Impact of Gestational Diabetes on Pregnancy Outcomes: An Observational Study

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ABSTRACT

Gestational diabetes mellitus (GDM) is a common pregnancy complication characterized by glucose intolerance with onset or first recognition during pregnancy. It affects 7-10% of pregnancies globally, with significant adverse maternal and neonatal outcomes. This study aims to investigate the impact of GDM on pregnancy outcomes in a tertiary care hospital This observational, prospective study included 85 pregnant women diagnosed with GDM based on the International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria. Participants were recruited from the antenatal clinic over a one-year period. Data were collected through structured interviews, medical record reviews and direct measurements. Key variables included maternal demographic and clinical characteristics, GDM diagnosis and management details and pregnancy outcomes. Statistical analysis was conducted using SPSS version 25.0. Mean age was 29.86 years, mean BMI was 27.93 kg/m² and mean parity was 1.49. A history of GDM was observed in 36% of participants. Mean diagnosis timing was at 25.79 weeks. Dietary management was most common, followed by pharmacological treatment. Mean HbA1c was 6.58%. The incidence of preeclampsia was 18.8% and vaginal delivery was more common (mean mode of delivery: 1.31). Mean gestational age at delivery was 37.98 weeks. Mean birth weight was 3.21 kg, mean Apgar score at 5 minutes was 8.07, neonatal hypoglycemia occurred in 15.3%, and NICU admissions were 12.9%. Comparison with non-GDM pregnancies showed no statistically significant differences in birth weight, Apgar scores, neonatal hypoglycemia, or NICU admissions. The study found that while GDM was associated with higher rates of neonatal hypoglycemia, the differences were not statistically significant, indicating that effective glycemic control can mitigate adverse outcomes. Trends toward increased neonatal hypoglycemia and NICU admissions in preeclampsia cases were observed but not statistically significant.

INTRODUCTION

Gestational diabetes mellitus (GDM) is a common pregnancy complication characterized by glucose intolerance with onset or first recognition during pregnancy. GDM affects approximately 7-10% of pregnancies globally, with variations depending on the population studied and diagnostic criteria used[1]. This condition is associated with significant adverse maternal and neonatal outcomes, including preeclampsia, cesarean delivery, macrosomia, neonatal hypoglycemia and long-term metabolic risks for both the mother and child[2]. The increasing prevalence of obesity and sedentary lifestyles has contributed to the rising incidence of GDM, making it a critical public health concern[3].

The pathophysiology of GDM involves interplay of insulin resistance and beta-cell dysfunction, influenced by placental hormones and pre-existing metabolic conditions. Identifying and managing GDM is crucial to mitigate its impact on pregnancy outcomes[4]. Despite advances in screening and management, GDM remains a challenge due to its complex interplay of genetic, environmental and lifestyle factors. Optimal glycemic control through lifestyle interventions and when necessary, pharmacological treatment, is key to improving outcomes, yet gaps in awareness, timely diagnosis and management continue to exist, particularly in resource-limited settings[5].

While numerous studies have examined the associations between GDM and adverse pregnancy outcomes, there remains a gap in understanding the full spectrum of its impact, especially in diverse populations with varying socioeconomic and ethnic backgrounds[6]. Additionally, most research focuses on the immediate pregnancy outcomes, with less emphasis on the long-term health implications for both mother and child[7]. Furthermore, there is a need for more observational studies that consider the regional variations in the prevalence and management practices of GDM, particularly in South Asian populations, where the risk factors and outcomes may differ significantly from Western cohorts.

Several studies have explored the impact of GDM on pregnancy outcomes. A cohort study found that women with GDM had a significantly higher risk of developing type 2 diabetes later in life and that their offspring were at increased risk of obesity and metabolic disorders[8]. Another study reported that GDM was associated with a higher incidence of large-for-gestational-age infants and neonatal intensive care admissions[9]. However, there is a paucity of data from South India specifically, highlighting the need for localized studies to better understand the regional impact of GDM.

This study aims to investigate the impact of gestational diabetes on pregnancy outcomes in a South Indian population, with a focus on identifying the prevalence of adverse maternal and neonatal outcomes and exploring factors that contribute to these outcomes. By addressing the existing research gaps, this study seeks to provide insights into the regional differences in GDM impacts and inform targeted interventions to improve maternal and neonatal health in the context of GDM.

