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Original Research Article

Gestational diabetes mellitus and its fetomateranal outcome: a prospective observational study

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ABSTRACT

Background: Gestational diabetes mellitus (GDM) is a common metabolic disorder of pregnancy associated with significant maternal, fetal, and long-term metabolic complications. It contributes to hypertensive disorders, operative delivery, neonatal morbidity, and increased future risk of type 2 diabetes in both mother and offspring. Evaluating fetomaternal outcomes in GDM is essential for improving clinical management and reducing adverse pregnancy outcomes.
Methods: A prospective observational study was conducted among 100 antenatal women, including 60 diagnosed with GDM and 40 with normal glucose tolerance for 18 months from September 2023 to February 2025. Participants were followed throughout pregnancy to assess maternal complications, delivery outcomes, neonatal health, and the influence of glycemic control. Clinical, laboratory, and outcome data were systematically recorded and analyzed using appropriate statistical methods, with significance set at $p \leq 0.05$.
Results: GDM pregnancies demonstrated higher maternal morbidity, including increased pre-eclampsia (28% versus 10%), caesarean delivery (55% versus 30%), and postpartum complications compared with non-GDM pregnancies. Neonatal complications were also more frequent in the GDM group, particularly macrosomia (25% versus 5%), hypoglycemia (18% versus 5%), respiratory distress, and greater neonatal intensive care unit admissions with longer hospital stay. Poor glycemic control and insulin-treated cases were associated with worse maternal and fetal outcomes. Postpartum follow-up indicated progression to type 2 diabetes in a proportion of mothers, highlighting persistent metabolic risk.
Conclusions: GDM is strongly associated with adverse maternal and neonatal outcomes as well as long-term metabolic consequences. Early detection, strict glycemic control, individualized management, and sustained postpartum surveillance are essential to reduce complications and improve both immediate and future health outcomes.

Keywords: Gestational diabetes mellitus, Fetomaternal outcome, Pre-eclampsia, Macrosomia, Neonatal hypoglycemia, Caesarean delivery, Postpartum diabetes

INTRODUCTION

Gestational diabetes mellitus (GDM) is a form of glucose intolerance that is first detected during pregnancy and represents one of the most common metabolic disorders complicating gestation. Physiological insulin resistance naturally increases during pregnancy to ensure adequate glucose availability for the developing fetus; however, in some women pancreatic β-cell compensation is insufficient, leading to maternal hyperglycemia.[1,2] This altered metabolic state not only affects maternal health during pregnancy but also has important implications for long-term metabolic disease. Women diagnosed with GDM have a markedly higher risk of developing type 2 diabetes mellitus in the years following delivery, making pregnancy an important window for early detection of metabolic vulnerability.[3]

The presence of GDM is associated with a range of maternal complications that can influence the course of pregnancy and delivery. Women with impaired glucose tolerance are more likely to develop hypertensive disorders such as gestational hypertension and pre-eclampsia, as well as polyhydramnios and increased obstetric interventions.[4] Additionally, the risk of operative delivery is often elevated because of fetal size abnormalities, dysfunctional labor, or clinician concerns regarding intrapartum complications. Persistent hyperglycemia may also contribute to postpartum metabolic disturbances and delayed recovery, further emphasizing the need for careful antenatal monitoring and appropriate metabolic control.

Maternal hyperglycemia also directly influences fetal development. Glucose readily crosses the placenta, stimulating increased insulin secretion in the fetus. Because insulin acts as a growth-promoting hormone, this process can result in excessive fetal growth or macrosomia, typically defined as a birth weight greater than 4,000 g.[5] Macrosomic infants are at greater risk of complications such as shoulder dystocia, birth trauma, and birth asphyxia. In addition to growth abnormalities, neonates born to mothers with GDM may experience metabolic and physiological disturbances including hypoglycemia, respiratory distress syndrome, jaundice, and electrolyte imbalance, often requiring admission to neonatal intensive care units.[6]

Increasing evidence also suggests that the effects of gestational diabetes extend beyond the perinatal period. Intrauterine exposure to maternal hyperglycemia can influence fetal metabolic programming, predisposing offspring to obesity, insulin resistance, and impaired glucose metabolism later in life.[7] These long-term effects highlight the intergenerational significance of GDM and support the concept that metabolic conditions during pregnancy can shape lifelong health outcomes for both mother and child.

