Maternal and Perinatal Outcomes in Gestational Diabetes Mellitus with and without Concomitant Preeclampsia

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ABSTRACT

Background: Gestational diabetes mellitus (GDM) and preeclampsia (PE) are common pregnancy complications associated with significant maternal and perinatal morbidity. The coexistence of these conditions may exacerbate adverse outcomes, yet data on their combined impact are limited, particularly in low-resource settings.Aim of the study: To compare maternal and perinatal outcomes in women with GDM with and without concomitant preeclampsia. **Methods & MAterials:** This hospital-based comparative observational study included 120 pregnant women with GDM, divided into two groups: Group A (GDM with PE, n=60) and Group B (GDM without PE, n=60). Maternal, perinatal, and neonatal outcomes were prospectively recorded and analyzed using SPSS v26. Continuous variables were compared using the Student's t-test and categorical variables using Chi-square or Fisher's exact test. A p-value <0.05 was considered significant. **Result:** Women with GDM and PE had significantly higher rates of labor induction (51.7% vs. 31.7%, p=0.01), preterm delivery (48.3% vs. 18.3%, p<0.001), postpartum hemorrhage (18.3% vs. 7.5%, p=0.02), eclampsia (6.7% vs. 0%, p=0.002), HELLP syndrome (6.7% vs. 0%, p=0.01), and ICU admission (21.7% vs. 3.3%, p<0.001). Neonatal outcomes were also worse, including low birth weight (35% vs. 11.7%, p<0.001), SGA (31.7% vs. 10%, p<0.001), APGAR <7 at 5 min (30% vs. 8.3%, p<0.001), NICU admission (51.7% vs. 15%, p<0.001), and higher rates of hypoglycemia, respiratory distress, birth asphyxia, and sepsis. **Conclusion:** The coexistence of preeclampsia in GDM pregnancies significantly increases maternal and perinatal morbidity. Early identification, close monitoring, and tailored management strategies are essential to mitigate these risks.

Keywords: *Gestational diabetes mellitus, Preeclampsia, Maternal outcomes, Perinatal outcomes, Neonatal complications*

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INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as glucose intolerance first recognized during pregnancy, resulting from insulin resistance and impaired pancreatic β-cell function [1]. Preeclampsia (PE) is a hypertensive disorder of pregnancy characterized by new-onset hypertension and proteinuria after 20 weeks' gestation, often accompanied by systemic manifestations such as endothelial dysfunction, multiorgan involvement, and impaired placental perfusion, which can significantly compromise both maternal and fetal health [2]. Globally, the prevalence of GDM has increased substantially, with recent estimates suggesting an overall frequency of approximately 14.7% among pregnant women based on standardized diagnostic criteria [3]. The global prevalence of preeclampsia is about 4.43% of all pregnancies, highlighting its significant contribution to maternal morbidity worldwide [2]. In Bangladesh, the prevalence of GDM among pregnant women has been variably reported, with nearly one-third of women potentially affected when using contemporary diagnostic criteria [4]. Preeclampsia in Bangladesh is comparatively high, affecting an estimated 10% of pregnancies and contributing substantially to adverse maternal outcomes [5]. Major causes of GDM include advanced maternal age, pre-pregnancy obesity, family history of type 2 diabetes, and metabolic syndrome, reflecting complex genetic and environmental interactions [6]. In addition, rapid urbanization, sedentary lifestyle, and nutritional transitions in low- and middle-income countries further exacerbate the burden of metabolic disorders during pregnancy. Risk factors for preeclampsia similarly encompass chronic hypertension, renal disease, obesity, and preexisting diabetes, indicating overlapping pathophysiological pathways with GDM [7]. Women with GDM are at increased risk of hypertensive disorders of pregnancy, including preeclampsia, due to shared etiologic mechanisms such as endothelial dysfunction, chronic inflammation, and placental vascular abnormalities [8]. The coexistence of gestational diabetes and preeclampsia has been associated with worsened maternal outcomes, including higher rates of cesarean delivery, gestational hypertension, postpartum complications, and overall maternal morbidity [9]. Adverse perinatal outcomes associated with GDM include macrosomia, neonatal hypoglycemia, respiratory distress, and increased rates of neonatal intensive care unit admissions [10]. Preeclampsia contributes significantly to perinatal risks such as preterm birth, intrauterine growth restriction, stillbirth, and neonatal mortality [11]. The combined effect of GDM and preeclampsia has been shown to amplify these risks, further increasing the likelihood of low birth weight, preterm delivery, and perinatal complications compared with either condition alone [1]. Despite advances in obstetric care, the burden of concurrent GDM and preeclampsia remains substantial, particularly in low-resource settings where screening, early diagnosis, and standardized management practices are often inconsistent [12]. Understanding the differential impact of concomitant preeclampsia on maternal and neonatal outcomes in women with GDM is crucial for optimizing antenatal care and resource allocation. The co-occurrence of gestational diabetes and preeclampsia represents a critical challenge in obstetric care due to synergistic effects on maternal and perinatal morbidity and mortality,

particularly in regions with high metabolic disease burdens. To compare maternal and perinatal outcomes among women with gestational diabetes mellitus with and without concomitant preeclampsia.

