels were measured using standard laboratory methods. Data were analysed using appropriate statistical tests, and a p-value <0.05 was considered statistically significant.
Results: The mean age and gestational age distribution were comparable between the two groups ($p > 0.05$). The mean serum vitamin B12 level was significantly lower in the GDM group (185.00 ± 30.52 pg/mL) compared to controls (214.88 ± 40.62 pg/mL; $p < 0.001$). Similarly, serum magnesium levels were significantly reduced in women with GDM (1.68 ± 0.15 mg/dL) compared to controls (2.16 ± 0.61 mg/dL; $p < 0.001$). No statistically significant variation in Vitamin B12 and magnesium levels was observed between the second and third trimesters within either group ($p > 0.05$).
Conclusion: Pregnant women with GDM exhibit significantly lower serum vitamin B12 and magnesium levels compared to healthy pregnant controls, suggesting a potential association between micronutrient deficiencies and GDM. Routine monitoring and correction of these deficiencies may improve maternal metabolic status and pregnancy outcomes.

Keywords*: Gestational diabetes mellitus, Vitamin B12, Magnesium, Pregnancy, Insulin function, Micronutrients.*

INTRODUCTION

Gestational diabetes mellitus (GDM) is a common metabolic disorder characterised by glucose intolerance first recognised during pregnancy and is associated with adverse maternal and fetal outcomes[1]. The burden of GDM is particularly high in developing countries such as India, where its prevalence ranges between 10% and 14%[2]. Identifying modifiable risk factors and biochemical alterations associated with GDM is therefore essential for improving pregnancy outcomes.

Micronutrients play a crucial role in metabolic homeostasis during pregnancy. Among these, vitamin B12 and magnesium have gained attention due to their involvement in glucose metabolism and insulin function. Vitamin B12 is essential for DNA synthesis and methylation pathways, and its deficiency has been linked to increased homocysteine levels, which may contribute to insulin resistance and metabolic dysfunction[3]. Several studies have demonstrated an association between low maternal vitamin B12 levels and an increased risk of GDM, particularly in the second and third trimesters[4]. Observational studies have reported significantly lower vitamin B12 levels in women with GDM compared to healthy pregnant women[5,6]. Furthermore, maternal Vitamin B12 deficiency has been associated with long-term metabolic consequences, including insulin resistance in offspring[7,8].

Magnesium, an essential intracellular cation, acts as a cofactor in numerous enzymatic reactions involved in glucose metabolism and insulin signalling. Hypomagnesemia has been implicated in the pathogenesis of insulin resistance and type 2 diabetes[9,10]. Clinical studies have also reported reduced serum magnesium levels in women with GDM, suggesting its potential role in glucose intolerance during pregnancy[11]. Additionally, magnesium supplementation has been shown to improve metabolic parameters and pregnancy outcomes in women with GDM[12].

Despite growing evidence, the relationship between these micronutrients and GDM remains inconsistent across populations, and regional data, particularly from Indian settings, are limited[13,14,15]. Therefore, the present study aims to compare serum Vitamin B12 and magnesium levels between pregnant women with GDM and healthy pregnant controls.

MATERIAL AND METHODS

This analytical cross–sectional study was conducted in the Departments of Biochemistry and Obstetrics and Gynaecology at a tertiary care teaching hospital over a period of four months. The study included a total of 100 pregnant women between 20 to 40 years of age, all in their second or third trimester of pregnancy. Participants were divided into two groups: 50 pregnant women diagnosed with gestational diabetes mellitus (GDM) and 50 apparently healthy pregnant women serving as controls. The control group was selected to be comparable in terms of maternal age and gestational age.

Gestational diabetes mellitus was diagnosed according to the American Diabetes Association (ADA) criteria is used during the study period. Pregnant women with pre-existing diabetes mellitus, chronic systemic illnesses, or those receiving vitamin B12 supplementation, magnesium supplements, or medications known to influence their levels were excluded from the study. Only women with singleton pregnancies who were willing to participate were included after obtaining written informed consent.

Participants were recruited from antenatal outpatient clinics and inpatient wards using a purposive sampling approach. After enrollment, detailed clinical history and relevant demographic data were recorded using a structured proforma.

Approximately 5 ml of venous blood was collected aseptically from each participant under standard conditions. The collected samples were allowed to clot and were then centrifuged to separate serum, which was used for biochemical analysis. Serum vitamin B12 levels were estimated using an automated immunoassay-based method, and serum magnesium levels were measured using a standard colorimetric method. All analyses were carried out in the central clinical biochemistry laboratory following standard operating procedures.

Data were entered into Microsoft Excel and analysed using SPSS version 22.0 (IBM SPSS Statistics, Somers, NY, USA). Continuous variables were expressed as means with standard deviations, and categorical variables were expressed as frequencies and percentages. Comparisons between groups were performed using the independent t-test for continuous variables and the Chi-square test for categorical variables

RESULTS

The baseline characteristics of the study participants showed that the mean age of women in the GDM group was 26.80 ± 2.88 years, while in the control group it was 26.24 ± 4.07 years, with no statistically significant difference between the groups ($p = 0.450$) (Table 1). The gestational age distribution was also comparable between the two groups, with 48.0% and 52.0% of women in the GDM group being in the second and third trimesters, respectively, compared to 46.0% and 54.0% in the control group, and this difference was not statistically significant ($p = 0.840$) (Table 1).

