International Journal of Medicine

journal homepage: www.ijmjournal.org

Original Research Article

Special Issue: Obsietrics and Gynaecology

Study of Impact of Gestational Diabetes Mellitus on Maternal and Neonatal Health in Tertiary Care Center: A Clinical Evaluation

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HIGHLIGHTS

1.Analyzing gestational diabetes effe-ctson mothers.

2. Evaluating neonatal health out comes in infants.

3. Clinical study conducted in tertiary care.

4. Assessing long-term implications for families.

5.Improving care strategies for affe-cted patients.

ARTICLE INFO

Handling Editor: Dr. S. K. Singh

Key words:

Gestational diabetes mellitus (GDM)

Maternal complications

Neonatal outcomes

Postpartum glucose intolerance

ABSTRACT

Background: Gestational diabetes mellitus (GDM) is a prevalent metabolic disorder during pregnancy, characterized by glucose intolerance. GDM poses significant risks for both mother and child, including increased chances of caesarean section, pre-eclampsia, macr-osomia, and long-term development of type 2 diabetes mellitus (T2DM). Early diagnosis and management can reduce these comp-lications. **Aims and Objectives:** To study the impact of gestational diabetes mellitus on maternal and neonatal health. **Materials and Methods:** This prospective study was conducted at S.R.T.R, G.M.C Ambajogai hospital over 12 months. A total of 55 pregnant women diagnosed with GDM were included based on American Diabetes Association (ADA) criteria. All patients underwent detailed clinical and laboratory evaluations, including fasting blood sugar (FBS) and postprandial blood sugar (PLBS). Delivery outcomes, maternal complications, and neonatal outcomes were recorded. Postpartum glucose levels were monitored at six weeks to assess glucose intolerance. **Results:** The incidence of GDM in the studied population was 3.5%. Preeclampsia was observed in 28% of the patients, and 56% underwent caesarean sections. Macrosomia, defined as birth weight above 3.5 kg, was seen in 29% of neonates. Neonatal complications included respiratory distress (14%), hypoglycemia (10%), and hyper-bilirubinemia (12%). At six week follow up, 32.4% of mothers showed impaired glucose tolerance, indicating a high risk of progressing to T2DM. **Conclusion:** GDM is associated with significant maternal and neo-natal complications. Early detection and individualized management of GDM, along with rigorous postpartum monitoring, are crucial for improving outcomes and preventing future metabolic disorders. Public health strategies focusing on lifestyle modification and long term follow-up are essential in reducing the burden of GDM related complications.

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Received 16 September 2024; Received in Revised form 07 October 2024; Accepted 17 October 2024

INTRODUCTION

Gestational diabetes mellitus (GDM) is one of the most common metabolic disorders encountered during pregnancy and is characterized by glucose intolerance with onset or first recognition during pregnancy. The rising global prevalence of diabetes has mirrored an increase in the incidence of GDM, particularly in developing countries such as India, where rates are higher compared to other regions (Zhu and Zhang, 2016). This increase is largely driven by genetic predisposition, rapid urbanization, and lifestyle changes leading to higher rates of obesity and insulin resistance among women of childbearing age (American Diabetes Association, 2021).

GDM poses significant risks not only during pregnancy but also has long-term health implications for both the mother and the child. For mothers, GDM increases the risk of developing preeclampsia, preterm labor, and caesarean section (Farrar et al., 2017). Moreover, up to 50% of women with GDM are at risk of developing type 2 diabetes mellitus (T2DM) within five to ten years postpartum (Kim et al., 2010). For the child, GDM is associated with an increased risk of macrosomia, neonatal hypoglycemia, respiratory distress syndrome, and long-term risks of obesity and glucose intolerance (Billionnet et al., 2017).

Despite these known risks, there is still debate about the most effective methods for screening and diagnosing GDM. Universal screening is recommended in many countries; however, there is variability in the diagnostic criteria used across regions (McIntyre et al., 2019). In India, the prevalence of GDM has been reported to range between 3.8% and 21%, depending on the population and diagnostic criteria used (Zhu and Zhang, 2016). The International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria have been widely adopted, with evidence suggesting that early diagnosis and management can significantly reduce adverse maternal and fetal outcomes (American Diabetes Association, 2021).

