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Original Article

Correlation of third-trimester Doppler abnormalities and amniotic fluid volume with preterm birth in pregnant women of Southern Bihar.

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Abstract

Background
Preterm birth remains a major contributor to neonatal morbidity and mortality worldwide. Early detection of pregnancies at risk is critical, especially in resource-limited regions. Third-trimester ultrasonography—specifically Doppler velocimetry and amniotic fluid volume (AFV) assessment—offers a non-invasive way to identify compromised fetal environments that may precipitate preterm labor.
Aim: To evaluate the association between abnormal Doppler findings and abnormal amniotic fluid volume in the third trimester with preterm birth among pregnant women in Southern Bihar.

Methods
A prospective observational study was conducted over 11 months at Narayan Medical College and Hospital, Sasaram, Bihar, involving 115 pregnant women in their third trimester. Participants underwent detailed Doppler velocimetry and AFV assessment. Data on maternal characteristics, ultrasonographic findings, and pregnancy outcomes were recorded. Statistical analysis was performed using SPSS version 23.0, and associations were analyzed using chi-square tests, with $p < 0.05$ considered statistically significant.

Results
Among the 115 participants, 28.7% exhibited abnormal Doppler findings, and 21.7% had abnormal AFV (18.3% oligohydramnios, 3.5% polyhydramnios). Preterm birth occurred in 27% of the study population. Preterm delivery was significantly higher in women with abnormal Doppler (57.6%) compared with those with normal Doppler (14.6%) ($p < 0.001$). Similarly, preterm birth occurred in 57.1% of women with oligohydramnios and 60% with polyhydramnios compared with 15.7% with normal AFV ($p < 0.001$).

Conclusion
Abnormal third-trimester Doppler and AFV findings are strongly associated with preterm birth. Integrating these parameters into routine antenatal care could improve early risk stratification and allow timely interventions.

Recommendations
We recommend incorporating combined Doppler and AFV screening into third-trimester antenatal protocols, particularly for high-risk pregnancies. Enhanced surveillance, early referral, and delivery planning at equipped centers may reduce preterm birth complications and improve neonatal outcomes. Further multicenter studies with larger cohorts are advised to validate these findings.

Keywords: *Preterm birth; Doppler velocimetry; Amniotic fluid volume; Oligohydramnios; Third-trimester ultrasound.*
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Introduction

Preterm birth, defined as delivery before 37 completed weeks of gestation, continues to be a critical global health challenge, accounting for significant neonatal morbidity and mortality [1]. In low- and middle-income regions like Bihar, India, limitations in antenatal surveillance amplify risks tied to hidden yet preventable contributors such as fetal compromise [2]. Third-trimester ultrasonographic tools—especially Doppler velocimetry and amniotic fluid

volume assessment—are increasingly essential for identifying high-risk pregnancies and guiding timely clinical interventions.

Doppler ultrasonography assesses blood flow characteristics in key fetal and placental vessels. Abnormal uterine artery Doppler findings—such as elevated pulsatility index or the presence of notching—have been linked to higher rates of preterm birth and associated perinatal complications [3]. In a large cohort study, rates of preterm delivery before term markedly increased among women exhibiting unilateral or bilateral uterine artery notches compared to those without [3]. A recent review also underscored that third-trimester Doppler abnormalities remain moderately predictive of adverse outcomes including preterm birth, fetal growth restriction, and neonatal intensive care admissions; however, combining Doppler with maternal characteristics or biochemical markers may further enhance predictive accuracy [4].

Amniotic fluid volume, measured via (AFI) or deepest vertical pocket (DVP), is another critical fetal well-being parameter. Abnormal fluid states—oligohydramnios and polyhydramnios—are associated with elevated risks of preterm labor, low birth weight, and perinatal complications [5]. A multicountry study in low-resource settings reported that oligohydramnios was associated with increased odds of preterm birth, low birth weight, stillbirth, and neonatal mortality [6].

Emerging evidence suggests that the combined presence of Doppler abnormalities and altered amniotic fluid volumes may have an additive impact on the risk of preterm birth. For example, studies in India, such as data from the Samrakshan program, have aimed to integrate fetal Doppler and AFV assessments to stratify risk, though their discriminatory power for preterm birth remains modest [7]. Despite this, it is widely acknowledged that integrated ultrasonographic screening strategies—blending hemodynamic and fluid assessments—enhance early detection of fetal compromise, particularly in resource-limited settings.

