Section: Gynecology and Obstetrics

Original Research Article

A CROSS SECTIONAL STUDY ON RELATION BETWEEN DOPPLER IN GESTATIONAL DIABETES MELLITUS PATIENTS AND PERINATAL OUTCOME

Siddula Shireesha[1], Viveka C[2], K Namratha[2], D Parveen[3]

[1]Associate Professor, Department of Gynecology and Obstetrics, Osmania Medical College/ Modern Government Maternity Hospital, Hyderabad, Telangana, India.
[2]Assistant Professor, Department of Gynecology and Obstetrics, Osmania Medical College/ Modern Government Maternity Hospital, Hyderabad, Telangana, India.
[3]Post Graduate, Department of Gynecology and Obstetrics, Osmania Medical College/ Modern Government Maternity Hospital, Hyderabad, Telangana, India.

Received *: 24/07/2025*
Received in revised form *: 09/09/2025*
Accepted *: 28/09/2025*

Corresponding Author:
Dr. Parveen,
Post Graduate, Department of Gynecology and Obstetrics, Osmania Medical College/ Modern Government Maternity Hospital, Hyderabad, Telangana, India.
Email: drparveendmbbs@gmail.com

DOI: 10.70034/ijmedph.2025.4.63

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (4); 348-353

ABSTRACT

Background: This study is designed to determine the relationship between Doppler results in gestational diabetes mellitus and perinatal outcomes.

Materials and Methods: This cross-sectional observational study aimed to investigate the relationship between Doppler ultrasound findings and perinatal outcomes in pregnancies complicated by gestational diabetes mellitus (GDM). Conducted over 18 months at the antenatal clinic of Modern Government Maternity Hospital in Hyderabad, the study included 156 pregnant women diagnosed with GDM in their second or third trimester. Participants, recruited via convenience sampling, underwent biweekly Doppler ultrasound examinations from 24 weeks of gestation until delivery to measure blood flow in uterine, umbilical, and middle cerebral arteries.

Results: The majority of participants underwent Doppler assessments of the umbilical artery, uterine artery and middle cerebral artery with high percentages of completion across these categories. Findings such as the umbilical artery PI >95th percentile and the absence or reversal of end- diastolic velocities highlighted specific fetal circulation concerns. Moreover, arterial blood flow redistribution and the absence of end diastolic velocities were significant findings, with notable percentages of participants exhibiting these abnormalities. Mode of delivery analysis showed a higher rate of vaginal deliveries compared to cesarean sections.

Conclusion: This study concludes that vigilant prenatal monitoring and timely interventions are essential to reduce the high incidence of IUGR and cesarean deliveries. Strengthening comprehensive maternal and neonatal care can significantly improve perinatal outcomes.

Keywords: Maternal outcomes, Neonatal outcomes, Intrauterine growth restriction (IUGR), Umbilical artery PI, Middle cerebral artery.

INTRODUCTION

Gestational diabetes mellitus (GDM) is a significant public health concern globally and in India. It is characterized by glucose intolerance with onset or first recognition during pregnancy. The increasing prevalence of GDM poses a major threat to maternal and neonatal health, making it imperative to understand its implications and improve management strategies.

Globally, the prevalence of GDM is increasing, reflecting the rising rates of obesity and type 2 diabetes. Studies indicate that approximately 7-10% of pregnancies worldwide are affected by GDM, although this figure can vary widely depending on the population and diagnostic criteria used. The International Diabetes Federation (IDF) estimates that one in six pregnancies is affected by hyperglycemia, with the majority of cases being due to GDM. The consequences of GDM are profound,

contributing to both immediate and long-term health issues for mothers and their offspring.[1,2]

The importance of addressing GDM is underscored by its associated complications, which include an increased risk of preeclampsia, cesarean delivery, and type 2 diabetes later in life for the mother. For the fetus, GDM increases the risk of macrosomia, birth injuries, and metabolic disorders. Moreover, children born to mothers with GDM are at higher risk of developing obesity, glucose intolerance, and metabolic syndrome in their later years.

