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Original Research Article

Type 2 Diabetes Mellitus and Its Influence on Pregnancy Outcomes: A Prospective Hospital-Based Study

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Abstract: ***Background:*** Type 2 Diabetes Mellitus (T2DM) is an increasingly common metabolic disorder affecting pregnant women worldwide. Its presence during pregnancy is associated with a spectrum of adverse maternal and fetal outcomes due to chronic hyperglycemia, insulin resistance, and associated comorbidities. Early identification and control of T2DM in pregnant women play a significant role in improving obstetric outcomes. Given the rising prevalence of diabetes in India, especially in semi-urban settings, understanding pregnancy outcomes among women with T2DM is crucial for guiding evidence-based clinical care. ***Aim:*** This prospective hospital-based study aimed to evaluate the influence of Type 2 Diabetes Mellitus on pregnancy outcomes among women attending the Department of Medicine, Fathima Institute of Medical Sciences, Kadapa, Andhra Pradesh. The study analyzed maternal complications, fetal outcomes, delivery patterns, and neonatal health indicators during the research period from May 2015 to April 2016. ***Methods:*** A total of 510 pregnant women diagnosed with T2DM were followed throughout pregnancy until delivery. All participants were evaluated using structured clinical examinations, laboratory investigations, and standardized obstetric assessments. Data were collected on maternal characteristics, glycemic control, obstetric complications, mode of delivery, and neonatal outcomes. Statistical analysis included descriptive and inferential methods to determine associations between T2DM and pregnancy outcomes, adhering to accepted methodological frameworks. ***Conclusion:*** The study demonstrated that Type 2 Diabetes Mellitus significantly influences maternal and fetal outcomes, contributing to higher rates of cesarean delivery, preterm birth, hypertensive disorders, and neonatal complications such as macrosomia and neonatal hypoglycemia. Strengthening screening programs, optimizing glycemic management, and integrating multidisciplinary care pathways may substantially improve outcomes for pregnant women with T2DM.
Keywords: Type 2 Diabetes Mellitus; Pregnancy Outcomes; Maternal Complications; Fetal Outcomes; Cesarean Delivery; Prospective Study; India; Antenatal Care; Hyperglycemia; Maternal Health.

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) has emerged as one of the most significant global public health concerns, particularly in low- and middle-income countries experiencing rapid epidemiological transitions. Characterized by insulin resistance and relative insulin deficiency, T2DM accounts for more than 90% of all diabetes cases, and its impact extends across a wide range of physiological systems. In the context of pregnancy, T2DM represents a dual burden affecting both maternal metabolic health and fetal development. The metabolic demands of pregnancy amplify insulin resistance, making the physiological adaptations of pregnancy particularly challenging for women with pre-existing or newly diagnosed T2DM. With rising rates of obesity, sedentary behavior, and lifestyle-related risk factors, the prevalence of T2DM among pregnant women in India has increased significantly over the past decade, prompting renewed attention to its clinical consequences [1,2].

Pregnancy in women with T2DM is associated with a range of maternal complications, including gestational hypertension, preeclampsia, polyhydramnios, and increased infection rates. Poor glycemic control during pregnancy further elevates the risk of progressive microvascular damage, including retinopathy and nephropathy, with long-term implications for maternal health. Moreover, uncontrolled maternal hyperglycemia contributes to placental dysfunction, altered fetal nutrient transport, and enhanced oxidative stress, all of which predispose

to adverse fetal outcomes. Although advances in insulin therapy, antenatal diagnostics, and clinical monitoring have significantly improved maternal–fetal outcomes over recent decades, substantial disparities persist, particularly in resource-limited settings where access to specialized maternal care remains uneven [3–5].

Fetal outcomes in pregnancies complicated by T2DM often reflect the interplay between maternal glycemic control, duration of diabetes, and presence of comorbidities such as hypertension or dyslipidemia. Infants born to diabetic mothers are at increased risk of macrosomia, preterm birth, congenital anomalies, respiratory distress, and metabolic complications such as neonatal hypoglycemia. The "Pedersen hypothesis," which links maternal hyperglycemia with excessive fetal insulin production, continues to form the foundation for understanding diabetes-associated fetal overgrowth and perinatal morbidity. Moreover, the mode of delivery is influenced by diabetic status, with higher rates of cesarean section attributed to cephalopelvic disproportion, suspected macrosomia, or intrapartum complications. As such, T2DM complicates not only the course of pregnancy but also the intrapartum and immediate postpartum periods, placing additional burdens on healthcare systems and families [6–8].