Against this backdrop, the present study aims to investigate the associations between third-trimester Doppler abnormalities and amniotic fluid volume deviations with preterm birth among pregnant women in Southern Bihar. Insights from this research could inform surveillance protocols and timely referral strategies, potentially reducing the burden of preterm-related morbidity in similar contexts.

Methodology

Study design

This was a prospective observational study.

Study setting

The study was carried out in the Department of Obstetrics and Gynecology at Narayan Medical College and Hospital, Sasaram, Bihar. All ultrasound and Doppler examinations were performed in the hospital's radiology department by trained professionals following standard protocols.

Study duration

The study was conducted over a period of 11 months, ensuring sufficient time for recruitment, follow-up, and analysis of outcomes.

Participants

A total of 115 pregnant women in their third trimester were enrolled in the study. All participants were evaluated for fetal Doppler parameters and amniotic fluid volume, and subsequently followed until delivery to record the occurrence of preterm birth.

Inclusion criteria

Pregnant women in their third trimester (≥28 weeks of gestation), who underwent Doppler studies and amniotic fluid assessment and provided informed consent to participate, were included in the study.

Exclusion criteria

Women with multiple gestations, known congenital fetal anomalies, pregnancies complicated by maternal systemic illnesses such as chronic hypertension, pregestational diabetes, renal disease, or connective tissue disorders, and those with incomplete medical records or unwillingness to participate were excluded.

Bias

To minimize selection bias, consecutive sampling was used, where all eligible women during the study period were invited to participate. Doppler and amniotic fluid assessments were performed by a single radiologist to reduce inter-observer variability. Data analysis was done by investigators blinded to individual patient identifiers to avoid observer bias.

Data collection

Demographic data, obstetric history, clinical findings, Doppler study results (including umbilical artery, middle cerebral artery, and ductus venosus flow patterns), and (AFI) or maximum vertical pocket (MVP) measurements were recorded using a predesigned proforma. Follow-up data regarding gestational age at delivery and neonatal outcomes were also collected.

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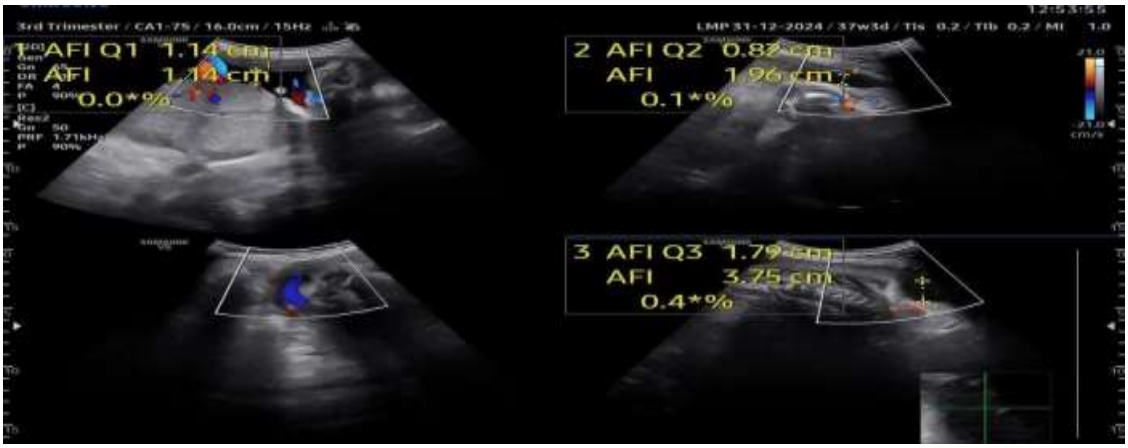

Fig 1: Four-quadrant AFI measurements is 3.5, which is <5, indicative of oligohydramnios