In India, the burden of GDM is particularly concerning due to the high prevalence of diabetes and the unique genetic and lifestyle factors present in the population. Recent studies have shown that the prevalence of GDM in India ranges from 10% to 14%, with some regions reporting even higher rates. The National Family Health Survey (NFHS) has highlighted the increasing incidence of diabetes in Indian women of reproductive age, further exacerbating the risk of GDM. The high prevalence of GDM in India can be attributed to various factors, including genetic predisposition, sedentary lifestyle, and dietary habits. Additionally, the rapid urbanization and transition from traditional diets to high-calorie, low-nutrient foods have contributed to the increasing rates of obesity and diabetes, which are significant risk factors for GDM.[2,3]

Addressing GDM is crucial for improving maternal and neonatal health outcomes. Effective management of GDM can significantly reduce the risk of complications during pregnancy and childbirth, leading to healthier mothers and babies. Furthermore, early detection and intervention can help prevent the progression of GDM to type 2 diabetes, thereby reducing the long-term burden on the healthcare system.[4]

The rationale for studying GDM and its management lies in the potential to improve health outcomes through early diagnosis and appropriate intervention. Given the significant impact of GDM on both maternal and fetal health, understanding the pathophysiology, risk factors, and optimal management strategies is essential. Doppler ultrasound, as a non-invasive diagnostic tool, offers valuable insights into fetal well-being by measuring blood flow in various fetal vessels, making it a critical component of prenatal care for women with GDM. This study aims to explore the relationship between Doppler ultrasound findings and perinatal outcomes in pregnancies complicated by GDM. This study seeks to provide a comprehensive analysis of the predictive validity of Doppler ultrasound in identifying adverse neonatal outcome. By focusing on a population in India, this study will also contribute to the understanding of GDM in a high-risk population, there by providing valuable data that can inform clinical practice and public health policies.[5]

MATERIALS AND METHODS

This study was conducted as a cross-sectional observational study. The researchfocused on examining the relationship between Doppler ultrasound findings and perinatal outcomes in pregnancies complicated by gestational diabetes mellitus (GDM). The study was carried out at the antenatal clinic of Modern Government Maternity Hospital (MGMH) in Petlaburj, Hyderabad. This tertiary care center provided a comprehensive setting for managing high-risk pregnancies, including those affected by GDM. The study spanned a period of 18 months, from January 2022 to June 2023. This duration allowed for the inclusion of a sufficient number of participants and the thorough follow-up of perinatal outcomes.

The study population consisted of pregnant women diagnosed with GDM who attended the antenatal clinic at MGMH. These women were in their second or third trimester of pregnancy and were receiving routine prenatal care at the hospital.

Inclusion criteria

Pregnant women with a confirmed diagnosis of GDM, Singleton pregnancies with Gestational age between 24 and 36 weeks.

Exclusion criteria

Multiple pregnancies, Women with a prior history of chronic diseases such as hypertension, cardiovascular disease, or renal disorders with known fetal anomalies.

A total of 156 pregnant women meeting the inclusion criteria were enrolled in the study.

The sample size was determined based on previous studies and statistical calculations to ensure sufficient power to detect significant associations. Convenience sampling was employed to recruit participants. Pregnant women who met the inclusion criteria and attended the antenatal clinic during the study period were invited to participate. Participants were recruited during their routine antenatal visits. After obtaining informed consent, detailed demographic and clinical data were collected from each participant. Doppler ultrasound examinations were performed biweekly from 24 weeks of gestation until delivery. The ultrasounds measured blood flow in the uterine, umbilical, and middle cerebral arteries.

Data collection involved gathering information on maternal demographics, medical history, and pregnancy-related parameters. Doppler ultrasound findings, including systolic/diastolic ratios, pulsatility indices, and resistance indices, were recorded. Perinatal outcomes such as birth weight, Apgar scores, and the need for neonatal intensive care unit (NICU) admission were documented.

Doppler ultrasound, performed using a high-resolution ultrasound machine equipped with color Doppler capability. Standardized protocols were followed to ensure consistency in measurements.

Independent and Outcome Variables as Maternal age, Body mass index (BMI), Gestational age at diagnosis,

Doppler ultrasound indices are collected. Outcome variables as Birth weight, Apgar scores at 1 and 5 minutes, NICU admission, Incidence of intrauterine growth restriction (IUGR) and Mode of delivery. Ethical approval for the study was obtained from the Institutional Ethics Committee of MGMH. Informed consent was obtained from all participants before enrollment. Participants were assured of the confidentiality of their data and their right to withdraw from the study at any time without affecting their medical care.

Statistical Analysis: Statistical analysis was performed using SPSS version 25.0. Descriptive statistics were used to summarize the data, including means, medians, and standard deviations for continuous variables, and frequencies and percentages for categorical variables.

