



CLINICAL PROFILE, ASSOCIATED MATERNAL FACTORS, DOPPLER VELOCIMETRY PATTERNS AND PERINATAL OUTCOME IN PREGNANCIES WITH FETAL GROWTH RESTRICTION: AN AMBISPECTIVE ANALYTICAL STUDY

Obstetrics & Gynaecology

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ABSTRACT

Background: Fetal growth restriction (FGR) is associated with impaired fetal growth, placental insufficiency, abnormal fetal haemodynamics and adverse perinatal outcomes. This study evaluated the clinical profile, associated maternal factors, Doppler velocimetry patterns and perinatal outcomes in pregnancies complicated by FGR. **Methods:** A single-centre ambispective analytical observational study was conducted over 18 months in a tertiary-care obstetric unit. One hundred singleton pregnancies of ≥ 28 weeks with ultrasound-diagnosed FGR and obstetric Doppler evaluation were included. Maternal demographic and clinical factors, fetal biometry, amniotic fluid, Doppler parameters, mode of delivery and neonatal outcomes were recorded and analysed. **Results:** Most women were aged 25–29 years (41%); mean maternal age was 25 ± 4 years. Mean gestational age at FGR diagnosis and delivery was 34 ± 2 and 36 ± 2 weeks, respectively. Gestational hypertension (29%) and eclampsia/pre-eclampsia (26%) were the commonest maternal risk factors. Mean umbilical artery and middle cerebral artery Doppler indices were 1.5 ± 0.33 and 1.5 ± 1.05 , respectively. Caesarean delivery occurred in 54%. AFI was not significantly associated with mode of delivery ($p=0.67$), whereas CPR <1 was significantly associated with caesarean delivery ($p<0.0001$). Mean birth weight was 1663.5 ± 469.4 g. Early neonatal death occurred in 20% and stillbirth in 2%. **Conclusion:** Hypertensive disorders were the predominant maternal risk factors. Reduced CPR showed a significant association with caesarean delivery. FGR was associated with low birth weight and substantial neonatal morbidity and mortality, supporting close antenatal surveillance and comprehensive Doppler assessment.

KEYWORDS

fetal growth restriction; Doppler velocimetry; cerebroplacental ratio; fetal biometry; perinatal outcome.

INTRODUCTION

Fetal growth restriction (FGR) is an important cause of perinatal morbidity and mortality and is commonly related to placental insufficiency. Maternal hypertensive disorders, anaemia, nutritional factors and other comorbidities may contribute to impaired placental perfusion and fetal growth. Doppler velocimetry provides information about fetal and placental haemodynamics. Umbilical artery Doppler reflects placental vascular resistance, while middle cerebral artery Doppler may demonstrate cerebral vasodilatation associated with the brain-sparing response.

The cerebroplacental ratio (CPR), calculated as the middle cerebral artery pulsatility index divided by the umbilical artery pulsatility index, is an important parameter in fetal surveillance.

The present study evaluated the clinical profile, associated maternal factors, Doppler velocimetry patterns and perinatal outcomes in pregnancies with FGR and examined the relationship between Doppler findings and delivery/neonatal outcomes.

AIM AND OBJECTIVES

Aim: To evaluate the clinical profile, associated maternal factors, Doppler velocimetry patterns and perinatal outcomes in pregnancies with fetal growth restriction.

- To determine the association between maternal factors and FGR.
- To analyse Doppler velocimetry patterns in pregnancies with FGR.
- To assess maternal and perinatal outcomes in pregnancies diagnosed with FGR.
- To correlate Doppler findings with fetal and neonatal outcomes.

MATERIALS AND METHODS

Study design and setting: A single-centre ambispective analytical observational study was conducted in the Department of Obstetrics & Gynaecology of a medical college attached to a tertiary-care district hospital over 18 months.

Study population: One hundred pregnant women diagnosed with FGR by ultrasound and evaluated with obstetric Doppler were included. Retrospective cases were identified from medical records and prospective cases were enrolled after consent.

Inclusion criteria: Singleton pregnancy; gestational age ≥ 28 weeks; ultrasound-diagnosed FGR with obstetric Doppler evaluation; complete retrospective records; informed consent for prospective participants.

Exclusion criteria: Major fetal anomalies; multifetal gestation; chromosomal abnormalities; intrauterine infections including TORCH, malaria, syphilis, tuberculosis or HIV; uncertain gestational age without early dating ultrasound; unwillingness to participate.

Sample size: Using $n = Z^2 p(1-p)/d^2$, with $p=0.169$, $Z=1.96$ and $d=0.0735$, the calculated sample size was 99.87 and was rounded to 100 participants.

