

Maternal and Neonatal Outcomes in Pregnancies Complicated by Gestational Diabetes Mellitus: A Hospital-Based Study

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Received: 10-02-2026 / Revised: 15-03-2026 / Accepted: 21-04-2026

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Conflict of interest: Nil

Abstract:

Background: Gestational diabetes mellitus (GDM) is a common metabolic disorder of pregnancy associated with adverse maternal and neonatal outcomes, necessitating timely diagnosis and appropriate management.

Aim: To evaluate maternal and neonatal outcomes in pregnancies complicated by GDM compared with normoglycaemic pregnancies.

Methodology: A hospital-based observational study was conducted in the Department of Obstetrics and Gynaecology, Jan Nayak Karpoori Thakur Medical College and Hospital, Madhepura, Bihar. Ninety pregnant women (45 with GDM and 45 normoglycaemic controls) were enrolled. Maternal complications, mode of delivery, and neonatal outcomes were recorded and analysed using SPSS version 27.0. A p-value <0.05 was considered statistically significant.

Results: Women with GDM had significantly higher rates of polyhydramnios (13.3% vs. 2.2%; p=0.049) and caesarean section (55.6% vs. 33.3%; p=0.038). Neonates born to mothers with GDM had higher frequencies of macrosomia (20.0% vs. 4.4%; p=0.025) and neonatal hypoglycaemia (17.8% vs. 2.2%; p=0.015). Mean maternal age and birth weight were significantly higher, whereas gestational age at delivery was significantly lower in the GDM group (p<0.05).

Conclusion: GDM was associated with increased maternal and neonatal morbidity. Early screening, effective glycaemic control, appropriate obstetric care, and vigilant neonatal monitoring are essential to improve pregnancy outcomes.

Keywords: Gestational Diabetes Mellitus, Maternal Outcomes, Neonatal Outcomes, Macrosomia, Neonatal Hypoglycaemia, Caesarean Section.

DOI: 10.25258/ijpqa.17.4.68

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Introduction

Gestational diabetes mellitus (GDM) is one of the most frequently occurring metabolic problems seen in pregnancy and has become a major public health problem owing to its high prevalence worldwide [1]. Defined as glucose intolerance occurring or first diagnosed in pregnancy, regardless of the need for insulin or dietary adjustment to control the glucose level. The increasing prevalence of obesity, sedentary lifestyle, advanced maternal age and the ever-increasing prevalence of type 2 diabetes mellitus have played a significant role in the ever-rising burden of GDM throughout the world. It is a serious condition for both mother and fetus and early diagnosis and proper management are important parts of antenatal care [2]. While blood glucose returns to normal after delivery, women who have been diagnosed with GDM are much more likely to develop T2DM later in life, and their babies are also at

increased risk of childhood and adult obesity, impaired glucose tolerance and metabolic disorders.

GDM is thought to be primarily caused by elevated insulin resistance associated with placental hormones like human placental lactogen, progesterone, cortisol, prolactin, and growth hormone [3]. In normal pregnancy, insulin production rises in order to help compensate for the physiological insulin resistance. In the absence of adequate pancreatic β -cell function to meet the increased metabolic demand, however, hyperglycaemia develops in the mother, known as gestational diabetes mellitus. Advanced maternal age, obesity, excessive weight gain during pregnancy, previous history of GDM, family history of diabetes mellitus, polycystic ovarian syndrome, delivery of a macrosomia baby and some ethnic predispositions have been associated with the

development of GDM. The early detection of women at risk and early intervention are crucial to reduce poor pregnancy outcomes [4].

GDM has been linked to many maternal complications that can impact the course of pregnancy and childbirth [5]. Women with GDM are more likely to develop other hypertension disorders during pregnancy such as gestational hypertension and preeclampsia, polyhydramnios, urinary tract infections, preterm labour, induction of labour, prolonged labour, operative vaginal delivery and caesarean section. Insulin resistance exacerbates the risk of maternal complications, such as postpartum haemorrhage, wound infection and metabolic complications in the future. These complications and the health of the mother can be minimised by careful antenatal monitoring, providing good nutritional advice, monitoring blood glucose levels and providing the appropriate medical management.