Early identification and appropriate management of GDM are therefore essential components of modern antenatal care. Screening is commonly recommended between 24 and 28 weeks of gestation using standardized glucose tolerance testing.[8] Once diagnosed, management strategies including dietary modification, physical activity, regular glucose monitoring, and pharmacologic therapy when necessary have been shown to significantly reduce maternal and neonatal complications.[9] Effective glycemic control during pregnancy not only improves immediate obstetric outcomes but also contributes to better long-term metabolic health.

The prevalence of GDM varies widely across populations due to differences in diagnostic criteria, genetic susceptibility, lifestyle factors, and healthcare access. Several studies have identified important risk factors associated with gestational diabetes mellitus.[10-13] Advanced maternal age shows a higher prevalence, with around 50% of women aged ≥30 years developing GDM compared with about 20.9% in younger women. Similarly, 64.3% of women with BMI ≥25 kg/m² were reported to develop GDM, highlighting the role of overweight and obesity.[10] In addition, approximately 50% of affected women had a family history of diabetes, while about 33.3% reported a previous history of GDM, indicating strong genetic and obstetric predisposition.[11] Despite these variations, most investigations consistently demonstrate an association between GDM and increased risks of hypertensive disorders, operative delivery, macrosomia, neonatal hypoglycemia, and neonatal intensive care admission.

Given the growing global burden of diabetes and the increasing recognition of pregnancy as an important period for identifying metabolic risk, further clinical evaluation of GDM and its outcomes remains essential. The present prospective study was therefore undertaken to determine the occurrence of gestational diabetes mellitus among antenatal women and to examine its relationship with maternal complications, fetal and neonatal outcomes, and the influence of glycemic control during pregnancy.

METHODS

Study design

This research was conducted as a prospective observational study designed to systematically observe and document the natural course of GDM and its effects on maternal and fetal outcomes without introducing any therapeutic intervention. Participants were followed over time throughout pregnancy, enabling real-time collection and recording of clinical events and outcomes as they occurred.

Study period

The total duration of the study was 18 months from September 2023 to February 2025. Of this period, fifteen months were devoted to active data collection from eligible antenatal patients, while the remaining three months were allocated for data compilation, verification, and statistical analysis. This timeframe ensured adequate case accrual and comprehensive evaluation of study variables.

Sample size

A total of 100 antenatal women were included in the study. This sample size was selected to provide a reasonable representation of the target population and to permit meaningful statistical assessment of maternal and fetal outcomes associated with GDM.

Study setting

The study was carried out at Gopnath Maternity Home, Sir T. General Hospital, a tertiary care centers in Bhavnagar,

India that manages a substantial volume of antenatal cases. Conducting the research in this setting facilitated access to a diverse obstetric population and enabled systematic follow-up of participants.

Study population

The study population comprised antenatal women attending the outpatient department of Gopnath Maternity Home on designated clinic days, specifically Tuesdays and Fridays. Restricting recruitment to fixed days allowed structured, consistent, and manageable data collection throughout the study duration.

Eligibility criteria

All antenatal women between 24 and 34 weeks of gestation with random blood sugar levels greater than 140 mg/dl were eligible for inclusion. Women with pre-existing overt diabetes, chronic hypertension, pregnancy-induced hypertension, or those receiving medications known to alter glucose metabolism such as corticosteroids were excluded. Additionally, previously diagnosed cases of GDM already receiving hypoglycemic therapy, including insulin or metformin, were not included in the study.

Investigations

Each participant underwent a standardized set of clinical and laboratory investigations. These included complete blood count, routine and microbiological urine examination, random blood sugar estimation, a two-hour oral glucose tolerance test based on DIPSI criteria, and measurement of glycated hemoglobin (HbA1c). These investigations were performed to evaluate glycemic status and associated clinical parameters relevant to pregnancy outcomes.