Outcome parameters: Maternal outcomes included mode of delivery, induction, ICU admission and maternal complications. Fetal/neonatal outcomes included gestational age at delivery, birth weight, APGAR scores, stillbirth, early neonatal death and neonatal complications.

Data collection and analysis: Data were collected using a case record form from clinical records, ultrasonography/Doppler reports, delivery registers and NICU records and analysed using Microsoft Excel. Descriptive and statistical analysis was performed.

RESULTS

Maternal Demographic Profile

Age Group

Category	n (%)
15–19	6 (6%)
20–24	37 (37%)
25–29	41 (41%)
30–34	12 (12%)
35–39	3 (3%)
40–45	1 (1%)
Total	100 (100%)

Education

Category	n (%)
Illiterate	34 (34%)
Primary	30 (30%)
Secondary	16 (16%)
Higher secondary	9 (9%)
Graduate	11 (11%)
Total	100 (100%)

Socio-economic Status

Category	n (%)
Upper	25 (25%)
Middle	37 (37%)
Lower	38 (38%)
Total	100 (100%)

BMI

Category	n (%)
Underweight	12 (12%)
Normal	60 (60%)
Pre-obese	13 (13%)
Obese	15 (15%)
Total	100 (100%)

Gestational Age And Fetal Assessment

Parameter	Mean	SD
Gestational age at FGR diagnosis (weeks)	34	2
Gestational age at delivery (weeks)	36	2
Umbilical artery Doppler index	1.5	0.33
Middle cerebral artery Doppler index	1.5	1.05
Biparietal diameter (mm)	75.6	8.86
Head circumference (mm)	286.7	29.3
Abdominal circumference (mm)	268.5	39.4
Femur length (mm)	55.6	10.1

Association of mode of delivery with AFI and CPR

Variable	Normal delivery n (%)	C-section n (%)	p value
AFI: Normal	30 (65.2)	29 (53.7)	
AFI: Oligohydramnios	15 (32.6)	23 (42.6)	0.67
AFI: Polyhydramnios	1 (2.2)	2 (3.7)	
CPR >1	38 (82.6)	23 (42.6)	
CPR <1	8 (17.4)	31 (57.4)	<0.0001

Maternal risk factors and maternal outcome

Risk factor	n (%)
Gestational hypertension	29 (29%)
Eclampsia / Pre-eclampsia	26 (26%)
Anaemia	17 (17%)
GDM	5 (5%)
Hypothyroidism	8 (8%)
None	15 (15%)
Maternal outcome	n (%)
ICU admission – Yes	23 (23%)
ICU admission – No	77 (77%)
NVD	46 (46%)
C-section	54 (54%)

Neonatal outcome

Parameter	Mean	SD
Birth weight (g)	1663.5	469.4
APGAR at 1 minute	6.13	0.81
APGAR at 5 minutes	8.19	0.71
Neonatal outcome	n (%)	
Discharged	78 (78%)	
Early neonatal death	20 (20%)	
Stillbirth	2 (2%)	
Neonatal complication	n (%)	
Meconium aspiration	16 (16%)	
Hypoglycaemia	14 (14%)	
Respiratory distress	10 (10%)	
Sepsis	8 (8%)	
No complication	52 (52%)	

DISCUSSION

The present study evaluated 100 pregnancies complicated by FGR. The findings are compared below with relevant published studies identified in the source material. The table presents study-specific comparisons without adding unsupported numerical results.

Parameter	Present study	Other study	Comparison
Maternal age	25–29 years: 41%; mean 25 ± 4 years	Husain et al. (2026): 26–30 years 42%; H.T.et al. (2018): 25-29 years 43.9%	Similar age distribution
Socio-economic status	Lower class 38%; middle 37%; upper 25%	H.T. et al. (2018): majority belonged to lower socioeconomic class	Broadly comparable
BMI	Normal 60%; underweight 12%; pre-obese 13%; obese 15%	Kamphof et al. (2025): maternal BMI significantly associated with composite adverse perinatal outcome (P=0.02)	Different outcome measures; direct numerical comparison not possible

