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Original Research Article

Impact of Diabetes Mellitus on Maternal and Fetal Outcomes: A Medicine–Gynecology Perspective

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Abstract:

Background: Diabetes mellitus is a common medical disorder complicating pregnancy and is associated with increased maternal and neonatal morbidity.

Aim: To evaluate the impact of different types of diabetes mellitus on maternal and neonatal outcomes from a combined medicine–gynecology perspective.

Methodology: This hospital-based observational study included 70 pregnant women with pre-existing type 1 diabetes, type 2 diabetes, or gestational diabetes mellitus managed at Department of General Medicine, Nalanda Medical College and Hospital, Patna, Bihar, India. Participants were followed from antenatal period until delivery, and maternal complications, obstetric outcomes, and early neonatal outcomes were recorded and analyzed.

Results: Gestational diabetes mellitus was the most prevalent type (57.2%), with diet-controlled GDM being the most common. Hypertensive disorders (28.6%), preterm labor (22.9%), and a high Caesarean section rate (57.1%) were notable maternal outcomes. Neonatal complications included low birth weight (25.7%), macrosomia (14.3%), hypoglycemia (22.9%), respiratory distress (20%), and increased NICU admissions (28.6%).

Conclusion: Diabetes mellitus in pregnancy significantly influences maternal and neonatal outcomes. Early screening, optimal glycemic control, and multidisciplinary care are essential to improve perinatal outcomes.

Keywords: Diabetes mellitus, Pregnancy, Gestational diabetes, Maternal outcomes, Neonatal outcomes.

Introduction

Diabetes mellitus (DM) represents one of the most common medical disorders complicating pregnancy and poses significant challenges to maternal and fetal health worldwide [1]. With the rising global prevalence of diabetes, particularly type 2 diabetes mellitus (T2DM), and the increasing incidence of gestational diabetes mellitus (GDM), the burden of hyperglycemia during pregnancy has become a major public health concern. Pregnancy induces profound metabolic and hormonal changes that alter glucose homeostasis, and women with pre-existing diabetes or those who develop glucose intolerance during gestation are at heightened risk of adverse outcomes [2]. From a combined medicine–gynecology perspective, diabetes in pregnancy requires multidisciplinary management, as it affects not only obstetric outcomes but also long-term maternal metabolic health and offspring morbidity.

Physiologically, pregnancy is characterized by progressive insulin resistance, particularly in the second and third trimesters, driven by placental hormones such as human placental lactogen, progesterone, estrogen, cortisol, and prolactin. These hormonal changes ensure adequate glucose supply to the growing fetus but may unmask underlying defects in insulin secretion or action [3]. When pancreatic β-cell compensation is inadequate, maternal hyperglycemia develops, resulting in gestational diabetes mellitus. Women with pre-existing type 1 diabetes mellitus (T1DM) or T2DM enter pregnancy with established metabolic dysregulation, which may worsen during gestation if not optimally controlled. Poor glycemic control during critical periods of fetal development is a key determinant of pregnancy-related complications [4].

From an obstetric standpoint, diabetes mellitus is associated with a wide spectrum of maternal complications, including hypertensive disorders of pregnancy, preeclampsia, polyhydramnios, increased rates of operative deliveries, and postpartum hemorrhage [5]. Pregnant women with diabetes are more likely to require induction of labor or cesarean section due to fetal macrosomia, labor dystocia, or non-reassuring fetal status. In addition, pre-existing diabetes increases the risk of progression of chronic complications such as diabetic nephropathy, retinopathy, and cardiovascular disease during pregnancy, necessitating close medical surveillance [6]. These risks underscore the importance of preconception counseling and antenatal optimization of glycemic control from a medical perspective.

Fetal and neonatal outcomes are profoundly influenced by maternal glycemic status. Chronic intrauterine exposure to hyperglycemia leads to fetal hyperinsulinemia, which promotes excessive growth and fat deposition, resulting in macrosomia and shoulder dystocia [7]. Conversely, placental insufficiency in long-standing diabetes may lead to intrauterine growth restriction. Infants born to diabetic mothers are at increased risk of congenital anomalies, particularly cardiac and neural tube defects, especially in pregnancies complicated by poorly controlled pregestational diabetes during organogenesis. Neonatal complications such as hypoglycemia, respiratory distress syndrome, hypocalcemia, polycythemia, and hyperbilirubinemia are also commonly reported [8]. These immediate neonatal risks have long-term implications, as offspring of diabetic pregnancies are more susceptible to obesity, glucose intolerance, and metabolic syndrome later in life.