Statistical analysis

Collected data were cleaned, coded, and entered into Microsoft Excel to ensure accuracy and organization prior to analysis. Continuous variables such as maternal age and gestational age were summarized using mean and standard deviation, whereas categorical variables including GDM status, mode of delivery, and neonatal outcomes were expressed as proportions and percentages. Associations between categorical variables were analyzed using the chi-square test. Outcomes such as delivery method, birth weight, and Apgar score were specifically examined for statistical relationships. A p value of ≤0.05 was considered indicative of statistical significance, suggesting that observed associations were unlikely to have occurred by chance.

RESULTS

Women diagnosed with gestational diabetes mellitus were comparatively older, had higher mean parity, and demonstrated markedly elevated random blood glucose levels than those without GDM. A greater proportion of affected women were overweight or obese and had identifiable metabolic or obstetric risk factors, including family history of diabetes, prior GDM, and coexisting hypertension. These findings indicate a clear clustering of demographic and clinical risk determinants among GDM pregnancies, supporting their role in early identification of high-risk mothers (Table 1).

Table 1: Baseline demographic and clinical characteristics.

Parameters	GDM (n=60)	Non-GDM (n=40)
Mean age (years)	32.4±4.1	29.1±3.8
Mean parity	3±1	2±1
Middle socioeconomic status (%)	65	55
Mean random blood sugar (mg/dl)	155±15	110±10
Mean gestational age at diagnosis (weeks)	28.5±2.5	—
BMI >25 kg/m² (%)	72	38
Family history of diabetes (%)	45	20
Previous GDM (%)	20	5
Hypertension (%)	30	10

Maternal outcomes were significantly less favorable in the presence of gestational diabetes. Hypertensive disorders, particularly pre-eclampsia, occurred more frequently and showed statistical significance, and operative delivery-especially cesarean section-was substantially higher among women with GDM. Additional complications such as polyhydramnios, preterm birth, postpartum hemorrhage, and postpartum infection were also more common in the GDM group, collectively demonstrating the increased obstetric morbidity associated with poor glycemic status during pregnancy (Table 2 and Figure 1).

Table 2: Comparison of maternal pregnancy outcomes between GDM and non-GDM groups.

Outcome	GDM (n=60) (%)	Non-GDM (n=40) (%)	P value
Pre-eclampsia	28	10	<0.01
Polyhydramnios	18	5	—
Preterm delivery	15	5	—
Cesarean delivery	55	30	<0.05
Postpartum hemorrhage	10	3	—
Postpartum infection	8	2	—

Neonatal outcomes similarly reflected the adverse intrauterine metabolic environment associated with maternal hyperglycemia. Rates of fetal macrosomia and neonatal hypoglycemia were significantly elevated in

infants of mothers with GDM, accompanied by higher frequencies of respiratory distress, jaundice, low Apgar scores, and neonatal intensive care unit admission with longer duration of stay. Although neonatal mortality remained low, overall neonatal morbidity was greater in the GDM group, highlighting the clinically meaningful impact of gestational diabetes on early neonatal health (Table 3 and Figure 2).

Table 3: Comparison of neonatal outcomes and complications between GDM and non-GDM pregnancies.

Outcome	GDM (n=60) (%)	Non-GDM (n=40) (%)	P value
Macrosomia (>4000 g)	25	5	<0.05
Low birth weight (<2500 g)	10	20	—
Apgar <7 at 1 min	15	5	—
Apgar <7 at 5 min	5	2	—
Neonatal hypoglycemia	18	5	<0.01
Jaundice	12	8	—
Respiratory distress syndrome	10	3	—
NICU admission	22	10	—
Mean NICU stay (days)	5.2±1.4	3.1±1.0	—
Neonatal mortality	2	1	—
Neonatal morbidity	15	8	—

The degree of glycemic control further influenced both maternal and fetal prognosis. Pregnancies requiring insulin therapy and those categorized as poorly controlled exhibited higher incidences of preterm delivery, macrosomia, pre-eclampsia, and cesarean section compared with diet-controlled or well-controlled cases.