FGR diagnosis	Mean 34 ± 2 weeks	H.T. et al. (2018): 34.29 weeks in abnormal Doppler group; 35.19 weeks in normal Doppler group; Husain et al. (2026): 49% diagnosed at 33–36 weeks	Diagnosis occurred predominantly in late preterm/early term period
ICU admission	23%	Barati et al. (2024): ICU admission 28% in severe preeclampsia; 69% had coexisting FGR	Comparable magnitude, but populations differ
Caesarean delivery	54%	Husain et al. (2026): 54%; Kamphof et al. (2025): vaginal delivery 69.3%	Caesarean rate similar to Husain et al.; populations/outcomes differ
Birth weight	1663.5 ± 469.4 g	Kamphof et al. (2025), H.T. et al. (2018), Vinodhini et al. (2024), Sarma et al. (2023): lower birth weight associated with growth/Doppler abnormalities	Findings support association of FGR with low birth weight
APGAR	6.13 ± 0.81 at 1 min; 8.19 ± 0.71 at 5 min	Şeker et al. (2025) and Hutcheon et al. (2021) reported relationships between growth restriction/Doppler findings and adverse fetal outcomes	Direction of findings is comparable
Neonatal outcome	Discharged 78%; early neonatal death 20%; stillbirth 2%	Roy et al. (2012), H.T. et al. (2018), Sarma et al. (2023), Husain et al. (2026): increased neonatal morbidity/NICU requirement with FGR or abnormal Doppler	Supports increased perinatal morbidity in FGR
CPR and delivery	CPR <1: 57.4% of C-sections vs 17.4% of NVD; p<0.0001	Singh et al. (2025) and Kumar et al. (2024) evaluated MCA/UA Doppler and CPR as predictors of perinatal outcome	Present study demonstrates significant association with mode of delivery

CONCLUSION

Hypertensive disorders were the predominant maternal risk factors among pregnancies complicated by FGR. Reduced CPR was significantly associated with caesarean delivery, whereas AFI was not significantly associated with mode of delivery. FGR was associated with low birth weight and substantial neonatal morbidity and mortality. Early diagnosis, serial antenatal surveillance and comprehensive Doppler evaluation may assist in timely obstetric decision-making.

REFERENCES

1. Gordijn SJ, Beune IM, Thilaganathan B, et al. Consensus definition of fetal growth restriction: a Delphi procedure. *Ultrasound Obstet Gynecol.* 2016;48(3):333–339.

2. Singh P, Prasad S, Tyagi N, et al. Comparison of Fetal Middle Cerebral Artery and Umbilical Artery Doppler Indices as Predictors of Perinatal Outcomes in Fetal Growth-Restricted Pregnancies. *Cureus.* 2025;17(7):e87102.

3. Kumar A, Singh A, Kumari S, et al. Role of Cerebroplacental Ratio in Predicting Perinatal Outcome. *Cureus.* 2024;16(2):e54816.

4. Husain M, Abdullah, Mansoor S, Rehman M. Maternal Risk Factors, Doppler Parameters and Perinatal Outcomes in Pregnancies Complicated by Intrauterine Growth Restriction: A Cross Sectional Study. *Int J Drug Deliv Technol.* 2026;16(32 Suppl):704–713.

5. T H, James S, T S. Maternal risk factors and perinatal outcomes in fetal growth restriction using obstetric Doppler in South Kerala, India. *Int J Reprod Contracept Obstet Gynecol.* 2018.

6. Kamphof HD, Marijnen MC, Damhuis SE, et al. Predictive value of fetal Doppler velocimetry, fetal growth trajectory and maternal serum biomarkers for short-term adverse perinatal outcome: secondary analysis of DRIGITAT study. *Ultrasound Obstet Gynecol.* 2025.

7. Roy A, Mukherjee S, Bhattacharyya S, et al. Perinatal outcome in pregnancies with intra-uterine growth restriction by using umbilical and middle cerebral artery colour Doppler. *J Indian Med Assoc.* 2012;110.

8. Sarma HK, Chaliha B, Sur R, Basu A. A study on Doppler ultrasound parameters in fetal growth restricted cases and its relation with perinatal outcome. *Int J Sci Res.* 2023.

9. Vinodhini K, Coumary AS. Doppler abnormalities and perinatal outcome in growth restricted fetuses in a tertiary care center: A retrospective study. *Indian J Obstet Gynecol Res.* 2024.

10. Barati M, Bajoli MC, Zamanpour Z, Kargarzadeh E. EP12.11: Concurrence of FGR and pre-eclampsia in mothers admitted to ICU. *Ultrasound Obstet Gynecol.* 2024;64(Suppl

- 1):300–301.
11. Hutcheon JA, Riddell CA, Himes KP. A new approach for classifying fetal growth restriction. *Epidemiology*. 2021;32(6):860–867.
 12. Şeker E, Çimen Y, Süt H, et al. Predicting fetal distress in growth-restricted fetuses: The role of umbilical vein diameter. *J Obstet Gynaecol Res*. 2025.