Maternal hyperglycaemia does not just affect during pregnancy, but has significant effects on fetal growth and neonatal health [6]. An excess of glucose goes across the placenta to the fetus, causing fetal hyperinsulinaemia, rapid fetal growth and greater deposition of adipose tissue, which is known as fetal macrosomia. Macrosomic babies are more likely to experience birth trauma, shoulder dystocia and experience birth asphyxia. Mothers with GDM also have an increased risk for their newborns developing hypoglycaemia, respiratory distress, hyperbilirubinaemia, hypocalcaemia, polycythaemia, neonatal intensive care unit (NICU) admission and perinatal mortality [7]. Moreover, exposure to hyperglycaemia during intrauterine development has been associated with adulthood metabolic disorders such as obesity, insulin resistance and type 2 diabetes. The results reinforce the need to keep glycaemic control in optimum range during pregnancy to benefit neonatal outcome."

"The combination of universal or risk-based screening, with standardised care that includes medical nutrition therapy, lifestyle changes, self-monitoring of blood glucose levels and, when necessary, insulin treatment has greatly improved the outcome of pregnancy for women with GDM [8]. However, still poor maternal and neonatal outcomes are seen, especially in low resource settings where poor adherence to treatment and delayed diagnosis and/or antenatal care are common issues [9]. Hospital data can offer important insights into the clinical characteristics, burden and efficacy of existing interventions and can help identify interventions that may be needed to improve maternal health services.

With the rise in incidence of GDM and its significant role in contributing to maternal and neonatal morbidity, ongoing monitoring of pregnancy outcomes is still essential. A detailed analysis of maternal complications in addition to neonatal outcomes

provides valuable data on the success of current management strategies and will inform future strategies to enhance obstetric and neonatal care. Hence a hospital based study was conducted in the present scenario to assess the maternal and neonatal outcome of pregnancies complicated with GDM with the aim of establishing evidence which could be beneficial in the clinical management of such pregnancies, early intervention plans and better pregnancy outcome.

Methodology

Study Design: The present study was conducted as a hospital-based observational study to evaluate the maternal and neonatal outcomes among pregnancies complicated by gestational diabetes mellitus (GDM). The study compared the obstetric and neonatal outcomes of pregnant women diagnosed with GDM with those of normoglycaemic pregnant women receiving antenatal care and delivery services at the study institution.

Study Area: The study was conducted in the Department of Obstetrics and Gynaecology, Jan Nayak Karpoori Thakur Medical College and Hospital, Madhepura, Bihar, India, which is a tertiary care teaching hospital providing comprehensive antenatal, intrapartum, and postnatal services to patients from Madhepura and the surrounding districts.

Study Duration: The study was carried out over a period of one year from March 2024 to February 2025.

Study Participants: A total of 90 pregnant women who fulfilled the eligibility criteria were included in the study. The participants comprised pregnant women diagnosed with gestational diabetes mellitus and normoglycaemic pregnant women attending the Department of Obstetrics and Gynaecology during the study period. All eligible participants were enrolled consecutively until the required sample size was achieved.

Inclusion Criteria

- Pregnant women aged 18–40 years.
- Singleton pregnancy.
- Gestational age of 24 weeks or more.
- Women diagnosed with gestational diabetes mellitus based on standard oral glucose tolerance test (OGTT) criteria.
- Normoglycaemic pregnant women with normal glucose tolerance test results (comparison group).
- Women who were willing to participate and provided written informed consent.

Exclusion Criteria

- Women with pre-existing Type 1 or Type 2 diabetes mellitus.

- Multiple pregnancies (twins or higher-order gestations).
- Pregnant women with chronic medical disorders such as chronic hypertension, renal disease, thyroid disorders, or cardiac disease.
- Pregnancies complicated by major fetal congenital anomalies.
- Women receiving long-term corticosteroid therapy.
- Women with incomplete clinical records or those who were lost to follow-up before delivery.

Sample Size: The total sample size for the study was 90 pregnant women, selected using a convenient consecutive sampling technique based on the predefined inclusion and exclusion criteria.

Procedures: eligible pregnant women attending the antenatal clinic or admitted to the Department of Obstetrics and Gynaecology were enrolled in the study. All participants underwent detailed clinical evaluation, including history taking, general physical examination, obstetric examination, and routine antenatal investigations. Screening for gestational diabetes mellitus was performed between 24 and 28 weeks of gestation using the standard oral glucose tolerance test (OGTT) as per institutional protocol. Women fulfilling the diagnostic criteria for gestational diabetes mellitus were included in the GDM group, whereas pregnant women with normal glucose tolerance served as the comparison group.