Postpartum follow-up revealed that a proportion of mothers progressed to type 2 diabetes despite undergoing glucose testing, underscoring the persistent metabolic risk following GDM and the importance of continued surveillance beyond delivery (Tables 4 and 5).

Table 4: Influence of glycemic control on pregnancy outcomes in GDM.

Parameters	Diet-controlled (%)	Insulin-controlled (%)
Preterm delivery	10	15
Macrosomia	20	30
Pre-eclampsia	15	40
Cesarean delivery	50	80

Table 5: Postpartum follow-up outcomes in GDM.

Parameters	Value (%)
OGTT performed	85
Type 2 diabetes incidence	10

DISCUSSION

This prospective observational investigation evaluated maternal and fetal outcomes among 100 antenatal women, including 60 diagnosed with GDM, and demonstrated clear differences between pregnancies complicated by GDM and those with normal glucose tolerance. The findings indicate that GDM is strongly associated with increased maternal morbidity, adverse delivery outcomes, and higher neonatal complications. Interpreting these results alongside previously published evidence helps clarify the clinical significance of GDM and highlights priorities for screening, treatment, and long-term follow-up.

Maternal outcomes in the present study showed a markedly higher burden of complications among women with GDM, particularly hypertensive disorders, operative delivery, and postpartum morbidity. The incidence of pre-eclampsia was substantially greater in the GDM group (28%) compared with non-GDM pregnancies (10%), supporting earlier research identifying GDM as an independent contributor to hypertensive disease in pregnancy.[16,17] Shared mechanisms such as endothelial dysfunction, oxidative stress, and systemic inflammation likely explain this association, as these pathophysiological pathways are characteristic of both insulin resistance and pre-eclampsia.[18] The coexistence of these conditions increases the risk of maternal organ dysfunction and adverse perinatal outcomes, emphasizing the importance of vigilant antenatal surveillance in women with abnormal glucose metabolism.

Operative delivery was also significantly more frequent in GDM pregnancies, with cesarean section occurring in 55% of affected women compared with 30% in the comparison group. This observation is consistent with prior studies demonstrating increased surgical delivery among women with diabetes in pregnancy.[19] Elevated cesarean rates are commonly attributed to fetal macrosomia, labor dystocia, and clinician concern regarding intrapartum complications.[20] While cesarean delivery can reduce certain intrapartum risks, it simultaneously increases the likelihood of hemorrhage, infection, and delayed recovery, thereby contributing to cumulative maternal morbidity. The higher rates of postpartum hemorrhage and infection observed among GDM mothers in this cohort align with evidence linking hyperglycemia to impaired immune response, abnormal placentation, and uterine atony.[21,22] Together, these findings illustrate how GDM can initiate a cascade of obstetric complications extending from pregnancy through the postpartum period.

Neonatal outcomes were likewise adversely affected by maternal GDM. The frequency of macrosomia was fivefold higher among infants of diabetic mothers (25% versus 5%), reinforcing the well-established relationship between maternal hyperglycemia and excessive fetal growth.[23] Increased transplacental glucose transfer stimulates fetal pancreatic insulin secretion, and insulin acts as a potent growth factor promoting adiposity and somatic enlargement. Macrosomia is clinically important because it elevates the risk of shoulder dystocia, birth trauma, and operative delivery, thereby linking fetal overgrowth to both maternal and neonatal morbidity.[6]

Neonatal hypoglycemia was another prominent complication, occurring in 18% of infants born to mothers with GDM. This phenomenon is widely recognized in diabetic pregnancies and results from persistent fetal hyperinsulinemia after removal of the maternal glucose supply at birth.[24] Without prompt detection and treatment, hypoglycemia may lead to seizures or long-term neurodevelopmental impairment, underscoring the need for routine glucose monitoring in exposed neonates. Respiratory distress syndrome (RDS) was also more common in the GDM group (10% versus 3%), consistent with evidence that fetal hyperinsulinemia delays pulmonary surfactant maturation.[25] The accompanying increase in neonatal intensive care unit admissions and longer hospitalization further demonstrates the clinical burden imposed by maternal dysglycemia.

