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Assessing neonatal complications in gestational diabetes affected pregnancies

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ABSTRACT

Background: Gestational diabetes mellitus (GDM) is a common metabolic disorder during pregnancy that significantly impacts both maternal and neonatal health. Neonates born to mothers with GDM are at increased risk for a range of complications, including macrosomia, hypoglycemia, respiratory distress, and NICU admission. This study was conducted to assess the prevalence of GDM and the spectrum of neonatal complications associated with it in a tertiary care setting.
Methods: A cross-sectional observational study was carried out at the Department of Obstetrics and Gynecology, Sree Mookambika Institute of Medical Sciences (SMIMS), Kulasekaram, Tamil Nadu, from January 2023 to December 2023. A total of 300 pregnant women were enrolled, of whom 60 were diagnosed with GDM using the IADPSG criteria. Neonatal outcomes were compared between the GDM group and 240 non-GDM controls. Data were analyzed using SPSS version 25.0, and p-values <0.05 were considered statistically significant.
Results: The prevalence of GDM was found to be 20%. Neonatal complications were significantly more common in the GDM group. Macrosomia was noted in 25% of neonates, hypoglycemia in 20%, respiratory distress in 16.7%, and NICU admissions in 30% of GDM pregnancies, all with statistically significant differences compared to the control group ($p<0.001$). Maternal risk factors such as obesity, family history of diabetes, and history of large-for-gestational-age babies were significantly associated with GDM.
Conclusion: GDM is associated with a high risk of adverse neonatal outcomes. Early diagnosis, maternal glycemic control, and appropriate neonatal monitoring are essential to reduce perinatal complications.

Keywords: Gestational diabetes mellitus, Neonatal complications, Macrosomia, Hypoglycemia, NICU admission, Pregnancy outcomes.

INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as glucose intolerance that is first identified during pregnancy. It is one of the most common medical complications of pregnancy and can have profound implications for both maternal and neonatal health. The pathophysiology of GDM involves hormonal changes that impair insulin action, resulting in increased blood glucose levels during gestation. If not detected and managed early, GDM increases the risk of obstetric complications such as preeclampsia, polyhydramnios, and operative delivery, and more importantly, can lead to serious neonatal consequences including macrosomia, neonatal hypoglycemia, respiratory distress syndrome (RDS), and admission to neonatal intensive care units (NICU)[1].

Globally, the prevalence of GDM is rising, with variations depending on ethnicity, diagnostic criteria, and population characteristics. In India, the prevalence ranges from 10% to 35%, with higher rates reported in urban and southern regions[2]. The increasing burden is attributed to sedentary lifestyles, advanced maternal age, obesity, and dietary transitions. Tamil Nadu has reported some of the highest GDM rates in the country, necessitating targeted regional studies to understand local trends and improve outcomes[3].

Numerous studies have demonstrated the adverse neonatal effects associated with GDM. A study by Masaraddi et al. (2018) found a GDM prevalence of 7.8% and reported significant associations with neonatal macrosomia and respiratory distress[4]. Other studies, such as those by Seshiah et al., emphasized the need for universal screening in Indian

populations due to high GDM rates and poor maternal-neonatal outcomes when undiagnosed[5]. International data further confirm the relationship between maternal hyperglycemia and complications like birth trauma, neonatal hypoglycemia, and hyperbilirubinemia[1]

Justification of the Study:
Despite growing awareness, there remains a gap in regional data specific to southern Tamil Nadu, especially in rural and semi-urban tertiary settings like SMIMS. Early identification and management of GDM are crucial to minimize preventable neonatal complications. Therefore, this study was undertaken to evaluate the prevalence of GDM and the associated neonatal complications in a cohort of pregnant women at Sree Mookambika Institute of Medical Sciences, Kulasekaram. The findings aim to guide local antenatal care protocols and reinforce the importance of routine GDM screening and follow-up.

AIM AND OBJECTIVES

To assess the neonatal complications associated with pregnancies complicated by gestational diabetes mellitus in a tertiary care center.

Objectives

1. To estimate the prevalence of gestational diabetes mellitus among antenatal mothers attending SMIMS.
2. To evaluate the spectrum and frequency of neonatal complications in GDM-affected pregnancies.
3. To identify maternal risk factors associated with adverse neonatal outcomes in GDM.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based, cross-sectional observational study carried out in the Department of Obstetrics and Gynecology at **Sree Mookambika Institute of Medical Sciences (SMIMS)**, Kulasekaram, Tamil Nadu. The study was conducted over a period of 12 months, from **January 2023 to December 2023**.