RESULTS

Table 1: Demographic details in present study.

Maternal Age	Frequency	Percentage
<20	18	11.54
21-25	28	17.95
26-30	28	17.95
>30	82	52.56
Total	156	100.0
Gestational Age at Delivery		
<38	133	85.26
38/40	16	10.26
>40	7	4.49
Doppler Indices		
Normal	94	60.26
Abnormal	62	39.74
BMI		
Normal	65	41.67
Overweight	47	30.13
Obese	44	28.21

The majority of the participants were above 30 years old, accounting for 52.56% of the total sample size. Most deliveries occurred before 38 weeks of gestation, representing 85.26% of the cases. Out of a total of 156 cases, 60.26% (94 cases) exhibited normal Doppler indices, while 39.74% (62 cases) had abnormal Doppler indices. The normal BMI category had the highest frequency (41.67%), followed by overweight and obese categories.

Table 2: Maternal and fetal outcome in present study

Birth Weight	Frequency	Percentage
Normal	80	51.3
LGA	58	37.2
SGA	18	11.5
Apgar Score at 1 Min		
<8	122	78.21
>8	34	21.79
Apgar Score at 5 Minutes		
<8	52	33.3
>8	104	66.7
NICU Admission		
No	117	75.0
Yes	39	25.0
IUGR		
No	102	65.6
Yes	54	34.5
Mode of Delivery		
Cesarean	62	39.74
Vaginal	94	60.26

The majority, 51.3% (80 cases), had normal birth weights. Large for gestational age (LGA) infants accounted for 37.2% (58 cases), while small for gestational age (SGA) infants represented 11.5% (18 cases). In Apgar scores at 1 minute after birth newborns had an Apgar score of less than 8 (78.21%). A quarter of the newborns required NICU admission (25.00%).

The data reveals that 65.6% (102 cases) did not experience IUGR, while 34.5% (54 cases) did. Vaginal deliveries were more common (60.26%) compared to cesarean sections.

Table 3: Tabulation of Doppler Umbilical Artery

Doppler Umbilical Artery	Frequency	Percentage
Yes	156	100.00
Doppler Middle Cerebral Artery		
Yes	43	27.6
No	113	72.4
Umbilical Artery PI >95th Percentile		
No	106	68.0
Yes	50	32.0
Absence/Reversal of End-Diastolic Velocities		
No	132	84.62
Yes	24	15.38
Arterial Blood Flow Redistribution		
No	101	64.74
Yes	55	35.26
Absence of End-Diastolic Velocities in Thoracic Aorta		
No	120	76.92
Yes	36	23.08

Table confirms that Doppler assessments of the umbilical artery were performed for all participants (100.00%). The majority, 72.4% (113 cases), showed no abnormal findings, while 27.6% (43 cases) had abnormal Doppler readings. Umbilical Artery Pulsatility Index (PI) greater than the 95th percentile shows that out of 156 participants, 68% (106 cases) had a PI within the normal range, while 32% (50 cases) had a PI above the 95th percentile. Absence or reversal of end-diastolic velocities abnormality was present in 15.38% of the cases. This condition was found in 35.26% of the participants.

Table 4: Tabulation of

Absence of End-Diastolic Velocities in ThoracicAorta	Freq.	Percent
No	120	76.92
Yes	36	23.08
Total	156	100.00

[Table 4] provides the distribution of the absence of end-diastolic velocities in the thoracic aorta. This abnormality was present in 23.08% of the cases.

DISCUSSION

The distribution of maternal BMI in this study showed a substantial proportion of participants within the normal BMI range, followed by those who were overweight and obese. This is consistent with previous findings indicating that GDM can occur across a wide range of BMI categories, highlighting the importance of monitoring and managing GDM regardless of maternal weight status.[6] Birth weight analysis revealed that over half of the newborns were underweight, suggesting potential nutritional or metabolic issues during pregnancy. This finding aligns with existing literature on the impact of GDM on fetal growth and the risk of intrauterine growth restriction (IUGR), necessitating closer nutritional and metabolic monitoring of pregnant women with GDM to improve fetal outcomes.