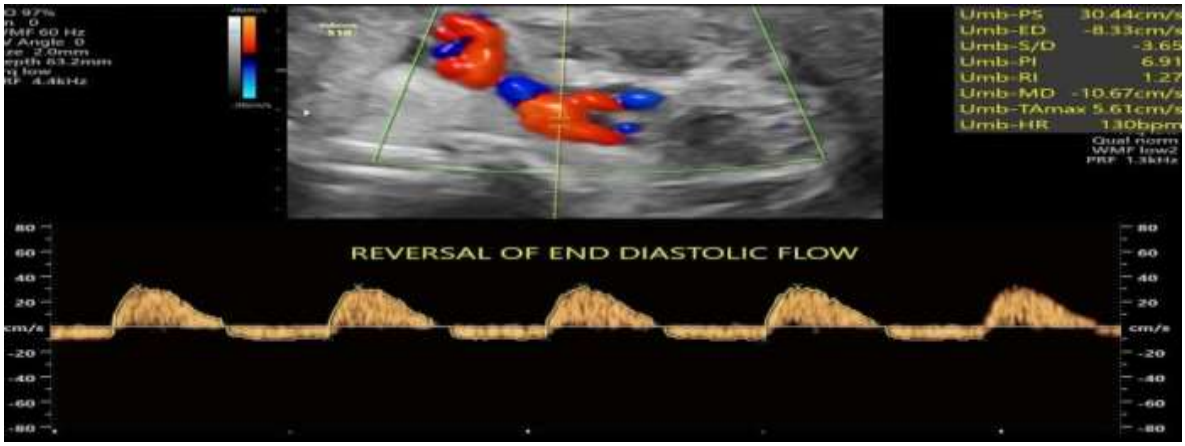

Fig 2: Umbilical artery Doppler shows reversal of end diastolic volume

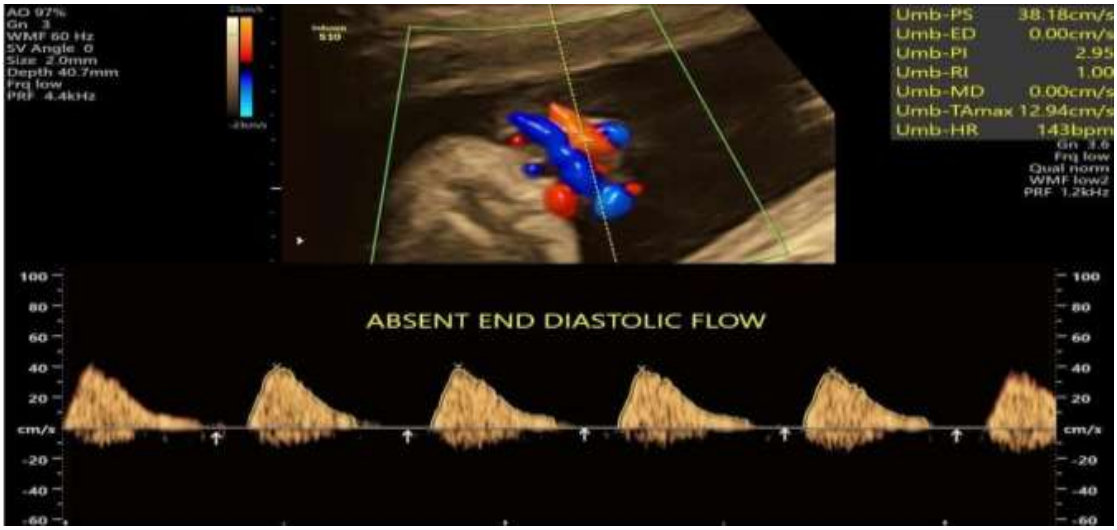

Fig.3: Umbilical artery Doppler shows absent end diastolic volume in another patient in the 3rd trimester

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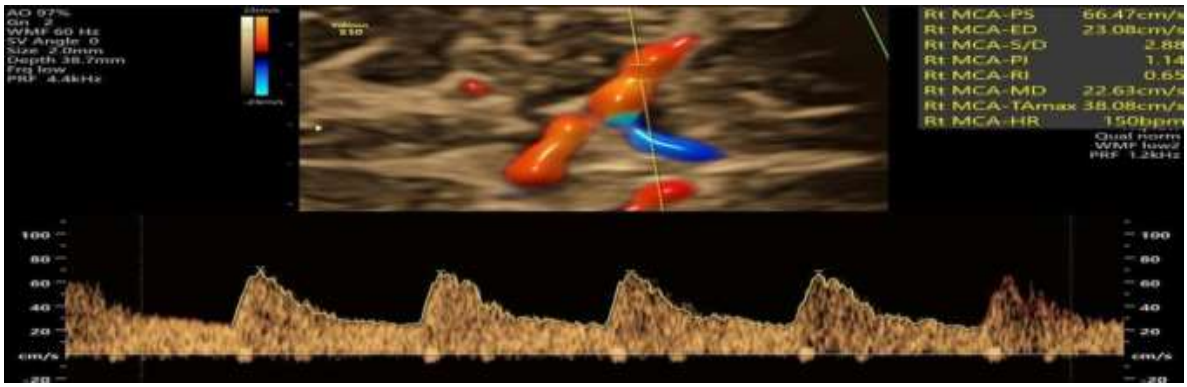