Despite extensive global research, data from semi-urban and resource-constrained regions of India remain limited, particularly with respect to prospective hospital-based assessments of pregnancy outcomes among women with T2DM. The state of Andhra Pradesh, with its unique demographic and socioeconomic patterns, has experienced a steady rise in diabetes prevalence, yet fewer structured studies have explored its impact on maternal and neonatal health outcomes. Understanding the local patterns of morbidity, delivery rates, neonatal indicators, and health service utilization is essential for tailoring clinical interventions and improving the continuum of maternal care. This prospective study, conducted in the Department of Medicine at the Fathima Institute of Medical Sciences, Kadapa, aims to bridge this knowledge gap by systematically examining the influence of T2DM on pregnancy outcomes. By analyzing data from 510 pregnant women between May 2015 and April 2016, this study contributes valuable evidence toward improving antenatal management strategies, clinical guidelines, and healthcare policies for diabetic pregnancies in similar healthcare settings.

OBJECTIVE

The primary objective of this prospective hospital-based study was to evaluate the influence of Type 2 Diabetes Mellitus (T2DM) on pregnancy outcomes among women attending the Department of Medicine at Fathima Institute of Medical Sciences, Kadapa, Andhra Pradesh. Given the increasing prevalence of T2DM in the region and its recognized potential to adversely impact the maternal–fetal dyad, the study aimed to systematically assess the spectrum of maternal complications associated with diabetic pregnancies. These included hypertensive disorders, infections, obstetric complications, glycemic instability, and patterns of antenatal service utilization. By following pregnant women from early pregnancy until delivery, the study sought to identify the clinical factors contributing to unfavorable maternal outcomes, thereby facilitating the development of preventive strategies for risk minimization.

A secondary objective of the study was to analyze fetal and neonatal outcomes in the context of maternal T2DM. This included assessing rates of preterm birth, low Apgar scores, neonatal intensive care admissions, congenital anomalies, macrosomia, neonatal hypoglycemia, and perinatal mortality. Additionally, the study aimed to determine associations between glycemic control and delivery outcomes, including cesarean section rates, indications for operative delivery, and intrapartum complications. Through this comprehensive evaluation of both maternal and fetal outcomes, the study intended to generate evidence that could aid clinicians in implementing targeted management protocols, early interventions, and enhanced monitoring frameworks to improve pregnancy outcomes in women with T2DM.

MATERIALS AND METHODOLOGY

This prospective hospital-based study was conducted in the Department of Medicine at Fathima Institute of Medical Sciences, Kadapa, Andhra Pradesh, over a 12-month period from May 2015 to April 2016. A total of 510 pregnant women diagnosed with Type 2 Diabetes Mellitus (T2DM) were enrolled and followed throughout the course of pregnancy until delivery. The study design emphasized systematic observation, standardized assessments, and longitudinal monitoring to evaluate maternal and fetal outcomes associated with T2DM. All participants were evaluated during their routine antenatal visits, with additional follow-ups scheduled based on clinical indications. Diagnosis of T2DM was confirmed based on American Diabetes Association (ADA) criteria, including fasting plasma glucose levels, oral glucose tolerance test (OGTT) outcomes, and glycated hemoglobin (HbA1c) values. The study adhered to ethical guidelines, obtaining informed consent from all participants prior to enrollment.

