

Association between Maternal Serum Magnesium Levels and Gestational Diabetes Mellitus

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ABSTRACT

Background: Gestational diabetes mellitus (GDM) is a common metabolic disorder during pregnancy associated with adverse maternal and fetal outcomes. Magnesium plays an important role in glucose metabolism and insulin sensitivity. Reduced maternal serum magnesium levels may contribute to insulin resistance and the development of GDM. This study aimed to evaluate the association between maternal serum magnesium levels and gestational diabetes mellitus. **Methods & Materials:** This case-control study was conducted in the Department of Obstetrics and Gynecology at Bangladesh Medical University, Dhaka, Bangladesh, from January 2025 to December 2025. A total of 102 pregnant women aged 18–35 years with gestational age between 24 and 40 weeks were included. **Results:** The mean serum magnesium level was significantly lower in the GDM group compared to the control group (1.58 ± 0.28 mg/dL vs 1.92 ± 0.24 mg/dL, $p < 0.001$). A higher proportion of GDM patients had low serum magnesium levels (< 1.7 mg/dL) compared with controls (64.7% vs 29.4%). Low serum magnesium was associated with a significantly increased risk of GDM (OR = 4.36; 95% CI: 1.97–9.63; $p < 0.001$). Additionally, BMI distribution differed significantly between the groups ($p = 0.04$). **Conclusion:** Lower maternal serum magnesium levels are significantly associated with gestational diabetes mellitus. Monitoring serum magnesium during pregnancy may help identify women at increased risk of GDM and contribute to improved maternal metabolic management.

Keywords: Gestational diabetes mellitus, serum magnesium, pregnancy, insulin resistance, maternal health.

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INTRODUCTION

Gestational diabetes mellitus (GDM) is one of the most common metabolic disorders during pregnancy and is characterized by glucose intolerance with onset or first recognition during pregnancy [1]. It is associated with significant maternal and fetal complications, including preeclampsia, cesarean delivery, fetal macrosomia, neonatal hypoglycemia and an increased risk of developing type 2 diabetes later in life [2]. The prevalence of GDM has been rising worldwide due to increasing maternal age, obesity and sedentary lifestyles. In developing countries, the burden of GDM is also increasing, posing a significant public health concern for both maternal and neonatal health [3].

Magnesium is an essential micronutrient involved in numerous physiological processes, including carbohydrate metabolism, insulin secretion and cellular glucose transport [4]. It plays a crucial role in maintaining normal insulin sensitivity and glucose homeostasis [5]. Magnesium acts as a cofactor for many enzymatic reactions involved in glucose metabolism

and insulin signaling pathways. Deficiency of magnesium has been associated with impaired insulin action and increased insulin resistance, which are important factors in the pathogenesis of gestational diabetes mellitus [6].

Several studies have suggested that low serum magnesium levels may contribute to the development of insulin resistance and glucose intolerance during pregnancy [7]. Hypomagnesemia has been reported in patients with diabetes mellitus and is thought to be associated with altered insulin secretion and decreased peripheral glucose uptake [8]. During pregnancy, physiological changes and increased nutritional demands may further influence maternal magnesium status. Therefore, assessing maternal magnesium levels may help in understanding the metabolic alterations associated with GDM [9].

Recent research has shown that pregnant women with gestational diabetes often have significantly lower serum magnesium levels compared with healthy pregnant women [10]. Reduced magnesium levels may worsen insulin resistance and contribute to poor glycemic control.

Furthermore, magnesium deficiency may increase oxidative stress and inflammatory responses, which are also implicated in the development of metabolic disorders during pregnancy [11]. Despite growing evidence, the relationship between maternal serum magnesium levels and gestational diabetes mellitus remains an area of ongoing investigation [12].