Fig. 4: MCA Doppler shows normal findings as per the gestation age

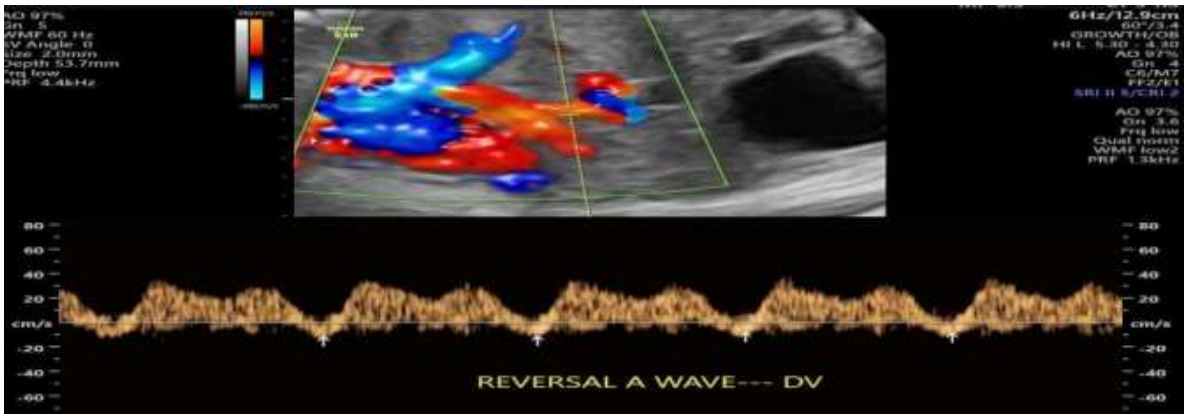

Fig. 5: Reversal of a wave in the ductus venosus Doppler

Procedure

Each participant underwent a detailed obstetric ultrasound with Doppler velocimetry during the third trimester. Amniotic fluid volume was assessed and categorized as normal or abnormal based on standard cut-off values (oligohydramnios: AFI < 5 cm; polyhydramnios: AFI > 24 cm). Doppler parameters were interpreted according to established reference values to classify findings as normal or abnormal. Patients were then followed until delivery, and gestational age at birth was documented to assess preterm birth incidence.

Statistical analysis

All collected data were compiled and analyzed using SPSS. version 23.0. Descriptive statistics were used to summarize demographic and clinical data. Correlations between abnormal Doppler findings, abnormal amniotic fluid volume, and preterm birth were analyzed using appropriate statistical tests (Chi-square test, Fisher's exact test, or logistic regression, as applicable). A p-value < 0.05 was considered statistically significant.

Results

A total of 115 pregnant women in their third trimester were enrolled. The mean age of participants was 27.8 ± 4.2 years. Of these, 48 (41.7%) were primigravida and 67 (58.3%) were multigravida. The mean gestational age at the time of enrollment was 31.4 ± 2.1 weeks.

Table 1. Demographic characteristics of study participants

Variable	Mean ± SD / n (%)
Age (years)	27.8 ± 4.2
Gravida (Primigravida/Multigravida)	48 (41.7%) / 67 (58.3%)
Gestational age at enrollment (weeks)	31.4 ± 2.1

Table 1 shows the baseline characteristics of the study population. The majority were multigravida women, reflecting a typical patient distribution in a tertiary care setting. The mean age and gestational age indicate that participants were predominantly in the early to mid-third trimester at enrollment, ensuring uniformity in Doppler and amniotic fluid assessments.