Gestational diabetes mellitus, although often considered a transient condition, has important implications for both short-term pregnancy outcomes and long-term health. Women with GDM have a higher likelihood of developing T2DM in the years following pregnancy, while their offspring are predisposed to metabolic disorders in adolescence and adulthood. From a gynecological viewpoint, GDM is also associated with increased recurrence in subsequent pregnancies and adverse reproductive outcomes. Therefore, pregnancy serves as a critical window for identifying women at high risk of future metabolic disease and implementing preventive strategies through lifestyle modification and medical follow-up.

The management of diabetes in pregnancy exemplifies the need for an integrated medicine–gynecology approach [9]. Optimal outcomes depend on early diagnosis, individualized glycemic targets, nutritional therapy, pharmacological interventions such as insulin or oral hypoglycemic agents where appropriate, and regular fetal surveillance. Advances in antenatal care, including continuous glucose monitoring, improved insulin formulations, and standardized screening protocols, have significantly reduced perinatal morbidity and mortality. However, disparities in access to care, late diagnosis, and poor adherence to treatment remain major challenges, particularly in low- and middle-income settings.

Diabetes mellitus in pregnancy is a complex condition with far-reaching implications for maternal, fetal, and long-term offspring health. Understanding its pathophysiology, clinical manifestations, and outcomes from both medical and gynecological perspectives is essential for comprehensive care. An integrated, multidisciplinary approach not only improves pregnancy outcomes but also offers an opportunity for early intervention to reduce the intergenerational transmission of metabolic disease. This perspective forms the basis for ongoing research and clinical strategies aimed at optimizing maternal and neonatal health in diabetic pregnancies.

Methodology

Study Design: This study was designed as a hospital-based observational study with a combined retrospective and prospective analytical approach. The objective was to evaluate the impact of diabetes mellitus on maternal and neonatal outcomes from both medical and gynecological perspectives. The study focused on pregnant women diagnosed with diabetes mellitus and followed them throughout pregnancy until delivery, documenting maternal complications, obstetric outcomes, and early neonatal morbidity.

Study Area: The study was conducted in the Department of General Medicine at Nalanda Medical College and Hospital (NMCH), Patna, Bihar, India from March 2025 to September 2025.

Study Participants

Inclusion Criteria

- Pregnant women diagnosed with diabetes mellitus.
- Women with pre-existing Type 1 diabetes mellitus.
- Women with pre-existing Type 2 diabetes mellitus.
- Women diagnosed with gestational diabetes mellitus (GDM).
- Participants registered for antenatal care and who delivered at Nalanda Medical College and Hospital (NMCH), Patna during the study period.
- Diagnosis of diabetes mellitus based on World Health Organization (WHO) criteria, including:
    - Fasting plasma glucose ≥ 7.0 mmol/L, and/or
    - Plasma glucose ≥ 10 mmol/L one hour after a 75 g oral glucose tolerance test, and/or
    - HbA1c ≥ 48 mmol/mol.

- Women diagnosed with gestational diabetes between 24–28 weeks of gestation.
- High-risk pregnant women diagnosed with diabetes mellitus before 24 weeks of gestation during early screening.

Exclusion Criteria

- Women with first-trimester miscarriages.
- Women with multiple pregnancies (e.g., twins or higher-order gestations).
- Pregnant women with chronic systemic illnesses unrelated to diabetes mellitus that could independently influence pregnancy outcomes.
- Women who were unwilling to provide informed consent for participation in the study.

Sample Size: A total of 70 pregnant women with diabetes mellitus fulfilling the inclusion criteria were enrolled in the study.

Study Period: The study was carried out over a defined study period during which eligible participants were recruited, followed up through pregnancy, and assessed until delivery and the early neonatal period.

Procedure: All enrolled participants underwent detailed clinical evaluation during their first antenatal visit, including recording of maternal age, obstetric history, gravidity, parity, previous pregnancy outcomes, family history of diabetes mellitus, and associated comorbidities such as chronic hypertension. Anthropometric measurements were taken, and body mass index was calculated. Routine antenatal screening for gestational diabetes was performed between 24 and 28 weeks of gestation using a 75 g oral glucose tolerance test after overnight fasting, with blood glucose levels measured at fasting, 1 hour, and 2 hours. Women diagnosed with gestational diabetes were initially managed with lifestyle modifications, including dietary counseling and physical activity. Those with persistent hyperglycemia were initiated on insulin therapy.