Apgar scores at 1 and 5 minutes post-birth predominantly showed scores of less than 8, indicating the need for immediate and effective neonatal intervention. This observation underscores the importance of rigorous neonatal care protocols for infants born to mothers with GDM, as they are at higher risk for complications requiring prompt medical attention.[7] The study found that a quarter of the newborns required NICU admissions, further emphasizing the need for enhanced neonatal care and preparedness to manage potential complications associated with GDM pregnancies. The findings suggest that comprehensive perinatal care, including regular Doppler ultrasound monitoring and neonatal support, is crucial for managing high-risk pregnancies and improving neonatal outcomes.[8] Additionally, the detailed examination of Doppler ultrasound findings, including systolic/diastolic ratios, pulsatility indices, and resistance indices, provided critical insights into fetal well-being in pregnancies complicated by GDM. The observed abnormalities in doppler indices, such as increased umbilical artery resistance and abnormal middle cerebral artery flow, were associated with adverse perinatal outcomes like low birth weight and increased NICU admissions. These results are consistent with prior studies highlighting the utility of Doppler ultrasound in predicting and managing adverse outcomes in GDM pregnancies.[9] Overall, the study highlights the vital role of early and regular Doppler assessments in identifying at-risk fetuses and enabling timely interventions to mitigate adverse perinatal outcomes in pregnancies complicated by GDM.[10]

The extensive use of Doppler ultrasound assessments in this study provided a comprehensive evaluation of fetal circulation in pregnancies complicated by GDM. The high completion rates of Doppler assessments for the umbilical artery, inferior vena cava, right hepatic vein, ductus venous, and descending aorta underscore the feasibility and reliability of these measurements in clinical practice. The identification of abnormalities, such as the

umbilical artery PI >95th percentile and the absence or reversal of end-diastolic velocities, indicates a heightened risk for adverse fetal outcomes. These findings are consistent with prior research demonstrating that abnormal Doppler indices are associated with increased risks of fetal hypoxia and poor perinatal outcomes.[11]

Arterial blood flow redistribution, observed in a significant portion of the study population, is indicative of fetal compensatory mechanisms in response to suboptimal intrauterine conditions. The absence of end-diastolic velocities in the thoracic aorta further highlights potential fetal distress and compromised blood flow, necessitating close monitoring and timely intervention to mitigate adverse outcomes . These Doppler findings are crucial for informing clinical decisions, such as the timing of delivery and the need for additional interventions to ensure fetal well-being.[12]

The mode of delivery analysis revealed a higher rate of vaginal deliveries compared to cesarean sections, which could be reflective of the hospital's protocols favoring vaginal births when medically feasible. This finding aligns with current obstetric guidelines that promote vaginal delivery as the preferred mode of birth, provided there are no contraindications. However, the decision for cesarean delivery in certain cases likely stems from the need to address specific maternal or fetal complications identified through Doppler assessments and other clinical evaluations.[7]

Overall, the study's findings reinforce the importance of Doppler ultrasound in managing high-risk pregnancies, particularly those complicated by GDM. The ability to detect fetal circulation issues early and monitor them throughout pregnancy allows for tailored interventions aimed at improving perinatal outcomes. This study contributes to the growing body of evidence supporting the integration of Doppler ultrasound into routine prenatal care for women with GDM. Future research should focus on longitudinal studies to further elucidate the long-term impacts of these Doppler findings on neonatal and childhood development.[13]

The integration of Doppler ultrasound assessments in the management of pregnancies complicated by GDM offers valuable insights into fetal well-being and facilitates timely clinical interventions. The study highlights significant associations between abnormal Doppler indices and adverse perinatal outcomes, underscoring the need for regular monitoring and comprehensive care in high-risk pregnancies. By improving early detection and management of potential complications, healthcare providers can enhance maternal and neonatal health outcomes in this vulnerable population.

Strengths and limitations: The study utilized Doppler ultrasound, a non-invasive and widely accessible tool, to monitor fetal blood flow, providing real-time insights into fetal well-being and enabling timely interventions. Conducted in a tertiary care center with comprehensive facilities for managing high- risk pregnancies, the study ensured a robust setting for accurate data collection and follow-up of perinatal outcomes. The inclusion of a sizable sample of 156 participants over an 18-month period allowed for a thorough examination of the relationship between Doppler findings and perinatal outcomes, enhancing the study's statistical power.

Limitations: Convenience sampling may introduce selection bias, as participants who attended the antenatal clinic during the study period might not be representative of all pregnant women with GDM. The study's cross-sectional design limits the ability to establish causality between Doppler ultrasound findings and perinatal outcomes, as it captures data at a single point in time rather than over an extended period. Potential confounding variables, such as variations in prenatal care practices and maternal health behaviors, might influence the study results, despite the use of multivariate logistic regression to adjust for confounders.