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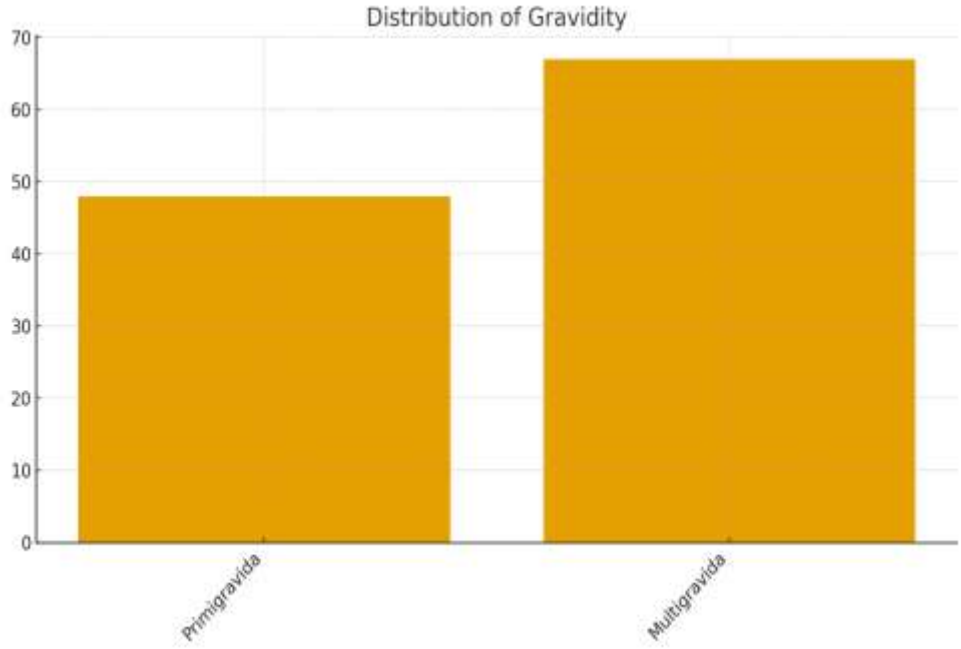

Distribution of Doppler and amniotic fluid findings

Among the study population, 82 women (71.3%) had normal Doppler findings, while 33 (28.7%) demonstrated abnormal Doppler velocimetry. Regarding amniotic fluid volume, 89 (77.4%) had normal AFI, 21 (18.3%) were diagnosed with oligohydramnios, and 5 (4.3%) with polyhydramnios.

Table 2. Doppler findings

Doppler Finding	Number (n=115)	Percentage (%)
Normal	82	71.3
Abnormal	33	28.7

Table 2 highlights the proportion of normal versus abnormal Doppler findings in the cohort. Approximately one-third of the study population showed abnormal Doppler velocimetry, suggesting a significant subgroup at potential risk for adverse perinatal outcomes.