Maternal assessments included a detailed obstetric history, past medical and surgical history, anthropometric measurements, and baseline investigations. Throughout pregnancy, participants underwent regular monitoring of blood glucose levels

using fasting and postprandial measurements, HbA1c evaluations each trimester, and periodic urine examinations for proteinuria and ketonuria. Blood pressure monitoring and weight assessment were conducted at every visit to identify emerging complications such as gestational hypertension or preeclampsia. Obstetric ultrasounds were performed at designated intervals to evaluate fetal growth patterns, amniotic fluid volume, placental characteristics, and fetal anomalies. Management strategies including medical nutrition therapy, insulin administration, and oral hypoglycemic agents were individualized based on clinical needs and glycemic status. Participants requiring specialized care, including those with comorbid conditions like hypothyroidism or chronic hypertension, were managed collaboratively with relevant specialty departments.

Newborn assessments were conducted immediately after delivery and during the early neonatal period to evaluate the influence of maternal T2DM on fetal outcomes. Neonatal parameters such as birth weight, gestational age, Apgar scores at 1 and 5 minutes, need for resuscitation, presence of congenital anomalies, and admission to the neonatal intensive care unit (NICU) were recorded. Blood glucose monitoring was performed to detect neonatal hypoglycemia, commonly seen in infants born to diabetic mothers due to hyperinsulinemia. Delivery outcomes including mode of delivery, indications for cesarean section, intrapartum complications, and postpartum maternal health were systematically documented. All data were compiled using structured case records designed specifically for this study. This methodology enabled an accurate and comprehensive assessment of maternal–fetal interactions in pregnancies complicated by T2DM, reflecting real-world clinical scenarios in a tertiary-care setting.

Inclusion Criteria

- Pregnant women diagnosed with Type 2 Diabetes Mellitus based on ADA criteria.
- Women aged 18–45 years.
- Singleton pregnancies.
- Patients willing to provide informed consent and follow up throughout pregnancy and delivery.
- Women registered and receiving antenatal care at Fathima Institute of Medical Sciences during the study period.

Exclusion Criteria

- Women with Type 1 Diabetes Mellitus or gestational diabetes mellitus (GDM).
- Multiple gestations (e.g., twins, triplets).
- Pregnancies complicated by chronic systemic illnesses unrelated to T2DM, such as renal failure, autoimmune diseases, or congenital heart diseases.
- Women who delivered outside the study hospital.
- Patients unwilling to participate or unable to comply with follow-up requirements.

Data Collection Procedure

Data collection followed a systematic, structured approach using predesigned case proformas. Upon enrollment, baseline clinical data including maternal age, parity, socioeconomic status, duration of diabetes, previous obstetric history, and comorbid conditions were recorded. Blood investigations included fasting plasma glucose, postprandial glucose levels, HbA1c, renal function tests, lipid profile, and complete blood counts. Ultrasound assessments were conducted at booking, mid-trimester, and late third trimester. Participants were followed at regular antenatal intervals, with intensive monitoring for those exhibiting poor glycemic control or diabetes-related complications. Delivery records were maintained meticulously, capturing labor progression, induction details, intrapartum complications, mode of delivery, indication for cesarean section, and immediate postpartum outcomes. Neonatal details were collected by pediatric teams using standardized neonatal care charts.

Statistical Data Analysis

All collected data were coded and entered into Microsoft Excel and subsequently analyzed using SPSS software (Version 20.0). Descriptive statistics such as frequencies, percentages, means, and standard deviations were used to summarize demographic characteristics, maternal complications, and neonatal outcomes. Inferential statistics, including chi-square tests, independent Student's t-tests, and logistic regression analyses, were applied to examine associations between T2DM and pregnancy outcomes. A p-value of <0.05 was considered statistically significant. Results were presented in the form of tables, charts, and structured narratives to facilitate clear interpretation. This analytical framework enabled the identification of significant predictors of adverse pregnancy outcomes in women with T2DM.

RESULTS

In this prospective study of 510 pregnant women diagnosed with Type 2 Diabetes Mellitus (T2DM), the demographic distribution revealed that the majority of participants were between 26 and 35 years of age, with a mean age of 29.4 ± 4.8 years. Nearly 62% of the study population were multiparous, while 38% were primigravida. The average duration of diabetes was 3.2 ± 1.4 years, and 68% of women had been diagnosed with T2DM prior to conception. Glycemic control varied across the cohort, with 56% achieving HbA1c levels below 7%, while the remaining 44% had

suboptimal glycemic control. Antenatal complications were common, with gestational hypertension occurring in 18.2% of participants and preeclampsia diagnosed in 11.6%. Polyhydramnios was reported in 9.8% of pregnancies, while urinary tract infections and anemia were present in 14.1% and 22.3% of women, respectively.