The comparison of biochemical parameters revealed that the mean serum vitamin B12 level was significantly lower in the GDM group (185.00 ± 30.52 pg/mL) compared to the control group (214.88 ± 40.62 pg/mL), with a mean difference of -29.88 pg/mL ($p < 0.001$) (Table 2). Similarly, the mean serum magnesium level was significantly reduced in the GDM group (1.68 ± 0.15 mg/dL) compared to the control group (2.16 ± 0.61 mg/dL), with a mean difference of -0.48 mg/dL ($p < 0.001$) (Table 2).

When analyzed based on gestational age, the mean vitamin B12 levels in the GDM group were 186.04 ± 28.24 pg/mL in the second trimester and 183.88 ± 33.39 pg/mL in the third trimester, with no statistically significant difference between the trimesters (p = 0.990) (Table 3). In the control group, the mean vitamin B12 levels were 223.78 ± 42.03 pg/mL in the second trimester and 207.30 ± 38.54 pg/mL in the third trimester, and this difference was also not statistically significant (p = 0.190) (Table 3).

Similarly, the mean serum magnesium levels in the GDM group were 1.70 ± 0.13 mg/dL in the second trimester and 1.67 ± 0.16 mg/dL in the third trimester, with no statistically significant variation (p = 0.800) (Table 4). In the control group, the mean serum magnesium levels were 2.18 ± 0.76 mg/dL in the second trimester and 2.14 ± 0.47 mg/dL in the third trimester, and the difference was not statistically significant (p = 0.490) (Table 4).

Overall, these findings indicate that while baseline characteristics such as age and gestational age were comparable between the groups, women with gestational diabetes mellitus exhibited significantly lower levels of both Vitamin B12 and serum magnesium compared to healthy pregnant women, with no significant variation across trimesters.

Table 1. Baseline Characteristics of Study Participants

Variable		GDM (n = 50)	Control (n = 50)	p-value
Age (years)		26.80 ± 2.88	26.24 ± 4.07	0.450[a]
Age range (years)		22–31	20–38	—
Gestational age	Second trimester	24 (48.0%)	23 (46.0%)	0.840[b]
	Third trimester	26 (52.0%)	27 (54.0%)	

[a] Independent t test, [b] Chi-square test

Table 2. Comparison of Serum Vitamin B12 and Magnesium Levels Between Groups

Parameter	GDM (n = 50)	Control (n = 50)	Mean Difference	p-value
Vitamin B12 (pg/mL)	185.00 ± 30.52	214.88 ± 40.62	-29.88	**<0.001***[a]
Serum magnesium (mg/dL)	1.68 ± 0.15	2.16 ± 0.61	-0.48	**<0.001***[a]

[a] Independent t test

* Statistically significant

Table 3. Comparison of Serum Vitamin B12 Levels by Gestational Age

Group	Trimester	n	Mean ± SD (pg/mL)	p-value
GDM	Second	24	186.04 ± 28.24	0.990[a]
	Third	26	183.88 ± 33.39	
Control	Second	23	223.78 ± 42.03	0.190[a]
	Third	27	207.30 ± 38.54	

[a] Independent t test

Table 4. Comparison of Serum Magnesium Levels by Gestational Age

Group	Trimester	n	Mean ± SD (mg/dL)	p-value
GDM	Second	24	1.70 ± 0.13	0.800[a]
	Third	26	1.67 ± 0.16	
Control	Second	23	2.18 ± 0.76	0.490[a]
	Third	27	2.14 ± 0.47	

[a] Independent t test

DISCUSSION

The present study demonstrated that pregnant women with GDM had significantly lower serum vitamin B12 and magnesium levels compared to healthy controls, while no significant variation was observed across gestational age. These findings suggest that altered micronutrient status may be associated with the metabolic disturbances characteristic of GDM.

The reduction in vitamin B12 levels observed in this study is consistent with previous research demonstrating an association between low vitamin B12 status and increased risk of GDM[4,6]. A systematic review and meta-analysis reported that lower vitamin B12 concentrations, particularly in later pregnancy, were associated with a higher risk of GDM[4]. The underlying mechanism may involve impaired one-carbon metabolism and elevated homocysteine levels, which contribute to insulin resistance[3]. Furthermore, maternal vitamin B12 deficiency has been linked to long-term metabolic consequences, including insulin resistance in offspring[7,8].

In addition, the present study found significantly lower serum magnesium levels in women with GDM, which is in agreement with earlier studies[11]. Magnesium plays a critical role in insulin secretion and action, and its deficiency has been associated with impaired glucose tolerance and increased insulin resistance[9,10]. Interventional studies have also shown that magnesium supplementation can improve glycaemic control and metabolic outcomes in women with GDM[12]. Interestingly, no significant differences in vitamin B12 or magnesium levels were observed between the second and third trimesters within each group. This suggests that these micronutrient alterations may be related to the disease condition itself rather than gestational age. However, previous studies have reported inconsistent findings regarding trimester-specific variations, indicating the need for further research[4,5].

The strengths of this study include its analytical cross–sectional study design and evaluation of two key micronutrients involved in glucose metabolism. However, limitations such as small sample size, lack of dietary assessment, and single-centre design should be considered. Further large-scale prospective studies are required to confirm these findings and explore the potential role of micronutrient supplementation in the prevention and management of GDM.

CONCLUSION

This study demonstrates that pregnant women with gestational diabetes mellitus exhibit significantly lower serum vitamin B12 and magnesium levels compared to healthy controls, while no significant variation is observed across gestational age. These findings suggest a potential association between micronutrient deficiencies and the metabolic disturbances underlying GDM. Given the roles of vitamin B12 and magnesium in glucose metabolism and insulin function, their deficiency may contribute to disease pathophysiology. Routine screening and timely correction of these micronutrient deficiencies during pregnancy may aid in improving maternal metabolic status and potentially reduce adverse pregnancy outcomes associated with GDM.

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