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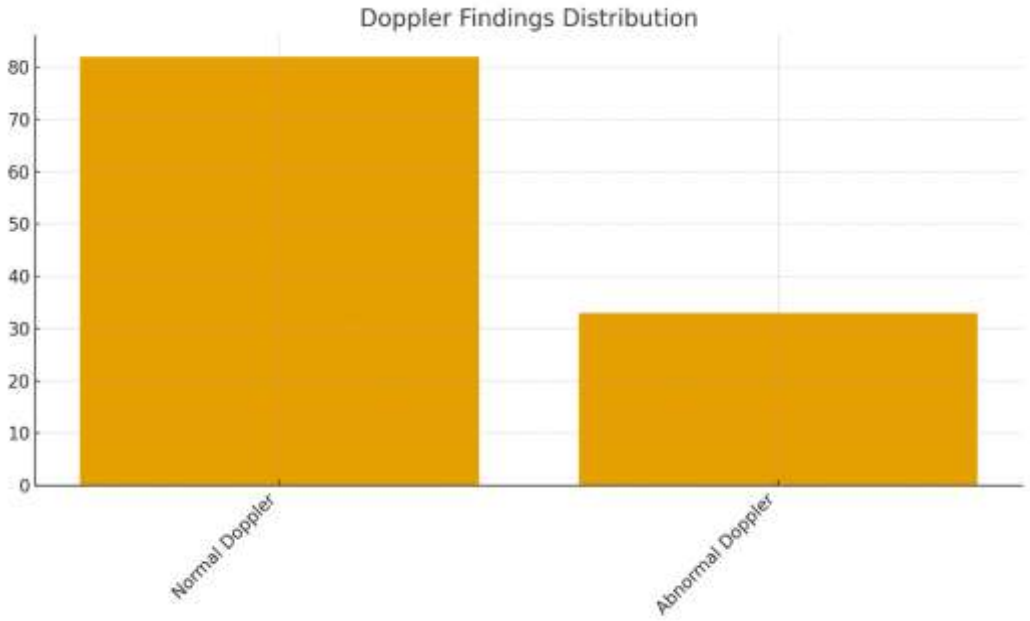
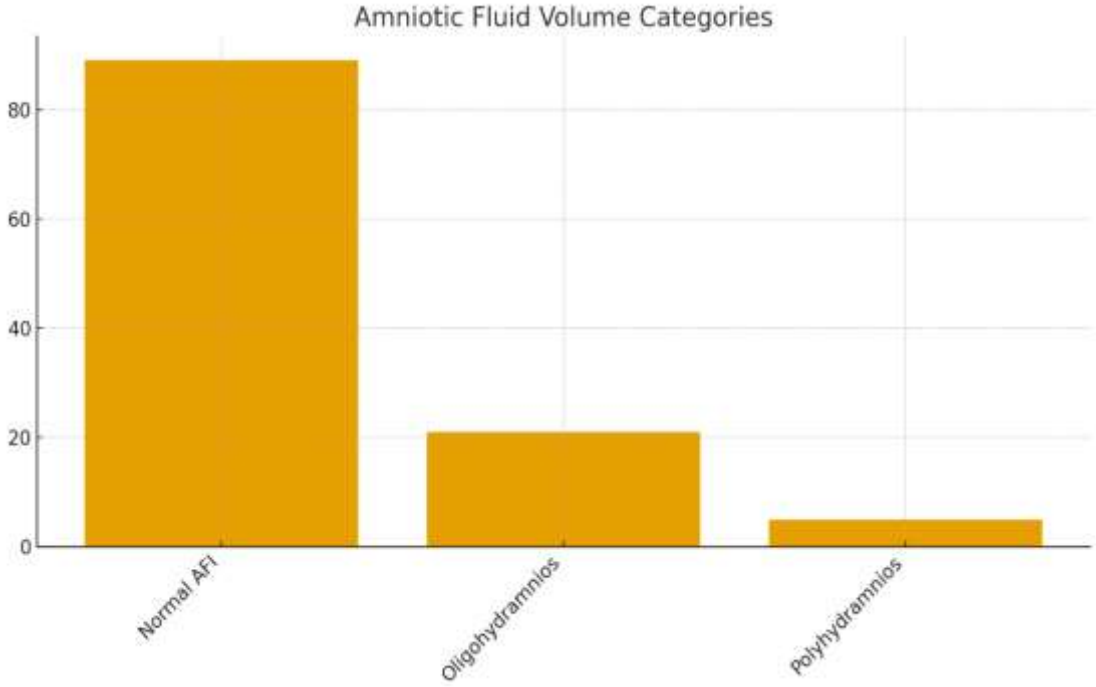


Table 3. Amniotic fluid volume categories

AFI Category	Number (n=115)	Percentage (%)
Normal	89	77.4
Oligohydramnios	21	18.3
Polyhydramnios	5	4.3

Table 3 describes the distribution of amniotic fluid categories. Most participants had normal AFI, while about one-fifth had oligohydramnios and a smaller proportion had polyhydramnios. These abnormalities are clinically important as they may signify placental insufficiency or fetal compromise.



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Correlation with preterm birth

Preterm birth (<37 weeks) occurred in 31 women (26.9%). Abnormal Doppler findings were significantly correlated with preterm birth: 19 of 33 (57.6%) with abnormal Doppler delivered preterm compared to 12 of 82 (14.6%) with normal Doppler ($p < 0.001$).

Similarly, abnormal amniotic fluid volume was also linked to preterm delivery. Among women with oligohydramnios, 12 of 21 (57.1%) delivered preterm, while 3 of 5 (60.0%) with polyhydramnios delivered preterm, compared to 14 of 89 (15.7%) in the normal AFI group ($p < 0.001$).

Table 4. Preterm Birth by doppler findings

Doppler Finding	Preterm Birth	Term Birth	p-value
Normal (n=82)	12 (14.6%)	70 (85.4%)	<0.001
Abnormal (n=33)	19 (57.6%)	14 (42.4%)	<0.001

Table 4 demonstrates a strong relationship between abnormal Doppler velocimetry and preterm birth. More than half of the women with abnormal Doppler delivered preterm, in contrast to only about 15% of those with normal Doppler. The statistically significant p-value confirms this Correlation.