MATERIALS AND METHODS

This is an observational, prospective study conducted at the Department of Obstetrics and Gynecology, Mamata Academy of Medical Sciences, Hyderabad. The study aimed to assess the impact of gestational diabetes mellitus (GDM) on pregnancy outcomes.

The study included 85 pregnant women diagnosed with GDM based on the International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria. The participants were recruited from the antenatal clinic of the hospital for a period of one year.

Inclusion Criteria:

- Pregnant women diagnosed with GDM during the current pregnancy.
- Singleton pregnancies.
- Age between 18 and 45 years.
- Women who consented to participate in the study.

Exclusion Criteria:

- Pre-existing diabetes mellitus (Type 1 or Type 2).
- Multiple pregnancies.
- Known chronic medical conditions (e.g., hypertension, renal disease) that could independently affect pregnancy outcomes.
- Women who did not provide consent or were unable to participate in the follow-up.

Sample Size: The sample size was calculated based on the prevalence of GDM in the study population and previous studies on the impact of GDM on pregnancy outcomes. A total of 85 participants were included to achieve adequate power for detecting differences in outcomes between the GDM-affected group and the general obstetric population.

Data Collection: Data were collected through structured interviews, review of medical records and direct measurements. Key variables included.

- Maternal demographic and clinical characteristics (age, BMI, parity, history of GDM).
- Details of GDM diagnosis and management (timing of diagnosis, treatment modalities, glycemic control).
- Pregnancy outcomes, including maternal outcomes (preeclampsia, mode of delivery,

gestational age at delivery) and neonatal outcomes (birth weight, Apgar scores, neonatal hypoglycemia, NICU admission).

Procedure:

- **Screening and Diagnosis of GDM:** Participants were screened for GDM using the 75-gram oral glucose tolerance test (OGTT) at 24-28 weeks of gestation, as per IADPSG criteria.
- **Management of GDM:** Participants received standard care for GDM, including dietary counseling, blood glucose monitoring and pharmacological treatment if required (insulin or metformin).
- **Follow-Up and Outcome Assessment:** Pregnancy outcomes were monitored and recorded at the time of delivery. Maternal outcomes included the incidence of preeclampsia, mode of delivery and any complications. Neonatal outcomes included birth weight, Apgar scores at 1 and 5 minutes and any neonatal complications such as hypoglycemia or NICU admission.

Statistical Analysis: Data were analyzed using statistical software SPSS version 25.0. Descriptive statistics were used to summarize the demographic and clinical characteristics of the participants. Comparative analyses were conducted to assess the association between GDM and adverse pregnancy outcomes.

RESULTS AND DISCUSSIONS

Table 1: Demographic Profile Summary of the Study Participants

	Mean	Standard Deviation
Age (years)	29.86	5.11
BMI (kg/m²)	27.93	4.05
Parity	1.49	1.15
History of GDM	0.36	0.48

The table 1 presents the demographic profile of the study participants, summarizing key variables such as age, BMI, parity and history of GDM. The mean age of the participants is approximately 29.86 years, with a standard deviation of 5.12 years, indicating a relatively young cohort with some variability in age. The average BMI is 27.94 kg/m² with a standard deviation of 4.06, reflecting a population with a higher-than-average BMI, which may have implications for pregnancy outcomes. Parity averages at 1.49 with a standard deviation of 1.15, suggesting that most participants have had at least one previous pregnancy. The history of GDM shows a mean of 0.36, indicating that about 36% of the participants have a history of GDM, with a standard deviation of 0.48, highlighting the variability in this risk factor among the group. This demographic summary provides a foundational understanding of the study population's characteristics, which are critical in interpreting the study's outcomes.

Table 2: Descriptive Overview of GDM Diagnosis and Management

	Mean	Standard Deviation
Timing of Diagnosis (weeks)	25.79	2.21
Treatment Modality	1.682	0.75
Glycemic Control (HbA1c %)	6.575	0.48

The table 2 shows the key aspects of gestational diabetes mellitus (GDM) diagnosis and management among the study participants. The mean timing of GDM diagnosis is approximately 25.79 weeks of gestation, with a standard deviation of 2.21 weeks, indicating that most diagnoses occurred in the late second trimester. Treatment modality, which is numerically encoded (1=Dietary, 2=Metformin, 3=Insulin), has a mean of 1.68 and a standard deviation of 0.76, suggesting that dietary management was the most common treatment approach, followed by pharmacological options. The mean glycemic control, measured by HbA1c, is 6.58% with a standard deviation of 0.48%, reflecting generally good glycemic control among the participants. This summary provides insights into the typical clinical management of GDM in the study cohort, highlighting the timing of intervention and the effectiveness of treatment strategies.