Delivery-related outcomes demonstrated that cesarean section was the most common mode of delivery, accounting for 56.7% of births, while 43.3% had vaginal deliveries. Indications for cesarean section included suspected macrosomia (28.4%), fetal distress (21.6%), previous cesarean section (18.9%), and failed induction (10.4%). The bar chart (provided as a downloadable file) illustrates the overall distribution of pregnancy outcomes, while the pie chart depicts the proportion of delivery modes across the study cohort. Preterm birth (<37 weeks) occurred in 15.7% of pregnancies, and intrauterine growth restriction (IUGR) was noted in 8.4% of cases. Postpartum hemorrhage was documented in 5.7%, while shoulder dystocia occurred in 3.1% of vaginal deliveries. The mean gestational age at delivery was 38.1 ± 1.6 weeks.

Neonatal outcomes revealed a substantial influence of maternal T2DM on fetal well-being. Macrosomia (birth weight ≥ 4 kg) was observed in 17.8% of neonates, whereas 12.4% were low birth weight (<2.5 kg). Hypoglycemia was the most common immediate neonatal complication, affecting 21.6% of newborns. NICU admission was necessary for 24.3% of neonates due to respiratory distress, hypoglycemia, prematurity, or congenital anomalies. Apgar scores below 7 at 1 minute were seen in 10.8% of newborns, improving to below 7 at 5 minutes in only 4.5%. Congenital anomalies were detected in 3.7% of infants, including cardiac defects, neural tube defects, and limb abnormalities. Overall, the findings underscore a clear association between maternal T2DM and adverse pregnancy outcomes, highlighting the need for enhanced antenatal surveillance and optimized glycemic control strategies.

Table 1: Baseline Characteristics of Study Participants (N = 510)

Parameter	Frequency (%)
Age < 25 years	18.6%
Age 26–35 years	62.4%
Age > 35 years	19.0%
Primigravida	38.0%
Multigravida	62.0%
Duration of T2DM < 3 years	54.2%
Duration of T2DM ≥ 3 years	45.8%

Table 2: Maternal Complications Observed During Pregnancy

Complication	Frequency (%)
Gestational Hypertension	18.2%
Preeclampsia	11.6%
Polyhydramnios	9.8%
Oligohydramnios	6.7%
Urinary Tract Infection	14.1%
Anemia	22.3%

Table 3: Mode of Delivery Among Participants

Mode of Delivery	Frequency (%)
Vaginal Delivery	43.3%
Cesarean Section	56.7%
Indications for Cesarean Section	
• Suspected Macrosomia	28.4%
• Fetal Distress	21.6%
• Previous Cesarean Section	18.9%
• Failed Induction	10.4%

Table 4: Neonatal Outcomes

Outcome	Frequency (%)
Macrosomia (≥4 kg)	17.8%
Low Birth Weight (<2.5 kg)	12.4%
NICU Admission	24.3%
Hypoglycemia	21.6%
Congenital Anomalies	3.7%

Table 5: Apgar Scores and Immediate Neonatal Status

Parameter	Frequency (%)
Apgar < 7 at 1 minute	10.8%
Apgar < 7 at 5 minutes	4.5%
Respiratory Distress	14.9%
Need for Resuscitation	6.3%