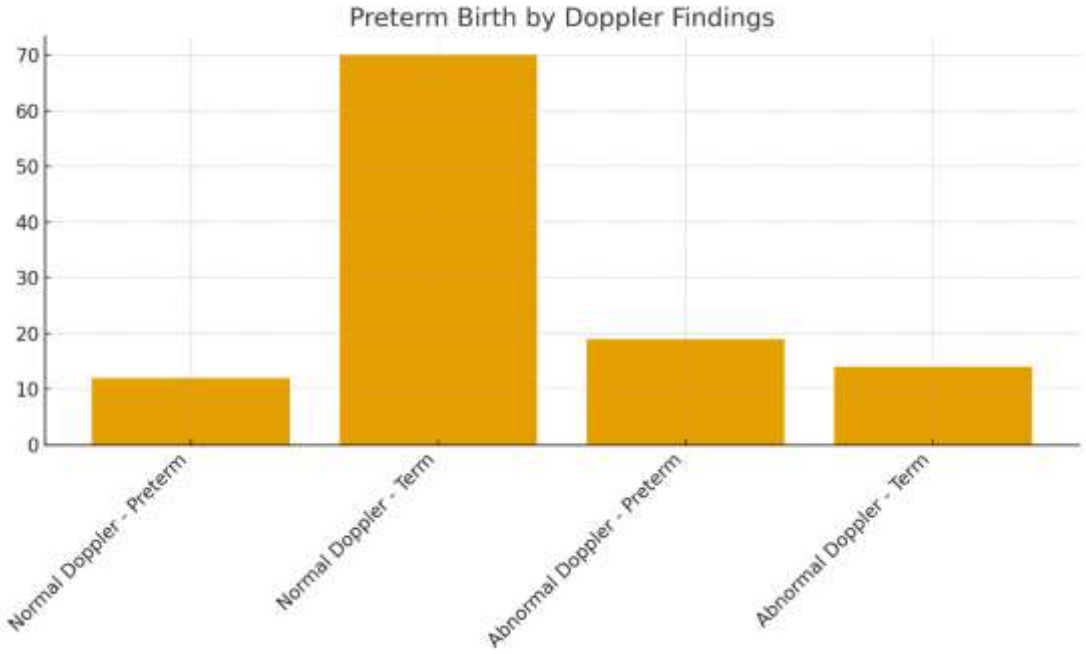

Table 5. Preterm birth by amniotic fluid volume

AFI Category	Preterm Birth	Term Birth	p-value
Normal (n=89)	14 (15.7%)	75 (84.3%)	<0.001
Oligohydramnios (n=21)	12 (57.1%)	9 (42.9%)	<0.001
Polyhydramnios (n=5)	3 (60.0%)	2 (40.0%)	<0.001

Table 5 indicates that both oligohydramnios and polyhydramnios significantly increase the risk of preterm birth. While most women with normal AFI delivered at term, over half of those with abnormal fluid volumes delivered prematurely, underscoring the prognostic value of AFI measurements in the third trimester.

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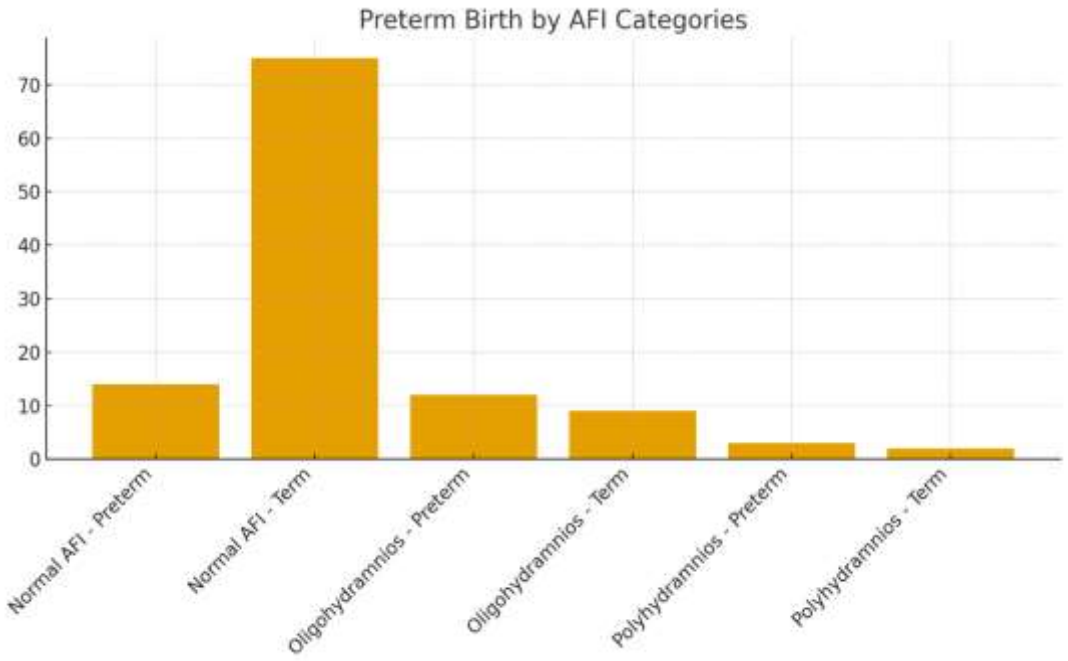