METHODS & MATERIALS

This was a hospital-based comparative observational study conducted at the Department of Obstetrics and Gynaecology, Bangladesh Medical University, Dhaka, Bangladesh. The study was carried out for one year from January 2024 to December 2024 among pregnant women diagnosed with gestational diabetes mellitus (GDM). A total of 120 pregnant women with GDM were enrolled and divided into two groups:

Group A (n=60): GDM with concomitant preeclampsia
Group B (n=60): GDM without preeclampsia

Inclusion and Exclusion Criteria

Inclusion Criteria

Patients were eligible if they met all of the following criteria:

1. Age 25-40 years.
2. Singleton pregnancy
3. Diagnosis of gestational diabetes mellitus
4. Gestational age ≥28 weeks

Exclusion Criteria

Patients were excluded if they had:

1. Pre-existing diabetes mellitus
2. Known renal, cardiac, or autoimmune disease
3. Major fetal congenital anomalies diagnosed before enrollment

Diagnostic Criteria

Gestational Diabetes Mellitus: GDM was diagnosed using standard OGTT thresholds. Preeclampsia: Preeclampsia was defined as blood pressure ≥140/90 mmHg on two occasions at least 4 hours apart after 20 weeks of gestation with proteinuria (≥300 mg/24 h) or evidence of end-organ dysfunction.

Data Collection Procedure

After obtaining informed consent, data were collected using a structured questionnaire and review of medical records. Information on demographic characteristics including age, education level, occupation, and family income was recorded. Obstetric and menstrual history such as gravida and menstrual pattern were documented. Anthropometric measurements including body mass index (BMI) and gestational weight gain were assessed. Relevant laboratory parameters such as fasting blood glucose, HbA1c, and hemoglobin levels were obtained from hospital investigations. Sonographic findings, including fetal movements and fetal heart rate, were noted from ultrasonography reports. All participants were followed prospectively until delivery and during the early postpartum period.

Maternal outcomes evaluated included induction of labor, preterm delivery before 37 completed weeks of gestation, postpartum hemorrhage, occurrence of eclampsia and HELLP syndrome, requirement for intensive care unit admission, and maternal mortality. Perinatal and neonatal outcomes comprised birth weight with classification into small for gestational age (SGA), large for gestational age (LGA), and macrosomia, APGAR score at 5 minutes, need for neonatal intensive care unit (NICU) admission, stillbirth, and neonatal mortality. In addition, neonatal complications such as hypoglycemia, respiratory distress syndrome, hyperbilirubinemia, meconium aspiration, birth asphyxia, congenital anomalies, and neonatal sepsis were recorded systematically for analysis.

Statistical Analysis

Data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) software version 26.0. Continuous variables were presented as mean ± standard deviation (SD), while categorical variables were summarized as frequency and percentage. The Student's t-test was applied to compare continuous variables between groups, and the Chi-square test or Fisher's exact test was used for comparison of categorical variables as appropriate. All statistical tests were two-tailed, and a p-value less than 0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of the study hospital. Written informed consent was taken from all participants. Confidentiality and anonymity were maintained throughout the study.

RESULT

Table I showed that most participants in both groups were <35 years (Group A: 75.00%, Group B: 83.33%), with mean ages of 29.65 ± 5.34 and 32.78 ± 3.89 years, respectively. SSC or lower education was higher in Group A (50.00% vs. 30.00%, p=0.018). Most were housewives, and family income distributions were similar (p>0.05).

Table I
Demographic characteristics of the study population (*n*=120).