Beyond immediate perinatal effects, the study findings highlight important long-term metabolic risks for both mothers and offspring. A proportion of women with prior GDM developed type 2 diabetes mellitus within months of delivery, and elevated glycated hemoglobin levels were observed in a subset during postpartum follow-up. These results correspond with longitudinal research showing a high lifetime progression rate from GDM to type 2 diabetes.[26] Pregnancy therefore functions as an early metabolic "stress test," revealing underlying susceptibility to chronic dysglycemia. Structured postpartum surveillance, lifestyle modification, and early therapeutic intervention are essential to interrupt this trajectory.

Children exposed to intrauterine hyperglycemia also demonstrated early metabolic consequences, including higher rates of obesity and metabolic syndrome during infancy. Such findings support the concept of fetal programming, whereby the intrauterine environment induces lasting alterations in metabolism, insulin sensitivity, and adiposity regulation.[27] These intergenerational effects broaden the significance of GDM from a transient pregnancy disorder to a contributor to long-term population health burden. Preventive strategies beginning in pregnancy- and extending through childhood nutrition and lifestyle counselling- may therefore have far-reaching benefits.

The influence of treatment modality and glycemic control on outcomes was another key observation. Women whose glucose levels were adequately managed with diet alone experienced lower rates of preterm delivery and macrosomia compared with those requiring insulin therapy. This pattern likely reflects greater disease severity among insulin-treated patients, yet it also underscores the effectiveness of early lifestyle intervention in mild GDM.[28] Importantly, poorly controlled GDM- regardless of treatment- was associated with markedly higher rates of pre-eclampsia and cesarean delivery, reinforcing evidence that strict glycemic regulation is central to improving pregnancy outcomes.[29] Advances such as continuous glucose monitoring and individualized insulin titration may further enhance metabolic control and reduce complications.

From a clinical perspective, these findings emphasize several priorities. Early screening is critical to identify high-risk pregnancies before complications develop. Continuous maternal and fetal monitoring allows timely detection of hypertensive disease, fetal overgrowth, and metabolic instability. Management must be individualized, integrating nutritional therapy, pharmacologic treatment when necessary, and patient education to ensure adherence. Equally important is structured postpartum follow-up to detect persistent dysglycemia and to counsel families regarding long-term metabolic health.

Despite providing important clinical insights, the present study has several limitations that should be considered when interpreting the findings. First, the research was conducted at a single tertiary care center, which may limit the generalizability of the results to broader populations with different demographic, socioeconomic, or healthcare characteristics. Second, the sample size of 100 participants, although adequate for preliminary comparisons, may not fully capture the variability of maternal and neonatal outcomes associated with gestational diabetes mellitus. Third, the observational design of the study restricts the ability to establish causal relationships between GDM and the observed complications. Additionally, some outcomes such as long-term metabolic effects in mothers and children could not be thoroughly evaluated because postpartum follow-up duration was relatively short. Finally, potential confounding factors including lifestyle habits, dietary patterns, and levels of physical activity were not extensively assessed, which might have influenced both glycemic control and pregnancy outcomes.

CONCLUSION

The present prospective observational study demonstrates that gestational diabetes mellitus is strongly associated with increased maternal and neonatal morbidity, including higher rates of hypertensive disorders, cesarean delivery, fetal macrosomia, neonatal hypoglycemia, and greater need for neonatal intensive care. The findings highlight that women with GDM are typically older, more likely to be overweight, and frequently possess identifiable metabolic risk factors, which emphasizes the importance

of early risk assessment and timely screening during pregnancy. Furthermore, the study underscores that the degree of glycemic control significantly influences pregnancy outcomes, with poorly controlled GDM being linked to worse maternal and fetal prognosis. By systematically evaluating maternal characteristics, pregnancy outcomes, and neonatal complications in a real-world clinical setting, this study contributes to existing evidence by reinforcing the critical role of early detection, strict glycemic management, and structured postpartum follow-up in reducing complications and preventing the long-term progression to type 2 diabetes. These findings strengthen the understanding of GDM as not only a pregnancy-related condition but also an important marker of future metabolic risk for both mother and child.

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