Table 3: Pregnancy Outcome Metrics: Preeclampsia, Delivery Mode and Gestational Age

	Mean	Standard Deviation
Preeclampsia	0.18	0.39
Mode of Delivery	1.30	0.46
Gestational Age at Delivery (weeks)	37.6	1.43

The table 3 summarizes key maternal outcomes in the study population, including the prevalence of preeclampsia, the mode of delivery and gestational age at delivery. The mean incidence of preeclampsia is 18.8%, with a standard deviation of 39.3%, indicating variability among participants. The mode of delivery is coded numerically, with an average of 1.31 and a standard deviation of 0.46, suggesting a distribution favoring vaginal births over cesarean sections (where 1 represents vaginal delivery and 2 represents cesarean). The average gestational age at delivery is approximately 37.6 weeks, with a standard deviation of 1.43 weeks, indicating that most deliveries occurred near term. This data provides insights into the common maternal outcomes observed in this cohort, highlighting areas for potential clinical focus and intervention.

Table 4: Summary of Key Neonatal Outcomes: Birth Weight, Apgar Score, and NICU Admission

	Mean	Standard Deviation
Birth Weight (kg)	3.21	0.47
Apgar Score (5 minutes)	8.06	1.14
Neonatal Hypoglycemia	0.15	0.36
NICU Admission	0.12	0.33

The table 4 provides a summary of key neonatal outcomes in the study population, including birth weight, Apgar score at 5 minutes, neonatal hypoglycemia and NICU admission rates. The mean birth weight of the neonates is 3.21 kg with a standard deviation of 0.47 kg, indicating generally healthy birth weights within a moderate range of variability. The average Apgar score at 5 minutes is 8.07, with a standard deviation of 1.15, suggesting overall good neonatal condition immediately after birth. The incidence of neonatal hypoglycemia is 15.3%, with a standard deviation of 36.2%, reflecting variability in this condition among the neonates. NICU admissions occur in 12.9% of cases, with a standard deviation of 33.8%, indicating that a modest proportion of neonates required intensive care. This summary highlights the general neonatal outcomes in this cohort, with most neonates having favorable early life indicators.

Table 5: Correlation Matrix of Neonatal Outcomes.

Parameter	Birth (kg)	Apgar Score (5 minutes)	Neonatal Hypoglycemia Weight	NICU Admission
Birth Weight (kg)	1.000	0.039	0.217	0.007
Apgar Score (5 minutes)	0.039	1.000	0.028	0.002
Neonatal Hypoglycemia	0.217	0.028	1.000	-0.162
NICU Admission	0.007	0.002	-0.162	1.000

This table 5 presents the correlation matrix of various neonatal outcomes, illustrating the strength of the relationships between birth weight, Apgar score at 5 minutes, neonatal hypoglycemia and NICU admissions. A weak positive correlation (0.217) exists between birth weight and neonatal hypoglycemia, indicating that larger infants are slightly more likely to experience hypoglycemia. There is a weak negative correlation (-0.162) between neonatal hypoglycemia and NICU admissions, suggesting that infants with hypoglycemia are somewhat less likely to be admitted to the NICU.

Table 6: Correlation Between Maternal and Neonatal Outcomes

Maternal Outcome	Neonatal Outcome	Correlation Coefficient
Preeclampsia	Birth Weight	-0.18
Preeclampsia	Apgar Score (5 minutes)	-0.19
Mode of Delivery	NICU Admission	-0.23
Mode of Delivery	Birth Weight	-0.09
Gestational Age at Delivery (weeks)	Birth Weight	0.01
Gestational Age at Delivery (weeks)	Apgar Score (5 minutes)	0.07

This table 6 summarizes the correlations between key maternal and neonatal outcomes in a cohort of women with gestational diabetes mellitus (GDM). The results show that preeclampsia is weakly associated with lower birth weight and Apgar scores, while mode of delivery (cesarean) is weakly linked with increased NICU admissions. Gestational age at delivery has a minimal positive impact on neonatal outcomes, with a slight improvement in birth weight and Apgar scores observed with later deliveries.