Variable	Group A (n=60)		Group B (n=60)		p-value
	n	%	n	%	
Age (years)					
<35	45	75.00	50	83.33	0.24
≥35	15	25.00	10	16.67	
Mean ± SD	29.65 ± 5.34		32.78 ± 3.89		0.08
Education					
SSC and lower	30	50.00	18	30.00	0.018
HSC and above	30	50.00	42	70.00	
Occupation					
Housewife	45	75.00	51	85.00	0.19
Service	15	25.00	9	15.00	
Family Income					
Lower middle and below	46	76.67	49	81.67	0.49
Higher middle and above	14	23.33	11	18.33	

Table II indicated that most participants were obese (Group A: 55.00%, Group B: 56.67%) with mean BMI 30.45 ± 6.98 and 32.76 ± 3.91 kg/m². Excessive weight gain occurred in 55.00% vs. 63.33%. Anaemia was more common in Group A (33.33% vs. 13.33%, p=0.015). Fasting glucose (108.4 ± 12.9 vs. 97.8 ± 10.6 mg/dL) and HbA1c (6.9 ± 0.7 vs. 6.2 ± 0.6%) were significantly higher (p<0.001).

Table II
Baseline characteristics of the study population (*n*=120).

Variable	Group A (n=60)		Group B (n=60)		p-value
	n	%	n	%	
BMI (kg/m²)					
Normal (18.5–24.9)	5	8.33	7	11.67	0.79
Overweight (25–29.9)	22	36.67	19	31.67	
Obese (>30)	33	55.00	34	56.67	
Mean ± SD	30.45 ± 6.98		32.76 ± 3.91		0.08
Weight gain					
Excessive	33	55.00	38	63.33	0.36
Normal	27	45.00	22	36.67	
Anaemia					
Absent	40	66.67	52	86.67	0.015
Mild	19	31.67	7	11.67	
Moderate	1	1.67	1	1.67	
Fasting glucose (mg/dL)					
Mean ± SD	108.4 ± 12.9		97.8 ± 10.6		<0.001
HbA1c (%)					
Mean ± SD	6.9 ± 0.7		6.2 ± 0.6		<0.001
Menstrual cycle					
Regular	33	55.00	38	63.33	0.36
Irregular	27	45.00	22	36.67	
Gestational age (weeks)					
Mean ± SD	34.67 ± 2.51		35.73 ± 2.88		0.06
Gravida					
Primigravida	18	30.00	22	36.67	0.43
Multigravida	42	70.00	38	63.33	

Fetal movement was present in 95.00% of Group A and 100% of Group B (p<0.05). Mean fetal heart rate was 145.42 ± 14.98 bpm in Group A and 142.83 ± 28.66 bpm in Group B, with no statistically significant difference (p=0.51) (*Table III*).

Table III
Sonographic findings among patients (*n*=120).

Fetal movement	Group A (n=60)		Group B (n=60)		p-value
	n	%	n	%	
Present	57	95.00	60	100	<0.05
Absent	3	5.00	0	0	
Fetal heart sound (Mean ± SD)	145.42 ± 14.98		142.83 ± 28.66		0.51

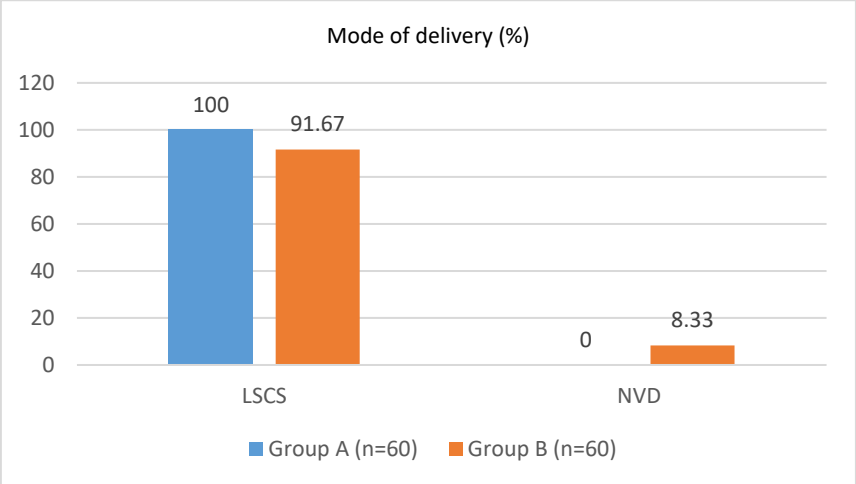

Figure 1 Mode of delivery among woman.

LSCS was the predominant delivery mode, occurring in 100% of Group A and 91.67% of Group B, while NVD was reported only in 8.33% of Group B (Figure 1). Table 4 showed higher rates of adverse maternal outcomes in Group A: induction of labor (51.67% vs. 31.7%, p=0.01), preterm delivery (48.33% vs. 18.3%, p<0.001), postpartum hemorrhage (18.33% vs. 7.5%, p=0.02), eclampsia and HELLP syndrome (6.67% vs. 0%, p≤0.01), and ICU admission (21.67% vs. 3.3%, p<0.001). Maternal mortality was 1.67% in Group A (p=0.16) (*Table IV*).