Management of GDM typically involves lifestyle modifications, including dietary changes and increased physical activity, and, if necessary, pharmacological interventions such as insulin or oral hypoglycemic agents (Brown et al., 2017). Recent studies emphasize the importance of individualized care and continuous monitoring to achieve optimal glycemic control and reduce complications (Barbour and McCurdy, 2020; Reddy et al, 2024). Early intervention and treatment can have a lasting impact, reducing the risk of adverse outcomes during pregnancy and preventing the progression of diabetes in the future (Metzger et al., 2019).

This study aims to evaluate the maternal and fetal outcomes in patients with GDM and the effectiveness of different management strategies. The findings will contribute to the growing body of evidence on GDM in India and highlight the need for tailored approaches to screening, diagnosis, and treatment in high-risk populations.

MATERIAL AND METHODS

The present study was conducted at S.R.T.R G.M.C AMBAJOGAI over a period of 12 months, from January 2023 to December 2023. It included both outpatient and inpatient pregnant women attending the antenatal and medicine clinics or admitted to the obstetrics ward.

Patient Selection- All pregnant women registered at the antenatal clinic were screened for risk factors associated with gestational diabetes mellitus (GDM). High-risk factors included a history of previous abortions, prior intrauterine fetal deaths (IUFD), previous deliveries of large babies, polycystic ovarian syndrome (PCOS), a history of congenital anomalies, or a previous diagnosis of GDM. Patients with any of these risk factors were screened for GDM at the first visit and again between 24-28 weeks of gestation. Women were excluded from the study if they had pre existing diabetes mellitus diagnosed before pregnancy, regardless of whether they were undergoing treatment. After applying these criteria, a total of 55 patients were included in the study.

Screening for Gestational Diabetes- All antenatal patients underwent venous blood testing for fasting blood sugar (FBS) and two-hour post-lunch blood sugar (PLBS) between 24-28 weeks of gestation, following routine clinical practice. Patients whose FBS was above 92 mg/dL or whose PLBS exceeded 140 mg/dL were subjected to further testing. These abnormal values warranted an oral glucose tolerance test (OGTT) to confirm the diagnosis of GDM, following the American Diabetes Association (ADA) criteria. The cut-off values for OGTT were set as follows: FBS >92 mg/dL, one-hour glucose >180 mg/dL, and two-hour glucose >153 mg/dL. A diagnosis of GDM was confirmed if any one of these values was above the specified thresholds.

Clinical and Laboratory Investigations A detailed clinical history was recorded for all patients, and a comprehensive physical examination was conducted. Special attention was paid to documenting symptoms of diabetes and any associated complications. Laboratory investigations included a complete blood count (CBC), liver function tests (LFT), kidney function tests (KFT),

and serum electrolytes. Patients also underwent an 18-week congenital anomaly scan, followed by an ultrasound in the third trimester. Patients diagnosed with GDM were closely monitored with frequent antenatal visits and intensive blood sugar monitoring. Dietary advice and pharmacological intervention (insulin or oral hypoglycemics) were initiated based on individual glycemic control.

Management and Delivery Women diagnosed with GDM were admitted at 37 weeks of gestation for close monitoring and timely delivery. For patients with cephalopelvic disproportion, abnormal presentation, or prior caesarean section, an elective lower segment caesarean section (LSCS) was performed at 38 weeks. Women with normal fetal presentation and without complications were induced at 38 weeks using dinoprostone gel. Patients presenting in labor prior to 38 weeks were managed accordingly. The delivery outcomes, including birth weight mode of delivery, and neonatal complications were carefully recorded. Neonatal outcomes such as APGAR scores, admission to the neonatal intensive care unit (NICU), and the presence of congenital anomalies were noted by the attending pediatrician.

Postpartum Follow Up After delivery patients were followed up for six weeks to monitor their postpartum glycemic status. At six weeks, patients were tested again for fasting blood sugar (FBS) and postprandial blood sugar (PLBS) to assess any persistent glucose intolerance. The aim was to identify those at risk of developing type 2 diabetes mellitus (T2DM) after delivery.

The study data including maternal demographic information, obstetric history, delivery outcomes, and neonatal complications, were analyzed to evaluate the relationship between GDM and mate-rnal fetal health outcomes.

Statistical Analysis The data were analyzed using descriptive statistics. The incidence of maternal and fetal complications, as well as the different modes of delivery, were expressed as percentages. The relationship between maternal glucose control and neonatal outcomes was examined using chi-square tests. Statistical significance was set at a p-value of less than 0.05.