In countries with limited healthcare resources, early identification of modifiable risk factors for GDM is important for improving maternal and fetal outcomes [13]. Measurement of serum magnesium is a simple and relatively inexpensive laboratory test that may provide useful information regarding metabolic status during pregnancy [14]. Understanding the association between maternal serum magnesium levels and gestational diabetes mellitus could help identify women at risk and guide preventive or therapeutic strategies [15]. Therefore, the present study was conducted in the Department of Obstetrics and Gynecology at Bangladesh Medical University, Dhaka, to evaluate the association between maternal serum

magnesium levels and gestational diabetes mellitus among pregnant women. The findings of this study may contribute to a better understanding of the role of magnesium in the development of GDM and may support future strategies for early detection and management of this condition.

METHODS & MATERIALS

This case-control study was conducted in the Department of Obstetrics and Gynecology at Bangladesh Medical University, Dhaka, Bangladesh, over a one-year period from January 2025 to December 2025. A total of 102 pregnant women were enrolled in the study and divided into two groups: cases ($n = 51$) and controls ($n = 51$). The case group consisted of pregnant women aged 18 to 35 years with a gestational age between 24 and 40 weeks who were diagnosed with gestational diabetes mellitus. The diagnosis of GDM was confirmed using oral glucose tolerance test (OGTT) reports according to the criteria recommended by the World Health Organization. The control group included healthy pregnant women without GDM who were matched with the cases in a 1:1 ratio based on age and gestational duration.

Pregnant women with multifetal gestation, a previous history of GDM, or a diagnosis of chronic kidney disease, liver disease, polycystic ovary syndrome, autoimmune disease, or thyroid disease were excluded from the study to minimize confounding

factors. After obtaining informed consent, detailed clinical evaluations were performed for all participants. Relevant socio-demographic, obstetric and clinical information were collected using a structured data collection sheet for each participant. Venous blood samples were collected from all participants under aseptic conditions to determine serum magnesium levels using standard laboratory procedures.

GDM cases were confirmed by their oral glucose tolerance test (OGTT) reports according to WHO criteria. A thorough clinical examination was performed for all participants. A separate data collection sheet was used for each subject. Data on relevant variables were collected through a semi-structured questionnaire using interviews, clinical observations, hematological investigations, and review of the patients' medical records.

Subsequently, 5 ml of venous blood was collected from the antecubital vein of each participant using a standardized phlebotomy procedure in a red-colored Vacutainer blood collection tube. The samples were sent to the laboratory of the Department of Biochemistry and Molecular Biology at Bangladesh Medical University (BMU) for analysis. Serum magnesium concentration was measured using a fully automated Thermo Scientific™ Indiko™ Plus Clinical Chemistry Analyzer (Thermo Scientific, USA) by a colorimetric method. A maternal serum magnesium level of <1.7 mg/dL was considered the cutoff value for

low magnesium in determining the risk of developing gestational diabetes mellitus (GDM).

Statistical analyses were performed using the Windows-based Statistical Package for Social Sciences (SPSS) version 27.0. Descriptive statistics were expressed as frequency, percentage and mean with standard deviation (SD). Comparisons between groups were conducted using appropriate statistical tests and odds ratios (OR) with 95% confidence intervals (CI) were calculated to assess the association between serum magnesium levels and GDM. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1 shows the socio-demographic characteristics of the study subjects in both groups ($n=102$). The majority of participants in both the case and control groups were aged 26–30 years (43.1% vs 41.2%), followed by 18–25 years. Most participants were from urban areas (62.7% of cases and 58.8% of controls). Regarding educational status, the largest proportion had secondary education (41.2% in cases and 39.2% in controls). Nearly half of the participants in both groups belonged to the middle socioeconomic class (49.0% vs 47.1%). There was no statistically significant difference between the two groups regarding socio-demographic characteristics ($p>0.05$).

Table I

Categorization of the Study Subjects According to Socio-Demographic Characteristics by Group ($n=102$).