Participants were categorized into four groups based on diabetes type: pre-existing insulin-dependent diabetes, pre-existing insulin-independent diabetes, gestational diabetes managed with diet alone, and gestational diabetes requiring insulin therapy. Regular antenatal follow-ups were conducted monthly or more frequently as required, including clinical examination, laboratory investigations, ultrasound evaluation of fetal growth and placental status, Doppler studies, cardiotocography, and assessment of amniotic fluid index. Maternal complications such as pre-eclampsia, antepartum hemorrhage, preterm labor, and infections were documented. At delivery, gestational age, mode of delivery, birth weight, Apgar scores, and neonatal sex were recorded. Early neonatal complications including hypoglycemia, jaundice, respiratory distress, need for resuscitation, and neonatal intensive care admission were also noted.

Statistical Analysis: All collected data were entered into a structured proforma and analyzed using IBM SPSS version 27.0 for Windows. Descriptive statistics were used to summarize maternal and neonatal characteristics. Analytical statistics were applied to assess associations between type of diabetes mellitus and pregnancy outcomes. The Kruskal–Wallis chi-square test was used to compare categorical variables across diabetes categories, while Spearman correlation analysis assessed relationships between diabetes type and outcome variables. Binary logistic regression analysis adjusted for maternal age, body mass index, and comorbidities was performed to determine the independent effect of diabetes mellitus on adverse maternal and neonatal outcomes. A p-value of <0.05 was considered statistically significant.

Result

Table 1 shows the distribution of the 70 study participants according to the type of diabetes mellitus. Gestational diabetes mellitus (GDM) constituted the majority of cases, accounting for 57.2% of the total participants, with 34.3% having diet-controlled GDM (A1) and 22.9% requiring insulin therapy (A2). Among pre-existing diabetes, type 2 diabetes mellitus was more common than type 1, representing 25.7% and 17.1% of cases, respectively. Overall, the findings indicate that gestational diabetes, particularly the diet-controlled form, was the most prevalent type of diabetes among the study population.

Table 1: Distribution of Study Participants According to Type of Diabetes Mellitus (n = 70)

Type of Diabetes Mellitus	Number of Cases (n)	Percentage (%)
Pre-existing Type 1 DM	12	17.1
Pre-existing Type 2 DM	18	25.7
Gestational DM (A1 – diet controlled)	24	34.3
Gestational DM (A2 – insulin required)	16	22.9
Total	**70**	**100**

Table 2 summarizes the baseline maternal characteristics of the study participants, indicating that the mean maternal age was 29.6 ± 4.8 years, reflecting a predominantly young reproductive-age population. Multigravida women constituted the majority of the cohort (60.0%), while primigravida women accounted for 40.0%. The mean body mass index was 26.8 ± 3.4 kg/m², suggesting that most

participants were in the overweight range. More than half of the women (54.3%) had a positive family history of diabetes mellitus, highlighting a significant genetic predisposition within the study group. Additionally, associated hypertension was observed in nearly one-third of the participants (31.4%), indicating a substantial burden of comorbid conditions that may influence pregnancy outcomes.

Table 2: Baseline Maternal Characteristics of the Study Participants	
Variable	**Mean ± SD / n (%)**
Mean maternal age (years)	29.6 ± 4.8
Primigravida	28 (40.0%)
Multigravida	42 (60.0%)
Mean BMI (kg/m²)	26.8 ± 3.4
Family history of DM	38 (54.3%)
Associated hypertension	22 (31.4%)

Table 3 depicts the distribution of maternal complications observed during pregnancy among the study participants. The most frequent complication was the requirement of emergency Caesarean section, reported in 26 cases (37.1%), indicating a high rate of obstetric intervention. Gestational hypertension or preeclampsia was noted in 20 cases (28.6%), making it the most common medical complication, followed by preterm labor in 16 cases (22.9%). Polyhydramnios was observed in 14 cases (20%), while oligohydramnios occurred in 8 cases (11.4%), reflecting notable amniotic fluid abnormalities. Antepartum hemorrhage was comparatively less common, affecting 6 cases (8.6%). Overall, the table highlights a substantial burden of hypertensive disorders, preterm delivery, and operative interventions among the pregnant women studied.