RESULTS

During the study period, 55 antenatal patients with gestational diabetes mellitus (GDM) were included. The incidence of GDM in the population was recorded at 3.5%. Of the 55 patients, 25 developed neonatal complications during or after delivery. The analysis focused on maternal demographic data,
significant past obstetric history, neonatal outcomes, and sugar levels post-delivery, along with antenatal complications and modes of delivery.

Table 1 outlines the demographic profile of the patients. The majority (54.5%) were aged between 26-30 years, and 31% were over 30 years. Only 14.5% of patients were aged 21-25. A considerable portion of the study group (72.7%) were multigravida, while 27.3% were primigravida. Most diagnoses of GDM (90.9%) occurred after 20 weeks of gestation, with only 9.1% diagnosed earlier. This suggests that GDM commonly manifests in the later stages of pregnancy, often requiring close monitoring as the pregnancy progresses.

Table 1: Demographic profile

Category	Number of Cases	Percentage
Age 21-25	8	14.5
Age 26-30	30	54.5
Age >30	17	31
Gravidity Primi	15	27.3
Gravidity Multi	40	72.7
Gestational age <20 weeks	5	9.1
Gestational age >20 weeks	50	90.9

This table presents the demographic distribution of the patients, including age groups, graviity (first-time or multiple pregnancies), and the gestational ageat diagnosis. of patients (54.5%) were between 26-30 years old, and 72.7% were multigravida. Most diagnoses were made after 20 weeks of gestation (90.9%).

Table 2 provides an overview of significant past obstetric history. Notably, 18.2% of the patients had previously delivered a macrosomic baby, and 9.1% had a history of intrauterine fetal death (IUFD). A further 7.3% of the patients had GDM in a previous pregnancy. This indicates that a significant number of patients had risk factors for developing GDM, including prior adverse pregnancy outcomes, which reinforces the need for vigilant prenatal screening. Additionally, 10.9% of the patients had a history of previous abortions, further complicating their obstetric history. A large portion (50.9%) had no significant past complications, suggesting that GDM can also occur in women without previous adverse pregnancy

Table 2: Significant Past History

Past History	No of Patients	Percentage
Anomalous baby	2	3.6
Macrosomia	5	9.09
GDM in prev. preg	9	16.3
H/o IUFD	5	9.1
H/o Prev. abortion/s	6	10.9
Normal	28	50.9

This table shows the past obstetric history of patients, highlighting conditions like GDM in previous pregnancy (16.3%) and a history of I ntrauterine fetal death (IUFD) (9.1%). Half of the patients (50.9%) had no significant past history.

Table 3 presents the birth weights of the neonates delivered by mothers with GDM. A notable 32.7% of the neonates weighed between 3.1-3.5 kg, while 29.1% were over 3.5 kg, indicative of a high incidence of macrosomia. This highlights one of the key risks associated with GDM larger than average babies, which can lead to complications during delivery, such as shoulder dystocia. Conversely, 10.9% of the neonates were under 2 kg, which may suggest growth restrictions or other complications related to maternal diabetes.

Table 3: Birth weight at delivery

Birth weight (Kg)	N	Percentage
< 2	6	10.9
2-2.5	5	9.1
2.5-3.1	10	18.2
3.1-3.5	18	32.7
> 3.5	16	29.1

This table details the birth weight distribution of newborns, with 32.7% of the babies weighing between 3.1-3.5 kg. A considerable number of babies (29.1%) weighed over 3.5 kg, indicating a high incidence of macrosomia.

Post-delivery follow-up at 6 weeks, as shown in Table 4, revealed that 67.6% of the patients had normal fasting blood sugar (FBS) levels, while 21.6% had impaired levels, and 10.8% had elevated levels, indicating persistent glucose intolerance. Postprandial blood sugar (PLBS) levels also reflected a similar trend, with 64.9% of patients showing normal levels, 24.3% impaired levels, and 10.8% elevated levels. These findings suggest that a significant proportion of women may develop postpartum glucose intolerance, increasing their risk of progressing to type 2 diabetes mellitus (T2DM) in the future. Early postpartum testing is crucial to detect ongoing glucose abnormalities.