Study Population

The study included **pregnant women attending the antenatal outpatient and inpatient services** at SMIMS during the specified period. A total of **300 antenatal women** were enrolled in the study after applying inclusion and exclusion criteria. Among them, 60 women were diagnosed with GDM, and 240 women without GDM were selected as controls for comparative analysis of neonatal outcomes.

Inclusion Criteria

- Singleton pregnancies
- Pregnant women diagnosed with GDM between 24 and 28 weeks of gestation
- Women willing to give informed consent
- Gestational age ≥ 28 weeks at delivery

Exclusion Criteria

- Pregnant women with pre-existing type 1 or type 2 diabetes mellitus
- Multiple gestations
- Pregnancies complicated by chronic illnesses such as renal, hepatic, or thyroid disorders
- Preterm deliveries <28 weeks of gestation
- Incomplete antenatal records

Diagnosis of GDM

GDM was diagnosed based on the **International Association of the Diabetes and Pregnancy Study Groups (IADPSG) criteria**. All participants underwent a **75-gram oral glucose tolerance test (OGTT)** between 24–28 weeks of gestation. The diagnosis was confirmed if **any one** of the following values was met or exceeded:

- Fasting plasma glucose ≥ 92 mg/dL
- 1-hour plasma glucose ≥ 180 mg/dL
- 2-hour plasma glucose ≥ 153 mg/dL

Data Collection
After obtaining informed written consent, detailed maternal demographic information including age, body mass index (BMI), gravidity, parity, family history of diabetes, and previous obstetric history was recorded. GDM diagnosis details, antenatal complications, and treatment methods were also documented.
After delivery, neonatal parameters were assessed, including:

- Birth weight
- Apgar score at 1 and 5 minutes
- Need for resuscitation
- Blood glucose levels within 2 hours of birth
- Clinical signs of respiratory distress
- NICU admission status and duration

All neonates were monitored throughout their hospital stay by the pediatric team.

Outcome Measures
The primary outcomes studied were the incidence and types of **neonatal complications** associated with GDM. These included:

- Macrosomia (birth weight >4.0 kg)
- Neonatal hypoglycemia (blood glucose <40 mg/dL)
- Respiratory distress syndrome (clinical signs with or without need for oxygen support)
- Neonatal Intensive Care Unit (NICU) admissions

Statistical Analysis
Data were entered and analyzed using **Microsoft Excel** and **SPSS software version 25.0**. Categorical variables were presented as frequencies and percentages. Chi-square test was used to assess the association between GDM and neonatal outcomes. A **p-value of <0.05** was considered statistically significant.

Ethical Considerations
The study protocol was reviewed and approved by the **Institutional Ethics Committee of SMIMS** prior to commencement. Confidentiality of all participants was strictly maintained, and written informed consent was obtained from all study subjects.

RESULTS

Table 1: Prevalence of GDM in the Study Population (N=300)

Parameter	Number	Percentage (%)
GDM diagnosed	60	20.0
Non-GDM	240	80.0

Table 2: Maternal Risk Factors in GDM vs Non-GDM Groups

Risk Factor	GDM (n=60)	Non-GDM (n=240)	p-value
BMI > 25	38 (63.3%)	66 (27.5%)	<0.001**
Family History of Diabetes	34 (56.7%)	52 (21.7%)	<0.001**
Previous LGA Baby	12 (20.0%)	14 (5.8%)	0.001**

Table 3: Neonatal Complications in GDM vs Non-GDM Groups

Complication	GDM (n=60)	Non-GDM (n=240)	p-value
Macrosomia (>4kg)	15 (25.0%)	10 (4.2%)	<0.001**
Hypoglycemia	12 (20.0%)	5 (2.1%)	<0.001**
Respiratory Distress	10 (16.7%)	6 (2.5%)	<0.001**
NICU Admission	18 (30.0%)	28 (11.7%)	<0.001**

Table 4: Mode of Delivery in GDM vs Non-GDM Pregnancies

Mode of Delivery	GDM (n=60)	Non-GDM (n=240)	p-value
Vaginal Delivery	28 (46.7%)	168 (70.0%)	0.001**
Cesarean Section	32 (53.3%)	72 (30.0%)	