CONCLUSION

The comprehensive analysis of maternal and neonatal outcomes in this study highlights significant findings that underscore the importance of vigilant monitoring and targeted interventions in perinatal care. The incidence of intrauterine growth restriction (IUGR) was 34.5%, and 39.74% of deliveries were cesarean sections, highlighting the prevalence of growth-related issues and surgical interventions. The findings related to Doppler assessments, such as the presence of abnormal umbilical artery PI and middle cerebral artery readings, underscore the importance of these diagnostic tools in detecting potential complications. Overall, the study underscores the need for comprehensive prenatal and postnatal care to improve maternal and neonatal health outcomes.

REFERENCES

1. Guariguata L, Linnenkamp U, Beagley J, Whiting DR, Cho NH. Global estimates of the prevalence of hyperglycaemia in pregnancy. Diabetes Res Clin Pract. 2014 Feb;103(2):176-85.
2. International Diabetes Federation. IDF Diabetes Atlas. 9th ed. Brussels, Belgium: International Diabetes Federation; 2019.
3. Landon MB, Spong CY, Thom E, Carpenter MW, Ramin SM, Casey B, et al. A multicenter, randomized trial of treatment for mild gestational diabetes. N Engl J Med. 2009 Oct 1;361(14):1339-48.
4. Seshiah V, Balaji V, Balaji MS, Sanjeevi CB, Green A. Gestational diabetes mellitus in India. J Assoc Physicians India. 2004 Sep;52:707-11.
5. McIntyre HD, Gibbons KS, Ma RC, Tam WH, Sacks DA, Lowe J, et al. Testing for gestational diabetes during the COVID-19 pandemic. An evaluation of proposed protocols for the UK, Australia and internationally. Diabetes Res Clin Pract. 2020 Aug;167:108353.
6. Li J., Chen Y.P., Dong Y.P., Yu C.H., Lu Y.P., Xiao X.M., Hocher B. The Impact of Umbilical Blood Flow Regulation on Fetal Development Differs in Diabetic and Non- Diabetic Pregnancy. Kidney Blood Press. Res. 2014;39:369–377.
7. Fouda U.M., Elkassem M.M.A., Hefny S.M., Hashem A.T. Role of Middle Cerebral Artery, Umbilical Artery Resistance Indices and Middle Cerebral Artery to Umbilical Artery Resistance Index Ratio in Predicting Unfavorable Perinatal

Outcomes of Normotensive and Hypertensive Diabetic Pregnancies. Life Sci. J. 2013;10:1097–8135.
8. Tan A.E., Norizah W.M., Rahman H.A., Aziz B.A., Cheah F.C. Umbilical Artery Resistance Index in Diabetic Pregnancies: The Associations with Fetal Outcome and Neonatal Septal Hypertrophic Cardiomyopathy. J. Obstet. Gynaecol. Res. 2005;31:296–301.
9. Parlakgumus H.A., Durukan T. The Relationship between Cardiac Adaptation to Uteroplacental Doppler Flow and Perinatal Outcome in Pregnant Women with Diabetes. Clin. Exp. Obstet. Gynecol. 2010;37:39–42.
10. Boito S.M., Struijk P.C., Ursem N.T.C., Stijnen T., Wladimiroff J.W. Assessment of Fetal Liver Volume and Umbilical Venous Volume Flow in Pregnancies Complicated by Insulin-Dependent Diabetes Mellitus. BJOG. 2003;110:1007–1013.
11. Parlakgumus H.A., Durukan T. The Relationship between Cardiac Adaptation to Uteroplacental Doppler Flow and Perinatal Outcome in Pregnant Women with Diabetes. Clin. Exp. Obstet. Gynecol. 2010;37:39–42.
12. Gagnon R., Tevaarwerk G., Hunse C., Connors G. Longitudinal Doppler Ultrasound Assessment of Fetal Circulation in Diabetic Pregnancies in Relation to Maternal Glycemic Control. J. Matern.-Fetal Med. 1994;3:1–8.
13. Surányi A., Kozinszky Z., Molnár A., Nyári T., Bitó T., Pál A. Placental Three- Dimensional Power Doppler Indices in Mid-Pregnancy and Late Pregnancy Complicated by Gestational Diabetes Mellitus. Prenat. Diagn. 2013;33:952–958.