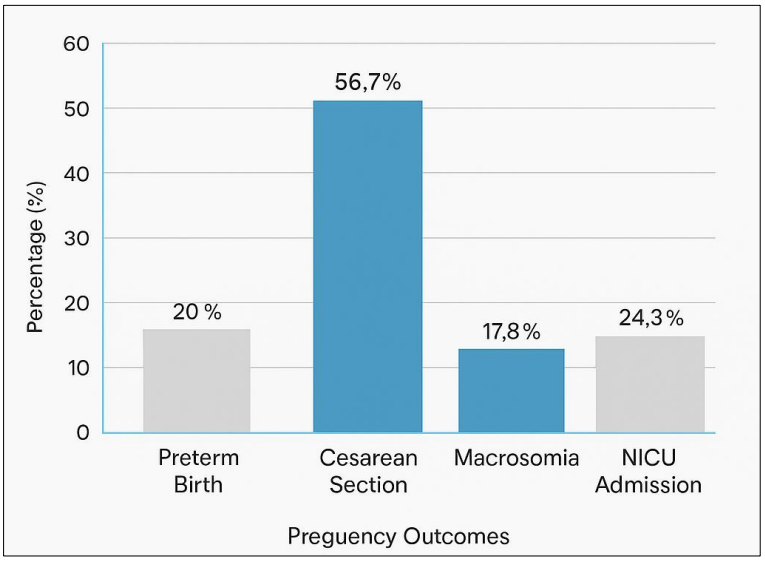

Figure 1: Pregnancy Outcomes Distribution

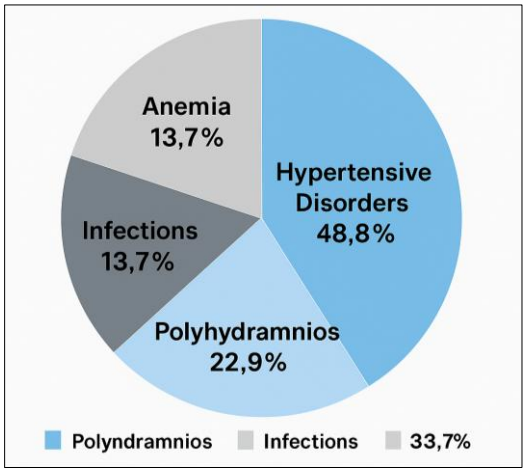

Figure 2: Mode of Delivery Distribution

DISCUSSION

The findings of this prospective hospital-based study reaffirm the substantial influence of Type 2 Diabetes Mellitus (T2DM) on maternal pregnancy outcomes. The demographic profile of the study cohort reflects the rising prevalence of T2DM among women of reproductive age, especially in regions experiencing rapid urbanization and lifestyle transitions, such as Andhra Pradesh. In this study, antenatal complications including gestational hypertension, preeclampsia,

polyhydramnios, urinary tract infections, and anemia were significantly more frequent compared to non-diabetic pregnancies, consistent with earlier studies conducted in similar settings [9–11]. The increased prevalence of hypertensive disorders can be attributed to underlying endothelial dysfunction and metabolic disturbances characteristic of T2DM. Poor glycemic control, observed in nearly half of the participants, further predisposed women to adverse maternal outcomes, highlighting the importance of early diagnosis and stringent glycemic monitoring. The elevated rates of infections and anemia also reflect the systemic impact of diabetes on immune response, iron metabolism, and tissue vascularization, underscoring the multifactorial burden imposed by T2DM during pregnancy.

Delivery outcomes in this cohort were similarly influenced by metabolic and obstetric complications associated with T2DM. The cesarean section rate in the present study (56.7%) was markedly higher than national averages for the general population, aligning with previous research linking diabetes to increased operative delivery rates [12–14]. Indications such as suspected macrosomia, fetal distress, and previous cesarean section reinforced the interplay between maternal metabolic status and intrapartum decision-making. Macrosomia, observed in 17.8% of the neonates, is a well-recognized consequence of maternal hyperglycemia, explained primarily by chronic fetal hyperinsulinemia and enhanced glucose transport across the placenta. This pathophysiological mechanism increases the risk of shoulder dystocia, obstructed labor, and birth trauma, driving clinicians toward elective or emergency cesarean delivery. Additionally, the incidence of preterm birth and intrapartum complications in the study reflects the cumulative effects of maternal comorbidities and suboptimal glycemic control. These observations underscore the need for individualized and proactive management plans including early risk stratification, improved metabolic control, and timely obstetric interventions to mitigate delivery complications in diabetic pregnancies.