Table 4: Sugar Levels on Follow up at 6 weeks

Category	Number of Cases	Percentage
FBS <100mg/dl	25	67.6
FBS 100-126mg/dl	8	21.6
FBS >126mg/dl	4	10.8
PLBS <140mg/dl	24	64.9
PLBS 140-200mg/dl	9	24.3
PLBS >200mg/dl	4	10.8

This table summarizes the fasting blood sugar (FBS) and post prandial blood sugar (PLBS) levels of patientson follow upat 6 weeks postpartum. A majority (67.6%) of patients had normal FBS levels while 21.6% show edimpaired levels.

Figure 1 depicts the antenatal complications observed among the study participants. Preeclampsia was the most common complication, affecting 28% of patients. This is consistent with other studies, which show that women with GDM are at increased risk of developing pre-eclampsia, a serious condition that can have severe maternal and fetal consequences.

Polyhydramnios, or excess amniotic fluid, was noted in 22% of patients, a common complication of GDM that can lead to preterm labor or other delivery complications. Furthermore, 25% of the women had a history of previous lower segment caesarean section (LSCS), which may have influenced their delivery choices in the current pregnancy.

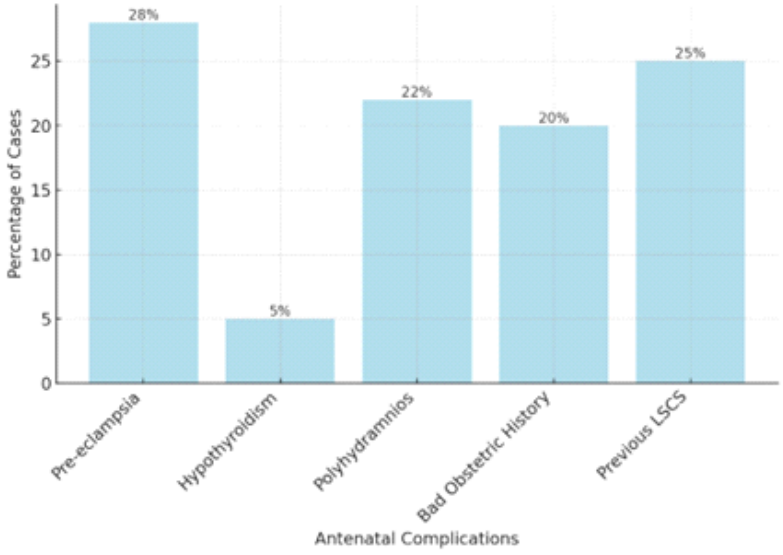

Figure1: Associated antenatal complications. This figure illustrates the antenatal complications observedamong patients with gestational diabetes, with pre-eclampsia (28%) being the most commoncomplication, followed by polyhydramnios (22%).

Figure 2 illustrates the modes of delivery for the patients. Elective lower segment caesarean section (LSCS) was the most common mode of delivery, accounting for 36% of cases. This is likely due to the high incidence of macrosomia and other complications like cephalopelvic disproportion. Spontaneous vaginal deliveries occurred in 28% of cases, while emergency LSCS was performed in 20% of patients, often due to fetal distress or complications that arose during labor. Induced vaginal deliveries accounted for 12% of the cases, while vacuum-assisted deliveries were relatively rare (4%).