Socio-demographic variables	Case (n=51)	Control (n=51)	p value
Age (years)			
18–25	16 (31.4%)	18 (35.3%)	0.91
26–30	22 (43.1%)	21 (41.2%)	
31–35	13 (25.5%)	12 (23.5%)	
Residence			
Urban	32 (62.7%)	30 (58.8%)	0.68
Rural	19 (37.3%)	21 (41.2%)	
Educational status			
Primary	12 (23.5%)	14 (27.5%)	0.89
Secondary	21 (41.2%)	20 (39.2%)	
Higher secondary & above	18 (35.3%)	17 (33.3%)	
Socioeconomic status			
Lower	17 (33.3%)	18 (35.3%)	0.97
Middle	25 (49.0%)	24 (47.1%)	
Upper	9 (17.7%)	9 (17.6%)	

Table II presents the obstetric and anthropometric characteristics of the study subjects ($n=102$). The mean gestational age was 31.8 ± 4.5 weeks in cases and 30.9 ± 4.2 weeks in controls, with no significant difference ($p=0.32$). Most participants in

both groups were multigravida (62.7% of cases and 56.9% of controls) and multiparous (58.8% vs 54.9%), showing no significant difference between groups. Regarding BMI, a higher proportion of cases were overweight or obese, whereas

most controls had normal BMI. The difference in BMI distribution between the groups was statistically significant ($p=0.04$).

Table II

Categorization of the Study Subjects by Group According to Obstetric and Anthropometric Parameters (n=102).

Variables	Case (n=51)	Control (n=51)	p value
Gestational age (weeks)	31.8 ± 4.5	30.9 ± 4.2	0.32
Gravida			
Primigravida	19 (37.3%)	22 (43.1%)	0.55
Multigravida	32 (62.7%)	29 (56.9%)	
Parity			
Nulliparous	21 (41.2%)	23 (45.1%)	0.69
Multiparous	30 (58.8%)	28 (54.9%)	
BMI (kg/m ²)			
Normal (18.5–24.9)	16 (31.4%)	25 (49.0%)	0.04
Overweight (25–29.9)	21 (41.2%)	18 (35.3%)	
Obese (≥30)	14 (27.5%)	8 (15.7%)	

Table III shows the mean serum magnesium levels of the study subjects (n=102). The mean serum magnesium level was 1.58 ± 0.28 mg/dL in the case (GDM)

group and 1.92 ± 0.24 mg/dL in the control group. The mean serum magnesium level was significantly lower among GDM patients compared to controls and the

difference was statistically significant (p<0.001).

Table III

Categorization of the Study Subjects According to Mean Serum Magnesium Levels (n=102).

Group	Mean Serum Magnesium (mg/dL)	SD	p value
Case (GDM)	1.58	±0.28	<0.001
Control	1.92	±0.24	

(Independent sample t-test)

Table IV presents the odds ratios (OR) and 95% confidence intervals (CI) for the association between serum magnesium levels and gestational diabetes mellitus

among the study subjects (n=102). A higher proportion of cases had low serum magnesium levels (<1.7 mg/dL) compared to controls (64.7% vs 29.4%). Low serum

magnesium was associated with a 4.36 times higher risk of GDM (OR = 4.36; 95% CI: 1.97–9.63) and the association was statistically significant (p<0.001).

Table IV

Odds Ratios (OR) and 95% Confidence Intervals (CI) for the Study Subjects According to Serum Magnesium Levels in Pregnancy (n=102).

Serum Magnesium Level	Case n (%)	Control n (%)	OR	95% CI	p value
Low (<1.7 mg/dL)	33 (64.7%)	15 (29.4%)	4.36	1.97–9.63	<0.001
Normal (≥1.7 mg/dL)	18 (35.3%)	36 (70.6%)			

DISCUSSION

The present case-control study evaluated the association between maternal serum magnesium levels and gestational diabetes mellitus (GDM) among pregnant women. In this study, socio-demographic variables such as age, residence, education and socioeconomic status were comparable between the case and control groups, indicating that the two groups were well matched. The majority of participants were aged 26–30 years (43.1% vs 41.2%) and most were from urban areas (62.7% vs 58.8%), with no statistically significant differences. These findings suggest that socio-demographic factors did not significantly influence the occurrence of GDM in our study population. Regarding obstetric and anthropometric parameters, the mean gestational age was similar between groups (31.8 ± 4.5 weeks in cases vs 30.9 ± 4.2 weeks in controls; p=0.32). However, body mass index (BMI) showed a significant difference, where a