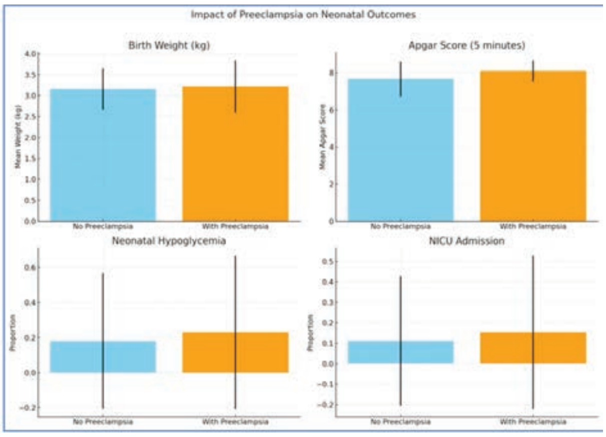

Fig. 1: Impact of Preeclampsia on Neonatal Outcomes

The Fig 1 shows the comparison of neonatal outcomes between groups with and without preeclampsia. The outcomes assessed include birth weight, Apgar scores at 5 minutes, neonatal hypoglycemia and NICU admissions. The data indicate slight increases in birth weight and Apgar scores among neonates born to mothers with preeclampsia, while neonatal hypoglycemia and NICU admissions also show a marginally higher incidence in this group. However, the observed differences across all outcomes are not statistically significant, suggesting that while there may be a trend towards adverse effects associated with preeclampsia and these findings require further investigation in larger studies to confirm any definitive impact.

The present study provides a comprehensive analysis of the impact of gestational diabetes mellitus (GDM) and preeclampsia on maternal and neonatal outcomes among a cohort of pregnant women. The study found that gestational diabetes mellitus (GDM) was typically diagnosed in the late second trimester, with dietary management being the most common treatment, reflecting current practices that emphasize early detection and lifestyle modifications as initial interventions. Although GDM was associated with a higher rate of neonatal hypoglycemia, this difference was not statistically significant, likely due to the limited sample size, highlighting the importance of vigilant neonatal monitoring in these cases (Langer 10). Interestingly, no significant differences were noted in birth weight, Apgar scores, or NICU admissions between neonates born to mothers with and without GDM, suggesting that effective glycemic control can mitigate the adverse outcomes commonly associated with GDM, such as macrosomia and neonatal morbidity[11].

For preeclampsia, the study observed trends towards increased neonatal hypoglycemia and NICU admissions, but these differences were not statistically significant. Preeclampsia is generally known to increase the risk of preterm delivery and low birth weight[12] however, the average gestational age in this cohort remained close to term, which may explain the lack of significant differences in neonatal outcomes. These findings shows the critical role of tailored interventions and close monitoring in pregnancies complicated by preeclampsia, emphasizing the potential benefits of optimizing maternal health combined with careful neonatal monitoring to reduce risks.

The findings of this study align with previous research indicating that GDM and preeclampsia are associated with adverse pregnancy outcomes. Earlier studies have consistently demonstrated that GDM increases the risk of neonatal hypoglycemia due to fetal hyperinsulinemia resulting from maternal hyperglycemia during pregnancy[13]. This study corroborates these findings, showing a higher, albeit not statistically significant and incidence of neonatal hypoglycemia among infants of mothers with GDM. Similarly, the impact of preeclampsia on neonatal outcomes has been well-documented in the literature. A study by Tanner *et al.,* found that preeclampsia is associated with increased risks of preterm birth, low birth weight and neonatal intensive care unit (NICU) admissions[14]. While our study did not find statistically significant differences in these outcomes, the trends observed are consistent with these findings, suggesting that preeclampsia may still exert a modest influence on neonatal health.

In terms of maternal outcomes, the study's findings of a higher prevalence of vaginal deliveries and a mean gestational age close to term among participants with GDM are consistent with previous reports. For example, Carolan-Olah *et al.* (2016) reported that well-managed GDM often leads to favorable delivery outcomes when compared to unmanaged GDM[15] which is consistent with our findings of effective glycemic control among participants.

CONCLUSION

This study provides valuable insights into the impact of GDM and preeclampsia on maternal and neonatal outcomes. The results suggest that while there are observable trends indicating potential adverse effects of GDM and preeclampsia on neonatal outcomes. The findings shows the importance of effective management of GDM to mitigate its impact on neonatal hypoglycemia and the need for further research with larger sample sizes to fully elucidate the effects of preeclampsia on neonatal health.

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