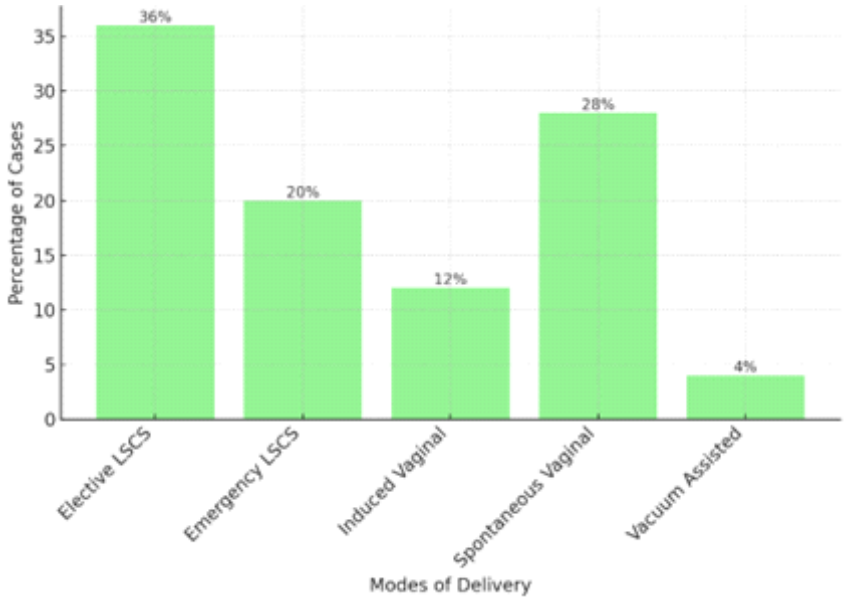

Figure 2: Mode of Delivery

Figure 2: Mode of delivery. This figure presents the distribution of delivery modes among the patients, with elective lower segment caesareansection (LSCS) being the most common (36%), followed by spontaneous vaginal delivery (28%).

Figure 3 summarizes the neonatal complications observed in the study. Respiratory distress syndrome, often due to prematurity or the effects of GDM on fetal lung development, was the most common complication, affecting 14% of neonates. Hyperbilirubinemia, a condition that can lead to jaundice, was observed in 12% of neonates, while hypoglycemia, a common issue in babies born to diabetic mothers, occurred in 10% of neonates. Neonatal sepsis was seen in 8% of cases, reflecting the increased susceptibility of these infants to infections. Other complications included meconium aspiration syndrome (6%), polycythemia (4%), and hypocalcemia (3%). These findings underscore the need for speci-alized neonatal care for babies born to mothers with GDM, as they are at higher risk for metabolic and respiratory complications.

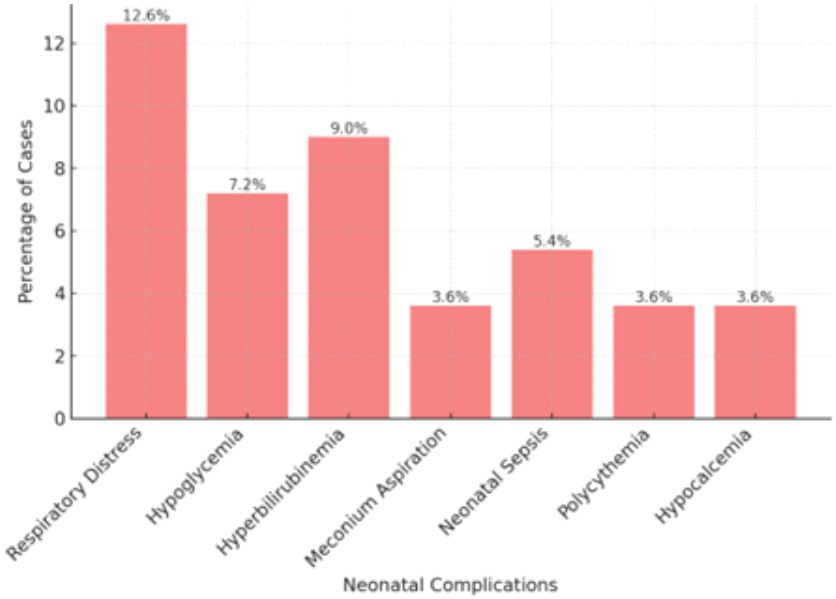

Figure 3 : Neonatal complications

Figure 3: Neonatal complications. This figure displays the neonatal complications associated with gestational diabetes. Respiratory distress (14%) and hyperbilirubinemia (12%) were the most frequently observed complications.

DISCUSSION

This study adds to the growing body of evidence that gestational diabetes mellitus (GDM) significantly increases the risk of adverse maternal and neonatal outcomes. The findings align with global trends, which show that GDM is associated with higher rates of caesarean deliveries, preeclampsia, macrosomia, and neonatal complications such as respiratory distress and hypoglycemia (Zhang et al., 2024; Oros et al., 2024; Mahat et al., 2020).

The caesarean delivery rate in this study was 56%, which is higher than some international figures but reflects trends seen in high risk populations, especially where fetal macrosomia is prevalent (Petry et al., 2018). Macrosomia, defined as birth weight above 3.5 kg, was present in nearly 29% of the cases, consistent with previous studies showing that women with GDM are at higher risk of delivering larger babies (Lowe et al., 2019). The risk of macrosomia and related delivery complications, such as shoulder dystocia, often necessitates caesarean delivery to ensure maternal and fetal safety (Mc Murrugh et al.,2024; Bowers et al., 2017). This high rate of macrosomia also increases the likelihood of neonatal complications, underlining the need for tailored delivery planning in GDM patients.