Women diagnosed with gestational diabetes mellitus were managed according to the institutional treatment protocol. Initial management consisted of medical nutrition therapy, dietary counselling, lifestyle modification, and regular antenatal follow-up. Women who failed to achieve satisfactory glycaemic control with dietary measures alone were treated with either insulin therapy or oral hypoglycaemic agents based on clinical assessment and treating obstetrician's judgement. Blood glucose levels were monitored periodically throughout pregnancy using fasting and postprandial blood glucose measurements.

Relevant maternal information, including age, gravidity, parity, body mass index, gestational age at diagnosis, family history of diabetes mellitus, associated antenatal complications, and mode of delivery, was recorded using a predesigned and pretested data collection proforma. Maternal complications such as gestational hypertension, polyhydramnios, preterm labour, premature rupture of membranes, and postpartum haemorrhage were documented. Neonatal data, including birth weight, APGAR score at five minutes, neonatal hypoglycaemia, macrosomia, respiratory distress, need for neonatal intensive care unit (NICU) admission, and other neonatal complications, were also recorded immediately after delivery. All participants were followed until delivery and during the immediate neonatal period to assess both maternal and neonatal outcomes.

Statistical Analysis: The collected data were entered into Microsoft Excel and analysed using the Statistical Package for the Social Sciences (SPSS) version 27.0. Continuous variables were expressed as mean $\pm$ standard deviation (SD), whereas categorical variables were presented as frequencies and percentages. Comparisons between groups were performed using the Student's *t*-test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables, as appropriate. A *p*-value of <0.05 was considered statistically significant."

“Result

Table 1 shows the distribution of the 90 study participants according to age group, with 45 women in the gestational diabetes mellitus (GDM) group and 45 in the control group. The majority of participants belonged to the 25–29 years age group, accounting for 42.2% of the total sample, including 40.0% in the GDM group and 44.4% in the control group. Participants aged 18–24 years constituted 24.4% of the study population, while 23.3% were aged 30–34 years. Women aged ≥ 35 years represented the smallest proportion (10.0%). Although relatively more women aged 30 years and above were observed in the GDM group, the difference in age distribution between the two groups was not statistically significant ($p=0.271$).

Table 1: Distribution of Study Participants According to Age Group (n = 90)

Age Group (Years)	GDM (n=45)	Control (n=45)	Total (n=90)	p-value
18–24	8 (17.8%)	14 (31.1%)	22 (24.4%)	0.271
25–29	18 (40.0%)	20 (44.4%)	38 (42.2%)	
30–34	13 (28.9%)	8 (17.8%)	21 (23.3%)	
≥ 35	6 (13.3%)	3 (6.7%)	9 (10.0%)	
Total	45 (100%)	45 (100%)	90 (100%)	

Table 2 presents the maternal outcomes among the 90 study participants, comparing women with gestational diabetes mellitus (GDM) and the control group. Gestational hypertension was observed in 22.2% of women with GDM compared to 8.9% of

controls, although the difference was not statistically significant ($p=0.083$). Polyhydramnios occurred significantly more frequently in the GDM group (13.3%) than in the control group (2.2%), showing a statistically significant association ($p=0.049$).

Preterm labour (17.8% vs. 6.7%), premature rupture of membranes (11.1% vs. 6.7%), and postpartum haemorrhage (8.9% vs. 4.4%) were also more

common among women with GDM; however, these differences were not statistically significant ($p>0.05$).

Table 2: Maternal Outcomes Among the Study Participants (n = 90)

Maternal Outcome	GDM (n=45)	Control (n=45)	p-value
Gestational hypertension	10 (22.2%)	4 (8.9%)	0.083
Polyhydramnios	6 (13.3%)	1 (2.2%)	0.049
Preterm labour	8 (17.8%)	3 (6.7%)	0.107
Premature rupture of membranes	5 (11.1%)	3 (6.7%)	0.461
Postpartum haemorrhage	4 (8.9%)	2 (4.4%)	0.398

Table 3 presents the mode of delivery among the 90 study participants. Overall, normal vaginal delivery was the most common mode of delivery, accounting for 47.8% of all cases, followed closely by caesarean section (44.4%), while instrumental delivery was the least common (7.8%). In the gestational diabetes mellitus (GDM) group, caesarean section was the predominant mode of delivery, performed in 55.6%

of women, compared with 33.3% in the control group. Conversely, normal vaginal delivery was more frequent among controls (60.0%) than women with GDM (35.6%). Instrumental delivery rates were comparable between the two groups (8.9% vs. 6.7%). The difference in the mode of delivery was statistically significant ($p=0.038$).