Table 3: Maternal Complications Observed During Pregnancy		
Maternal Complications	**Number of Cases (n)**	**Percentage (%)**
Gestational hypertension / Preeclampsia	20	28.6
Preterm labor	16	22.9
Antepartum hemorrhage	6	8.6
Polyhydramnios	14	20
Oligohydramnios	8	11.4
Requirement of emergency Caesarean section	26	37.1

Table 4 shows the distribution of gestational age at delivery and the mode of delivery among the study participants. A majority of the cases resulted in term deliveries (≥37 weeks), accounting for 52 cases (74.3%), while preterm deliveries (<37 weeks) were observed in 18 cases (25.7%), indicating that nearly one-fourth of the pregnancies ended prematurely. With respect to the mode of delivery, normal vaginal delivery was the most common, occurring in 30 cases (42.9%). Caesarean sections together constituted more than half of the deliveries, with emergency Caesarean sections performed in 22 cases (31.4%) and elective Caesarean sections in 18 cases (25.7%). This distribution reflects a substantial reliance on operative delivery alongside a predominance of term gestations in the study population.

Table 4: Mode of Delivery and Gestational Age at Delivery		
Variable	**Number of Cases (n)**	**Percentage (%)**
Term delivery (≥37 weeks)	52	74.3
Preterm delivery (<37 weeks)	18	25.7
Normal vaginal delivery	30	42.9
Elective Caesarean section	18	25.7
Emergency Caesarean section	22	31.4

Table 5 depicts the distribution of neonatal outcomes and early neonatal complications among the study population. Low birth weight (<2.5 kg) was observed in 25.7% of neonates, indicating a considerable proportion of growth-restricted infants, while macrosomia (>4 kg) was noted in 14.3%, reflecting the coexistence of both ends of the birth weight spectrum. Neonatal hypoglycemia occurred in 22.9% of cases, highlighting a common metabolic complication, particularly relevant in pregnancies complicated by diabetes. Respiratory distress was seen in 20% of neonates, suggesting a notable burden of early respiratory morbidity. NICU admission was required for 28.6% of neonates, underscoring the overall increased need for specialized neonatal care. Additionally, an Apgar score of less than 7 at

5 minutes was recorded in 11.4% of neonates, indicating a subset with compromised immediate postnatal adaptation.

Table 5: Neonatal Outcomes and Early Neonatal Complications		
Neonatal Outcome	**Number of Neonates (n)**	**Percentage (%)**
Low birth weight (<2.5 kg)	18	25.7
Macrosomia (>4 kg)	10	14.3
Neonatal hypoglycemia	16	22.9
Respiratory distress	14	20
NICU admission	20	28.6
Apgar score <7 at 5 minutes	8	11.4

Discussion

Diabetes mellitus remains one of the most prevalent medical disorders complicating pregnancy, with gestational diabetes mellitus (GDM) accounting for the largest proportion of cases worldwide. In the present study, GDM constituted the majority of diabetic pregnancies, with diet-controlled GDM being the most common subtype, followed by insulin-requiring GDM. This pattern is comparable to population-based data reported by Bell et al. (2008) [10], who observed that approximately 80–90% of diabetes in pregnancy is attributable to GDM. Similarly, Crowther et al. (2005) [11] demonstrated that a large proportion of women with GDM could be effectively managed with dietary modification alone, reinforcing the importance of early diagnosis and lifestyle-based interventions, as reflected in our cohort.

However, a substantial subset of women in the present study required insulin therapy, indicating greater disease severity and heterogeneous metabolic adaptation. Ringholm et al. (2019) [12] reported that 20–30% of women with GDM require pharmacological therapy, a finding closely aligned with our results. The presence of pre-existing type 2 diabetes mellitus among a considerable proportion of participants further reflects the rising burden of metabolic disorders among women of reproductive age, a trend consistently documented in epidemiological studies from both developed and developing countries (McCance, 2015) [13].

Maternal baseline characteristics in the present study revealed a predominance of overweight and multigravida women, with a high frequency of positive family history of diabetes and associated hypertension. These findings are consistent with Balsells et al. (2009) [14], who reported higher rates of obesity, chronic hypertension, and metabolic comorbidities among women with type 2 diabetes compared to those with type 1 diabetes. Obesity-related insulin resistance likely contributed to the increased requirement for insulin therapy and higher complication rates observed in our study. Weissgerber and Mudd (2015) [15] similarly emphasized the synergistic role of obesity and insulin resistance in increasing the risk of hypertensive disorders in diabetic pregnancies.