Table 5: Birth Weight Distribution in GDM vs Non-GDM Neonates

Birth Weight Category	GDM (n=60)	Non-GDM (n=240)
<2.5 kg (LBW)	6 (10.0%)	28 (11.7%)
2.5–4.0 kg (Normal)	39 (65.0%)	202 (84.2%)
>4.0 kg (Macrosomia)	15 (25.0%)	10 (4.2%)

DISCUSSION

The present study, conducted at SMIMS, Kulasekaram, highlights the significant neonatal complications associated with gestational diabetes mellitus (GDM), affirming findings from multiple previous studies. The prevalence of GDM in our study was 20%, which is higher than the 7.8% reported by Masaraddi et al.[4] (2018) in a similar hospital-based study in Tamil Nadu. This difference may be attributed to evolving diagnostic criteria, improved screening practices, or regional dietary and lifestyle factors influencing glucose metabolism during pregnancy.

A significant association was observed between maternal risk factors and GDM. In our study, obesity (BMI >25) was found in 63.3% of GDM cases, consistent with observations by Seshiah et al.[6] (2008), who reported that maternal obesity substantially increases the risk of developing GDM. Similarly, a positive family history of diabetes was seen in 56.7% of GDM mothers, paralleling findings by Ferrara [7](2007), who emphasized the genetic predisposition as a critical risk factor for GDM.

Regarding neonatal outcomes, **macrosomia** was found in 25% of neonates born to GDM mothers, compared to only 4.2% in the non-GDM group. This aligns with the findings of Coustan et al.[8] (2010), who demonstrated that maternal hyperglycemia leads to fetal hyperinsulinemia, promoting excessive fetal growth. The **rate of neonatal hypoglycemia** was 20% in the GDM group, a complication attributed to abrupt withdrawal of maternal glucose supply post-delivery, a well-documented mechanism supported by the Hyperglycemia and Adverse Pregnancy Outcomes (HAPO) study.

Respiratory distress syndrome (RDS) was significantly higher in neonates of GDM mothers (16.7%) compared to controls (2.5%). Similar observations were made by Erin et al.[9] (2005), who found delayed lung maturity among neonates of diabetic mothers, possibly due to high fetal insulin interfering with surfactant synthesis. Our findings also reflect those of Wahabi et al.[10] (2012), who emphasized the importance of antenatal corticosteroids in GDM cases at risk of preterm delivery or poor glycemic control.

The **NICU admission rate** in our study was 30% among GDM-affected neonates, much higher than in the non-GDM group (11.7%). This trend mirrors the findings of Dabelea et al.[11] (2000), who reported increased NICU admissions due to complications like hypoglycemia, macrosomia-related birth injuries, and respiratory difficulties. It also underlines the resource implications and burden on neonatal care facilities associated with poorly managed GDM.

In terms of **mode of delivery**, cesarean section was significantly more common in GDM mothers (53.3%) compared to non-GDM women (30%), consistent with studies by Yogev and Langer [12](2008), who associated GDM with higher operative delivery rates due to macrosomia, cephalopelvic disproportion, and fetal distress.

Lastly, our study showed a higher frequency of neonates with birth weight >4 kg among GDM pregnancies (25%) compared to 4.2% in controls, again confirming the relationship between maternal hyperglycemia and fetal overgrowth. This supports the concept of "fuel-mediated teratogenesis" proposed by Freinkel [13](1980), which links maternal glucose excess with adverse fetal metabolic programming.

In conclusion, our study corroborates the findings of earlier literature while contributing region-specific data on GDM-related neonatal complications. The strong associations between GDM and adverse neonatal outcomes observed in this study stress the need for **early screening, individualized management, and multidisciplinary antenatal care** to mitigate risks and improve neonatal health. Further research focusing on long-term outcomes of GDM-exposed infants could offer insights into prevention strategies for non-communicable diseases in later life.

CONCLUSION

This hospital-based study highlights a significant burden of gestational diabetes mellitus (GDM) among pregnant women, with a prevalence of 20%. The findings establish a clear association between GDM and increased risk of neonatal complications such as macrosomia, neonatal hypoglycemia, respiratory distress, and the need for NICU admission. Maternal risk factors including obesity, family history of diabetes, and previous large for gestational age babies were significantly linked to GDM. The study underscores the critical importance of early screening, timely diagnosis, and comprehensive antenatal care to manage GDM effectively. Implementing structured interventions and glycemic control during pregnancy can substantially reduce the incidence of adverse neonatal outcomes and improve overall perinatal health.

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