Table 3: Mode of Delivery Among Study Participants (n = 90)

Mode of Delivery	GDM (n=45)	Control (n=45)	Total (n=90)	p-value
Normal vaginal delivery	16 (35.6%)	27 (60.0%)	43 (47.8%)	0.038
Instrumental delivery	4 (8.9%)	3 (6.7%)	7 (7.8%)	
Caesarean section	25 (55.6%)	15 (33.3%)	40 (44.4%)	
Total	45 (100%)	45 (100%)	90 (100%)	

“Table 4 presents the neonatal outcomes among the 90 study participants, comparing infants born to mothers with gestational diabetes mellitus (GDM) and the control group. Macrosomia (birth weight ≥ 4.0 kg) was significantly more common in the GDM group (20.0%) than in the control group (4.4%) ($p=0.025$). Similarly, neonatal hypoglycaemia occurred significantly more frequently among

neonates of mothers with GDM (17.8%) compared to controls (2.2%) ($p=0.015$). Although lower APGAR score at 5 minutes (11.1% vs. 4.4%), respiratory distress (13.3% vs. 4.4%), and NICU admission (22.2% vs. 8.9%) were more frequent in the GDM group, these differences were not statistically significant ($p>0.05$).

Table 4: Neonatal Outcomes Among Study Participants (n = 90)

Neonatal Outcome	GDM (n=45)	Control (n=45)	p-value
Birth weight ≥ 4.0 kg (Macrosomia)	9 (20.0%)	2 (4.4%)	0.025
APGAR score <7 at 5 minutes	5 (11.1%)	2 (4.4%)	0.237
Neonatal hypoglycaemia	8 (17.8%)	1 (2.2%)	0.015
Respiratory distress	6 (13.3%)	2 (4.4%)	0.136
NICU admission	10 (22.2%)	4 (8.9%)	0.083

Table 5 compares the mean maternal age, gestational age at delivery, and birth weight between the gestational diabetes mellitus (GDM) and control groups. Women with GDM had a significantly higher mean maternal age than controls (29.8 ± 4.2 vs. 27.9 ± 3.8 years; $p=0.028$). The mean gestational age at delivery was significantly lower in the GDM

group (37.6 ± 1.8 weeks) compared with the control group (38.3 ± 1.4 weeks; $p=0.041$). Furthermore, the mean birth weight was significantly higher among neonates born to mothers with GDM (3.42 ± 0.51 kg) than those in the control group (3.08 ± 0.39 kg; $p=0.001$), indicating an increased risk of higher birth weight in pregnancies complicated by GDM.

Table 5: Mean Birth Weight and Gestational Age at Delivery Among Study Participants (n = 90)

Variable	GDM (n=45) Mean $\pm$ SD	Control (n=45) Mean $\pm$ SD	p-value
Maternal age (years)	29.8 ± 4.2	27.9 ± 3.8	0.028
Gestational age at delivery (weeks)	37.6 ± 1.8	38.3 ± 1.4	0.041
Birth weight (kg)	3.42 ± 0.51	3.08 ± 0.39	0.001

Discussion

The present hospital-based study aimed to compare maternal and neonatal outcomes of pregnancies complicated by gestational diabetes mellitus (GDM) with normoglycaemic pregnancies. The results showed that GDM was linked to increased risk of adverse maternal and neonatal outcomes such as polyhydramnios, caesarean section, macrosomia, neonatal hypoglycaemia, early gestational age at delivery and higher birth weight. These results are in line with the previous national and international studies established that maternal hyperglycaemia has a significant impact on pregnancy."

"Maternal age was significantly higher in the GDM group compared to controls (29.8 ± 4.2 years vs 27.9 ± 3.8 years, respectively; $p=0.028$), and there was a higher percentage of women ≥ 30 years of age in the GDM group. Increased insulin resistance and decreased β -cell function in women older than 30, are reported to contribute to substantially higher risk of developing GDM, as reported by Ferrara (2007) [10]. Likewise, in the HAPO Study Cooperative Research Group (2008) [11] maternal age was found to be an independent risk factor for adverse pregnancy outcomes. These observations are consistent with the need for early screening in older women who are pregnant.