Pre eclampsia was observed in 28% of the patients, reaffirming the strong association between GDM and hypertensive disorders of pregnancy. The combination of insulin resistance, obesity, and metabolic inflammation contributes to the increased risk of preeclampsia in women with GDM (McLaughlin et al., 2020). Early diagnosis and intensive monitoring of blood pressure and glycemic control are essential to minimize the risk of pre eclampsia and its complications (Ngene et al., 2024; Roberts et al., 2018). In this study, pre eclampsia was a key driver for caesarean deliveries, with the majority of these occurring before 38 weeks to prevent further maternal and fetal risks.

Neonatal complications were prominent in this cohort, with respiratory distress syndrome (14%) and hypoglycemia (10%) being the most common. These findings are consistent with previous research highlighting the vulnerability of infants born to mothers with GDM, particularly due to the effects of maternal hyperglycemia on fetal lung maturity and insulin regulation (Billionnet et al., 2017). Neonatal hypoglycemia remains a significant concern in GDM pregnancies, as untreated hypoglycemia can lead to long-term neurodevelopmental issues (Durnwald, 2019). Prompt postnatal monitoring and early feeding strategies are crucial in managing these neonates.

A significant proportion of mothers (32.4%) had persistent glucose intolerance at six weeks postpartum, highlighting the importance of postpartum follow up. The risk of developing type 2 diabetes mellitus (T2DM) after GDM is well documented, with estimates suggesting that up to 50% of women with GDM will develop T2DM within 5-10 years (Gunderson et al., 2017). The American College of Obstetricians and Gynecologists (ACOG) recommends postpartum screening with a 75-gram oral glucose tolerance test to identify women at risk (ACOG, 2018). In this study, impaired fasting and postprandial blood sugars were seen in a significant number of patients at follow-up, underscoring the need for long-term monitoring and lifestyle interventions to prevent the progression to T²DM.

Current guidelines emphasize a personalized approach to managing GDM, focusing on lifestyle modifications, including diet and exercise, as the first line of treatment (Han et al., 2019). Pharmacological intervention, particularly insulin, is recom-mended for women who do not achieve glycemic targets through lifestyle changes alone. In this study, insulin therapy was used in cases of poor glycemic control, which aligns with recent literature supporting insulin as the gold standard for managing GDM when lifestyle interventions fail (Jovanovic & Pettitt, 2018). Maintaining tight glycemic control throughout pregn-ancy is crucial in reducing the risk of macrosomia and other complications.

Moreover, the long-term health of the offspring of GDM mothers is increasingly recognized as a critical public health issue. Children born to mothers with GDM are at higher risk for obesity, metabolic syndrome, and diabetes later in life (Vrachnis et al., ²0¹9). This study underscores the need for early intervention and monitoring not only during pregnancy but also in the postpartum period to reduce the long-term health risks for both mother and child. Public health strategies should prioritize early detection and comprehensive management of GDM to prevent intergenerational transmission of metabolic disorders.

CONCLUSION

Gestational diabetes mellitus (GDM) remains a significant contributor to adverse maternal and neon-atal outcomes as demonstrated by the high rates of preeclampsia, caesarean deliveries and neonatal complications such as respiratory distress and hypoglycemia. Early screening, individualized management of glucose levels and timely interventions

during pregnancy can help mitigate these risks. Furthermore, postpartum follow-up is essential for identifying and managing glucose intolerance, thereby reducing the long-term risk of developing type 2 diabetes mellitus in mothers. Given the increasing prevalence of GDM, particularly in high risk populations, public health strategies focusing on early detection, lifestyle modifications, and long-term care are crucial in improving both maternal and neonatal health outcomes. Addressing these issues is vital for preventing future metabolic disorders in both mothers and their offspring.

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How to cite: Dr.Ruchee kumari,Dr. Preshit Chate, Dr.GaneshTondge,Dr.Nandkishore More.Study of Impact of Gestational Diabetes Mellituson Maternal and Neonatal Health in Tertiary Care Center A Clinical Evaluation.*International Journal of Medicine* ,2024; 8 (2) :1-9