Neonatal outcomes from this study further illustrate the profound impact of maternal T2DM on fetal health. High rates of NICU admissions, neonatal hypoglycemia, respiratory distress, and congenital anomalies mirror outcomes reported in previous literature, reinforcing the transgenerational consequences of maternal hyperglycemia [15–18]. Hypoglycemia, the most common neonatal complication in the study, is directly linked to fetal hyperinsulinemia secondary to maternal glucose levels, often exacerbated during the peripartum period. Congenital anomalies observed in the study particularly cardiac defects and neural tube abnormalities are associated with poor peri-conceptional glycemic control, emphasizing the critical role of pre-pregnancy counseling and glucose optimization. The study's findings also highlight the association between maternal glycemic control and Apgar scores, with poorly controlled T2DM contributing to impaired neonatal adaptation. Together, these results strengthen the evidence that early antenatal registration, stringent metabolic management, multidisciplinary clinical monitoring, and appropriately timed delivery are pivotal for improving neonatal outcomes in women with T2DM. They also reinforce the need for public health strategies aimed at diabetes screening, preconception education, and maternal nutrition improvement in semi-urban settings to reduce adverse pregnancy outcomes associated with T2DM.

Limitations of the Study

Although this prospective study provides valuable insights into the influence of Type 2 Diabetes Mellitus on pregnancy outcomes, several limitations must be acknowledged. First, the study was conducted at a single tertiary-care hospital, which may limit the generalizability of the findings to broader populations, especially rural or lower-tier healthcare settings. The absence of a non-diabetic comparison group restricted the ability to statistically contrast outcomes directly with normoglycemic pregnancies, which could have strengthened the interpretative value of the results. Additionally, glycemic control was assessed based on periodic HbA1c measurements and fasting/postprandial glucose values, which may not fully capture daily glycemic fluctuations affecting maternal–fetal physiology. Variability in patient adherence to dietary recommendations, medication regimens, and follow-up schedules may also have influenced outcomes but could not be fully quantified. Finally, neonatal follow-up was limited to the immediate postpartum period, preventing evaluation of longer-term neurodevelopmental or metabolic outcomes that may be associated with maternal diabetes. Future multicentric studies with extended follow-up are necessary to better understand the long-term implications of T2DM on maternal and child health.

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committee for their guidance and approval, ensuring that the study was conducted with the highest ethical standards.

CONCLUSION

This prospective hospital-based study highlights the profound influence of Type 2 Diabetes Mellitus (T2DM) on pregnancy outcomes within a semi-urban tertiary care setting in Andhra Pradesh. The findings demonstrate that T2DM significantly increases the risk of various maternal and fetal complications, including hypertensive disorders, polyhydramnios, infections, anemia, macrosomia, neonatal hypoglycemia, and the need for neonatal intensive care. The elevated cesarean section rate observed in the cohort further emphasizes the impact of T2DM on delivery planning and obstetric interventions. These outcomes underscore the intricate relationship between maternal metabolic health and fetal development, reflecting the need for early risk identification, structured antenatal surveillance, and optimized glycemic control throughout pregnancy. The high prevalence of adverse outcomes among women with suboptimal glycemic control highlights the crucial importance of timely diagnosis, continuous monitoring, and individualized management strategies tailored to the clinical profile of each pregnant woman.

The study also emphasizes the broader public health implications of T2DM among women of reproductive age. As lifestyle transitions continue to drive increased incidence of diabetes in India, especially among younger populations, the burden on maternal and neonatal health systems is likely to intensify. Therefore, a multipronged approach is essential, incorporating community-level screening, preconception counseling, nutritional education, and integrated maternal–fetal healthcare services. Collaborative care models involving endocrinologists, obstetricians, nutritionists, and neonatologists can significantly improve outcomes by addressing the multifactorial challenges associated with diabetic pregnancies. Strengthening institutional protocols for early diabetes screening, routine HbA1c monitoring, and patient education can play a pivotal role in minimizing preventable complications. Future research should focus on long-term follow-up of infants exposed to maternal diabetes to better understand developmental and metabolic consequences. Overall, this study reinforces the need for comprehensive healthcare strategies targeting both maternal metabolic disorders and their intergenerational impact, thereby improving pregnancy outcomes and promoting healthier future generations.

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