higher proportion of GDM patients were overweight or obese, while most controls had normal BMI (p=0.04). This finding is consistent with previous studies demonstrating that increased maternal BMI is an important risk factor for gestational diabetes mellitus. For example, Zeng et al. reported that maternal obesity is strongly associated with metabolic complications during pregnancy, including GDM and adverse maternal outcomes [16]. The primary finding of the present study was that maternal serum magnesium levels were significantly lower in women with GDM compared with healthy pregnant women. The mean serum magnesium level among GDM patients was 1.58 ± 0.28 mg/dL, whereas in the control group it was 1.92 ± 0.24 mg/dL and the difference was statistically significant (p<0.001). Magnesium plays an important role in glucose metabolism and insulin sensitivity. Reduced magnesium levels may impair insulin signaling and increase insulin

resistance, which are key mechanisms involved in the development of gestational diabetes. Similar findings have been reported in several previous studies evaluating micronutrients and metabolic markers in pregnancy. Zhao et al. observed that alterations in maternal metal concentrations during pregnancy are associated with the development of GDM, suggesting that trace elements may influence glucose metabolism [17]. Likewise, Tatsuta et al. reported that maternal metallic element concentrations may be associated with the risk of gestational diabetes and metabolic abnormalities during pregnancy [18]. Our study also demonstrated that 64.7% of GDM patients had low serum magnesium levels (<1.7 mg/dL) compared with 29.4% of controls, indicating a significantly higher prevalence of hypomagnesemia among women with GDM. The calculated odds ratio showed that women with low serum magnesium levels had a 4.36-fold

increased risk of developing GDM (OR = 4.36; 95% CI: 1.97–9.63; $p < 0.001$). This finding supports the hypothesis that magnesium deficiency may play a role in the pathophysiology of gestational diabetes mellitus.

Other investigators have also highlighted the importance of biochemical markers and metabolic factors in pregnancies complicated by GDM. Saucedo et al. reported significant alterations in maternal metabolic and inflammatory markers among women with gestational diabetes, suggesting that metabolic dysregulation contributes to adverse pregnancy outcomes [19]. Similarly, Visiedo et al. found that increased inflammation in GDM pregnancies can impair metabolic pathways within the placenta, further contributing to maternal and fetal complications [20].

Micronutrient imbalance during pregnancy has also been associated with other obstetric complications. For instance, Wadhvani et al. demonstrated the importance of trace elements such as calcium and magnesium in hypertensive disorders of pregnancy, while Syed et al. reported that altered maternal magnesium levels may be associated with preterm labour [21,22]. These findings emphasize the broader role of micronutrients in maintaining normal pregnancy physiology. Furthermore, emerging evidence suggests that metabolic and biochemical disturbances in GDM may influence fetal outcomes. Studies by Bernea et al. and Zeng et al. have reported that gestational diabetes is associated with complications such as fetal macrosomia and long-term metabolic risks in offspring [16,23]. Therefore, identifying modifiable biochemical factors such as magnesium deficiency may help improve maternal metabolic control and pregnancy outcomes.

LIMITATIONS

This study has several limitations that should be considered when interpreting the findings. First, the study was conducted in a single tertiary care center with a relatively small sample size, which may limit the generalizability of the results to the wider population. Second, the cross-sectional nature of the case–control design limits the ability to establish a causal relationship between low maternal serum magnesium levels and gestational diabetes mellitus. Additionally, dietary magnesium intake and other micronutrient levels were not assessed, which might influence serum magnesium concentrations during pregnancy.

CONCLUSION

The present study demonstrates a significant association between maternal serum magnesium levels and gestational diabetes mellitus. Pregnant women with

GDM had significantly lower mean serum magnesium levels compared with healthy controls and low magnesium levels were associated with a higher risk of GDM. These findings suggest that monitoring maternal serum magnesium levels during pregnancy may help identify women at increased risk of gestational diabetes and may contribute to improved maternal metabolic management and pregnancy outcomes.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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