Discussion

A total of 115 pregnant women in their third trimester were included in this study, with a mean age of approximately 28 years and a majority being multigravida. At enrollment, most participants were between 30–32 weeks of gestation, ensuring uniform timing of Doppler and amniotic fluid assessments. This demographic profile reflects a typical high-risk antenatal population presenting for routine or indicated ultrasound evaluation.

On evaluation, around 71% of women had normal Doppler velocimetry, while nearly 29% showed abnormal Doppler flow patterns, mainly involving umbilical or cerebral vessels suggestive of placental insufficiency or fetal compromise. Similarly, about three-fourths of the participants had normal amniotic fluid volumes, whereas oligohydramnios and polyhydramnios were observed in 18% and 4% of women, respectively. These abnormalities represent clinically significant deviations from normal fetal environment parameters, both of which have been linked to adverse pregnancy outcomes.

Preterm birth occurred in 27% of the study population. Importantly, both abnormal Doppler findings and abnormal amniotic fluid volumes showed a strong, statistically significant association with preterm birth. Over half (57.6%) of the women with abnormal Doppler delivered before 37 weeks compared to only 14.6% in the normal Doppler group. Similarly, preterm delivery was noted in more than half of women with oligohydramnios (57.1%) and polyhydramnios (60%) compared to only 15.7% among those with normal fluid levels. Both associations were highly significant ($p < 0.001$), indicating that these abnormalities independently increase the risk of preterm delivery.

These findings collectively suggest that third-trimester Doppler studies and amniotic fluid assessments are valuable tools for predicting preterm birth risk. Abnormal Doppler parameters likely reflect compromised uteroplacental perfusion, while abnormal amniotic fluid volumes may indicate underlying placental, fetal, or maternal pathology, each contributing to early delivery. Thus, the detection of either parameter should prompt closer monitoring, timely interventions, and possibly delivery planning in a setting equipped to manage preterm neonates.

Recent evidence highlights the predictive role of third-trimester Doppler abnormalities and amniotic fluid volume in preterm birth and adverse perinatal outcomes. Dall'Asta et al. [8] reported that abnormal uterine artery Doppler in both the second and third trimesters is strongly associated with preterm birth and fetal growth restriction, emphasizing its clinical utility in high-risk pregnancies. Similarly, Gandhi et al. [9] found that abnormal middle cerebral artery Doppler, particularly when coupled with oligohydramnios, significantly increases the risk of adverse neonatal outcomes, including preterm delivery. Mitra et al. [10] demonstrated that abnormal umbilical artery Doppler indices in the third trimester correlate with higher rates of preterm birth and negative perinatal outcomes, suggesting its importance in fetal surveillance. Amniotic fluid abnormalities, including oligohydramnios and polyhydramnios, have also been independently linked to preterm birth and low birth weight, with the risk being magnified when Doppler abnormalities coexist, as shown by Jain et al. [11]. Finally, Sharma et al. [12] emphasized that combining Doppler velocimetry with amniotic fluid assessment improves the prediction of preterm birth compared to either method alone, indicating that

integrated assessment strategies offer superior prognostic value.

In conclusion, recent studies consistently support that third-trimester Doppler abnormalities in uterine, umbilical, and middle cerebral arteries, alongside abnormal amniotic fluid volumes, are significant predictors of preterm birth. Integrating both Doppler and amniotic fluid evaluation enhances the accuracy of identifying pregnancies at risk of adverse outcomes.

Conclusion

Abnormal Doppler velocimetry and abnormal amniotic fluid volumes in the third trimester are strongly associated with an increased risk of preterm birth. Early detection of these abnormalities can help guide closer surveillance and timely interventions, potentially improving maternal and neonatal outcomes.

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