Women with GDM were more likely to have maternal complications. There were significant differences in the incidence of polyhydramnios and other differences in the incidence of gestational hypertension, preterm labour, premature rupture of membranes and postpartum haemorrhage, but not statistically significant. Polyhydramnios was also reported by Yogeve and Visser in about 8–12% of diabetic pregnancies and 2–4% of normoglycaemic pregnancies, which they believed to be caused by fetal osmotic diuresis due to maternal hyperglycaemia. Desoye and Nolan (2016) [13] also stated that elevated glucose transfer across the placenta results in fetal hyperglycaemia, which results in greater urine output, followed by increased amniotic fluid volume. The present study corroborates the observation of Retnakaran and Shah 2009 [14] who found that women with glucose intolerance during pregnancy were at higher risk of developing hypertensive disorders.

The mode of delivery was significantly different with caesarean section being significantly more common among women with GDM. Landon et al. 2009 [15] also found similar results, as the caesarean delivery rate was higher for women with mild GDM (33.8%) than for control women (26.9%). Similarly, diabetes is identified as an important driver of the increasing caesarean section rates due to foetal macrosomia, labour dystocia and obstetric complications by Betrán et al. (2016) [16]. The improved operative delivery rate shown in the present study can

be attributed to the proper care taken during the delivery of high-risk pregnancies and is in line with previous findings.

The neonatal outcomes also showed that there was a higher burden of neonatal complications in the GDM group. The incidence of macrosomia was significantly higher and the mean birth weight significantly greater than in the control group. The HAPO Study Cooperative Research Group (2008) found that there was a continual relationship between glucose levels and birth weight, with large-for-gestational-age babies found in nearly 19–22% of pregnancies involving high glucose levels and approximately 10% among normoglycaemic women. The findings are consistent with Pedersen's hypothesis that maternal hyperglycaemia leads to fetal hyperinsulinaemia, which leads to excessive fetal growth and adiposity.

Hypoglycaemia in the neonatal period was also significantly higher in the GDM group. Effective glycaemic control was seen to be beneficial by Crowley et al. 2005 [17] who recorded the prevalence of neonatal hypoglycaemia in about 8% of GDM pregnancies that were not treated as compared to about 3% of treated GDM pregnancies. Similarly, Landon et al. (2009) found decreased neonatal metabolic complications after treatment for mild GDM. Neonatal hypoglycaemia is caused mostly by ongoing fetal hyperinsulinaemia after birth and therefore, prompt glucose monitoring in the newborn is crucial.

Infants born to mothers with GDM were more likely to have APGAR score less than 7 at five minutes, to have respiratory distress, and to be admitted to the NICU, but the differences were not statistically significant. Crowther et al. (2005) reported similar results; however, the HAPO study reported significant increases in NICU admissions as glucose levels increased. In the present study, however, the lack of statistical significance is probably due to the moderate number of women in each group (45) and therefore the lack of statistical power to detect differences on less common neonatal outcomes."

The present study also showed significantly lower mean gestational age at delivery (37.6 ± 1.8 weeks vs. 38.3 ± 1.7 weeks) among women with GDM. In accord with this, Yogeve and Visser (2009) found that delivery was also earlier in GDM pregnancies, based on maternal/fetal indication such as poor glycaemic control, hypertension and overgrowth of the fetus. This early delivery and more weight was attributed to the complex obstetric management of the diabetic pregnancies.

The results of the present study are in good agreement with the other studies and can also be attributed as evidence in the tertiary level of health service delivery in India. Polyhydramnios, caesarean delivery, macrosomia, Neonatal Hypoglycemia, earlier

gestational age at delivery and increased birth weight are the factors that indicate the adverse effect of GDM on maternal and fetal health. The findings highlighted the need for universal antenatal screening, early diagnosis, strict glycaemic management, individual obstetric care and close monitoring of the newborns for better pregnancy outcomes and to minimize morbidity in both the mother and infant.

Conclusion

The present hospital-based study demonstrated that pregnancies complicated by gestational diabetes mellitus were associated with poorer maternal and neonatal outcomes compared with normoglycaemic pregnancies. Women with GDM had significantly higher rates of polyhydramnios and caesarean section, while their neonates were more likely to develop macrosomia and neonatal hypoglycaemia. Additionally, GDM was associated with higher maternal age, earlier gestational age at delivery, and increased mean birth weight. Although other maternal and neonatal complications were more frequent in the GDM group, these differences were not statistically significant. Overall, the findings highlight the adverse impact of gestational diabetes on pregnancy outcomes and emphasize the importance of universal antenatal screening, early diagnosis, effective glycaemic control, appropriate obstetric management, and careful neonatal monitoring to minimize complications and improve both maternal and neonatal health outcomes.

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