Hypertensive disorders emerged as the most common maternal complication in our cohort, followed by preterm labor and amniotic fluid abnormalities, particularly polyhydramnios. Comparable findings were reported by Nayak et al. (2013) [16], who observed hypertensive disorders in nearly 20–25% of diabetic pregnancies, especially among women with poor glycemic control. Insulin resistance during mid-pregnancy has been identified as an independent predictor of preeclampsia, explaining the high coexistence of diabetes and hypertension observed in our study (Phaloprakarn & Tangjitgamol, 2009) [17]. The relatively high incidence of polyhydramnios in our cohort is also consistent with maternal hyperglycemia-induced fetal osmotic diuresis, as described by McCance (2011) [18].

The overall Caesarean section rate in the present study exceeded 50%, with emergency procedures accounting for a substantial proportion. This finding aligns with global reports indicating Caesarean delivery rates of 50–60% among women with pre-existing diabetes and insulin-treated GDM (Bell et al., 2008). Crowther et al. (2005) noted that obstetricians often adopt a lower threshold for operative delivery in diabetic pregnancies due to concerns regarding fetal distress, macrosomia, and labor dystocia. Emergency Caesarean sections in our study further highlight the unpredictable intrapartum complications associated with diabetes in pregnancy.

Neonatal outcomes in the present study reflect the dual impact of maternal diabetes on fetal growth. Both low birth weight and macrosomia were observed, emphasizing the complex interaction between glycemic control, placental function, and gestational age at delivery. Similar bimodal growth patterns were reported by Ornoy et al. (2021) [19], who noted that diabetic pregnancies are associated with both growth restriction and excessive fetal growth depending on metabolic control and vascular status. The rate of macrosomia in our study is comparable to the 10–15% reported by Nayak et al. (2013), while the presence of low-birth-weight neonates may be attributed to preterm delivery and placental

insufficiency associated with hypertensive disorders.

Neonatal hypoglycemia was one of the most frequent metabolic complications observed in our cohort, consistent with fetal hyperinsulinemia secondary to maternal hyperglycemia. McCance (2015) reported neonatal hypoglycemia rates ranging from 15–30% in infants of diabetic mothers, closely mirroring our findings. Respiratory distress and increased NICU admissions further underscore the vulnerability of neonates born to diabetic mothers. Although some studies have reported conflicting associations between maternal diabetes and neonatal respiratory morbidity, Werner et al. (2019) [20] demonstrated a significantly increased risk of respiratory complications after adjusting for gestational age and mode of delivery.

Despite the high burden of maternal and neonatal complications, the majority of pregnancies in the present study resulted in live births with satisfactory Apgar scores, reflecting the benefits of timely diagnosis and structured antenatal care. Ringholm et al. (2019) emphasized that modern multidisciplinary management strategies have substantially improved perinatal survival rates in diabetic pregnancies. Our findings support this observation and reinforce the role of coordinated care involving obstetricians, physicians, and neonatologists.

The present study corroborates existing evidence that diabetes mellitus in pregnancy, particularly when associated with obesity and hypertension, significantly increases maternal and neonatal morbidity. While outcomes are generally favorable with appropriate management, the persistence of complications highlights the need for early screening, individualized glycemic control, and vigilant intrapartum and neonatal monitoring to optimize perinatal outcomes.

Conclusion

Diabetes mellitus in pregnancy represents a significant clinical challenge with substantial implications for maternal and neonatal health. The present study demonstrates that gestational diabetes mellitus is the most prevalent form; while pre-existing diabetes, obesity, and associated hypertension markedly increase the risk of adverse outcomes. High rates of hypertensive disorders, preterm labor, and Caesarean delivery underscore the obstetric burden of diabetic pregnancies. Neonatal complications such as hypoglycemia, respiratory distress, abnormal birth weights, and increased NICU admissions further highlight the impact of maternal hyperglycemia on early neonatal adaptation. Despite these risks, favorable outcomes were achieved in the majority of cases through structured antenatal surveillance and timely interventions. These findings emphasize the need for early screening, strict glycemic control, and a multidisciplinary medicine–gynecology approach to optimize pregnancy outcomes and reduce long-term metabolic risks for both mother and child.

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