Table IV
Maternal outcomes (*n*=120).

Outcomes	Group A (n=60)		Group B (n=60)		p-value
	n	%	n	%	
Induction of labor	31	51.67	19	31.7	0.01
Preterm delivery (<37 wk)	29	48.33	11	18.3	<0.001
Postpartum hemorrhage	11	18.33	4	7.5	0.02
Eclampsia	4	6.67	0	0	0.002
HELLP syndrome	4	6.67	0	0	0.01
ICU admission	13	21.67	2	3.3	<0.001
Maternal mortality	1	1.67	0	0	0.16

Group A had lower mean birth weight than Group B (2875 ± 505 g vs. 3335 ± 425 g, p < 0.001). Low birth weight, SGA, APGAR <7 at 5 min, and NICU admissions were higher in Group A (35.00%, 31.67%, 30.00%, 51.67%; p < 0.001). Macrosomia (6.67% vs. 16.67%), stillbirth (6.67% vs. 1.67%), and neonatal mortality (6.67% vs. 1.67%) were also more frequent in Group A (*Table V*).

Table V
Perinatal outcomes (*n*=120).

Outcomes	Group A (n=60)		Group B (n=60)		p-value
	n	%	n	%	
Mean birth weight (g)	2875 ± 505		3335 ± 425		<0.001
Low birth weight (<2500 g)	21	35.00	7	11.67	<0.001
Macrosomia (>4000 g)	4	6.67	10	16.67	0.04
SGA	19	31.67	6	10.00	<0.001
LGA	6	10.00	13	21.67	0.03
APGAR <7 at 5 min	18	30.00	5	8.33	<0.001
NICU admission	31	51.67	9	15.00	<0.001
Stillbirth	4	6.67	1	1.67	0.04
Neonatal mortality	4	6.67	1	1.67	0.03

Respiratory distress syndrome (36.67% vs. 10.00%), hypoglycemia (31.67% vs. 16.67%), birth asphyxia (26.67% vs. 6.67%), hyperbilirubinemia (31.67% vs. 18.33%), meconium aspiration (16.67% vs. 5.00%), and neonatal sepsis (28.33% vs. 6.67%) were all higher in Group A (all p < 0.05), while congenital anomalies showed no significant difference (*Table VI*).

Table VI
Neonatal complications (*n*=120).

Complications	Group A (n=60)		Group B (n=60)		p-value
	n	%	n	%	
Neonatal hypoglycemia	19	31.67	10	16.67	0.01
Respiratory distress syndrome	22	36.67	6	10.00	<0.001
Hyperbilirubinemia	19	31.67	11	18.33	0.04
Meconium aspiration	10	16.67	3	5.00	0.01
Birth asphyxia	16	26.67	4	6.67	<0.001
Congenital anomalies	3	5.00	1	1.67	0.34
Neonatal sepsis	17	28.33	4	6.67	<0.001

DISCUSSION

Gestational diabetes mellitus (GDM), particularly when accompanied by preeclampsia, poses significant risks to both maternal and perinatal outcomes, warranting careful evaluation of their combined impact [13]. In this study of 120 women with gestational diabetes mellitus, we compared outcomes between those with concomitant preeclampsia (Group A, n=60) and those with GDM alone (Group B, n=60). The majority of participants in both groups were under 35 years of age (Group A: 75.00%; Group B: 83.33%, p=0.24). The mean age was slightly higher in Group B (32.78 ± 3.89 years) compared to Group A (29.65 ± 5.34 years, p=0.08). Educational status differed significantly; 30 women (50.00%) in Group A had SSC or lower education compared to 18 (30.00%) in Group B (p=0.018). Most participants were housewives (Group A: 75%; Group B: 85%; p=0.19), and family income did not differ significantly (p=0.49). These findings are consistent with prior studies showing that maternal age and education may influence access to prenatal care but are not the sole determinants of adverse outcomes [14,15]. Obesity was common in both groups (Group A: 55%; Group B: 56.67%), and mean BMI was slightly higher in Group B (32.76 ± 3.91 kg/m²) versus Group A (30.45 ± 6.98 kg/m², p=0.08). Excessive gestational weight gain was reported in 55% in Group A and 63.33% in Group B (p=0.36). Anemia was significantly more prevalent in Group A (33.34%) versus Group B (13.34%; p=0.015). Fasting glucose and HbA1c were significantly higher in Group A (108.4 ± 12.9 mg/dL and 6.9 ± 0.7%) compared to Group B (97.8 ± 10.6 mg/dL and 6.2 ± 0.6%, both p<0.001), confirming poorer glycemic control in women with concomitant preeclampsia [16]. Fetal movement was absent in 5% cases in Group A but present in all women in Group B (p<0.05). Fetal heart rate was comparable between groups (Group A: 145.42 ± 14.98 bpm; Group B:

142.83 ± 28.66 bpm, p=0.51). This also shows similarities with previous studies [17]. In the present study, cesarean section was the predominant mode of delivery, occurring in all women (100%) in Group A (GDM with concomitant preeclampsia) and in the majority of women in Group B (91.67%). Normal vaginal delivery was observed only in a small proportion of women (8.33%) in Group B. These findings are comparable to those reported by Umer et al., who demonstrated that the coexistence of preeclampsia and gestational diabetes mellitus was associated with the highest cesarean section rate, occurring in 82.7% of cases. The consistently high rate of cesarean delivery across studies underscores the increased obstetric risk and the preference for operative delivery in pregnancies complicated by GDM, particularly when associated with preeclampsia [18]. Adverse maternal outcomes were significantly higher in Group A. Induction of labor was performed in 51.67% women versus 31.7% women (p=0.01), preterm delivery in 48.33% versus 18.3%, (p<0.001), postpartum hemorrhage in 18.33% versus 7.5%, (p=0.02), eclampsia in 6.67% versus none (p=0.002), and HELLP syndrome in 6.67% versus none (p=0.01). ICU admission was necessary in 21.67% women versus 3.3%, (p<0.001), while maternal mortality occurred in 1.67% cases in Group A. These results confirm the synergistic effect of preeclampsia on maternal morbidity in GDM, consistent with prior studies [19]. Neonatal outcomes were significantly compromised in Group A. Mean birth weight was lower (2875 ± 505 g) compared to Group B (3335 ± 425 g, p<0.001). Low birth weight (<2500 g) occurred in 35% neonates versus 11.67%, (p<0.001), SGA in 31.67% versus 10%, (p<0.001), LGA in 10% versus 21.67%, (p=0.03), APGAR <7 at 5 minutes in 30% versus 8.33%, (p<0.001), NICU admission in 51.67% versus 15%, (p<0.001), stillbirth in 6.67% versus 1.67%, (p=0.04), and neonatal mortality in 6.67% versus 1.67%, (p=0.03). These findings are consistent with Karkia et al., demonstrating increased perinatal morbidity in GDM with superimposed preeclampsia [13]. Specific complications were also significantly higher in Group A: hypoglycemia in 31.67% versus 16.67%, (p=0.01), respiratory distress syndrome in 36.67% versus 10%, (p<0.001), hyperbilirubinemia in 31.67% versus 18.33%, (p=0.04), meconium aspiration in 16.67% versus 5%, (p=0.01), and birth asphyxia in 26.67% versus 6.67%, (p<0.001). Congenital anomalies and neonatal sepsis occurred in (5%) and (28.33%) neonates in Group A versus (1.67%) and (6.67%) in Group B (p=0.34 and p<0.001). These results align with the observations of Karkia et al., who found an elevated rate of neonatal complications in pregnancies affected by both gestational diabetes and hypertensive disorders, underscoring a consistent trend of heightened perinatal risk in these high-risk cases [13].

LIMITATIONS

This study was conducted in a single tertiary care hospital with a relatively small sample size, which may limit the generalizability of the findings to broader populations. Long-term maternal and neonatal outcomes were not assessed, restricting insights into postnatal complications. Potential confounding factors, such as variations in glycemic control, antihypertensive therapy, and socioeconomic determinants, were not fully controlled. Additionally, reliance on hospital records and patient-reported data may introduce information bias. Multicenter studies with larger cohorts are needed to validate these results.

CONCLUSION & RECOMMENDATIONS

The present study demonstrates that the coexistence of gestational diabetes mellitus and preeclampsia significantly exacerbates adverse maternal and perinatal outcomes compared with GDM alone. Women with both conditions exhibited higher rates of labor induction, preterm delivery, postpartum hemorrhage, eclampsia, HELLP syndrome, and ICU admission. Neonates born to this group were more likely to have low birth weight, small-for-gestational-age status, lower APGAR scores, NICU admission, and complications such as hypoglycemia, respiratory distress, birth asphyxia, and sepsis. These findings underscore the synergistic impact of preeclampsia on GDM pregnancies, highlighting the need for intensified antenatal surveillance, early detection, and tailored management strategies to mitigate maternal and neonatal morbidity and mortality in high-risk populations.

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CONFLICT OF INTEREST

None declared.

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

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