

## APPLICATIONS OF DOPPLER ULTRASOUND IN ASSESSING FETAL WELL-BEING

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**Abstract:** The study aimed to determine the frequency of Doppler velocimetry usage in high-risk pregnancies and to compare the results between patients who received Doppler velocimetry and those who did not manage high-risk pregnancies. This descriptive study was conducted between January 2022 and December 2022 in the Gynaecology and Obstetrics Department of PUMHS Nawabshah. A total of 110 pregnant women were admitted to the Department of Obstetrics and Gynecology's OPD and ER. Both the patient and their guardian signed an informed consent form. Fifty-five patients underwent Doppler ultrasound in group I, while 55 patients did not have Doppler ultrasound in group II. A blood sample was obtained from each patient for baseline tests such as complete blood count, electrolytes, blood sugar level, blood urea, serum creatinine, and others. All data was analyzed using SPSS 26.0. The patient's mean age in group I was 26.12±6.39 years with a body mass index of 25.7±5.24 kg/m<sup>2</sup>, and in group II, the mean age was 27.4±10.67 years with a body mass index of 26.13±5.57 kg/m<sup>2</sup>. Gestational age in group I was 37.15±8.38 weeks, and in group II was 36.9±7.43 weeks. Frequency of C-section in group I was found in 30 (54.5%) and in group II was in 41 (74.5%) cases with  $p < 0.004$ . Preterm deliveries were higher in group II in 26 (47.3%) cases than in group I in 15 (27.3%) cases. Abnormal amniotic fluid was higher in group I in 27 (49.1%) cases than in group II in 20 (36.4%). Doppler studies played a significant role in managing high-risk pregnancies and improving perinatal and neonatal outcomes. However, using other fetal well-being tests already well-established in clinical practice at each institution affects the role of Doppler studies in late pregnancy.

**Keywords:** High-Risk Pregnancy, Pre-eclampsia, Doppler Ultrasound, C-section, Preterm Delivery

### Introduction

The primary cause of death for mothers and newborns is eclampsia and preeclampsia, mostly in developed nations (NEWNHAM et al., 1991). Each year, eclampsia is the cause of about 50,000 maternal deaths that are reported. It has been reported that eclampsia accounts for 34% of maternal deaths in Pakistan, according to the country's healthcare system (Heinonen et al., 1996). Pre-eclampsia is a multisystemic illness that primarily increases the risk of pregnancy complications. Usually, it happens after 20 weeks of pregnancy. An estimated 3.5 million pregnancies worldwide result in pre-eclampsia, according to reports from 3% to 8% of pregnancies (Williams et al., 2003). According to research, between 4% and 6% of complicated pregnancies in developed nations are caused by pre-eclampsia. Pre-eclampsia ranks third globally in terms of the causes of maternal death and morbidity. Roughly 60,000 females worldwide succumb to pre-eclampsia (Haws et al., 2009). These statistics come from WHO reports. Additionally, the figures indicate that 24% of deaths occur in India and 11% occur in the UK. In early pregnancies, the risk of pre-eclampsia is 4.1 percent.

A well-established surveillance technique in high-risk pregnancies due to compromised placentation, the UA's Doppler ultrasonography (US) yields valuable information

about the blood flow characteristics within the arteries (Alfirevic et al., 2015). It's estimated that the use of Doppler US has allowed the risk of perinatal death in high-risk pregnancies to drop by 29% (Alfirevic et al., 2017).

The Doppler Effect, defined as the difference in frequency transmitted to and received by US waves between two separate objects when at least one is moving, is the source of the technological name for the Doppler US system (Moorthy, 2002). Within obstetrics, the transducer is a constant, and the returning signal echoes are produced by red blood cells of the uterofetoplacental circulation, which act as shifting reflectors (Oglat et al., 2018).

Blood flow within the umbilical cord's blood vessels can be detected during pregnancy using Doppler ultrasonography, a stand-in for placental function (Alfirevic et al., 2017). In cases where blood flow is either reversed (reverse end diastolic flow, REDF) or absent (absent end diastolic flow, AEDF), prompt referral for specialized care is necessary to prevent perinatal death (Karsdorp et al., 1994). It has been demonstrated that perinatal deaths can be avoided by using Doppler ultrasonography to measure umbilical blood flow in women carrying high-risk pregnancies; the studies used this technique between 24 and 40 weeks gestation (Alfirevic et al., 2017). In comparison, only five trials (involving 14,185 women) in high-income country settings were found

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in a Cochrane review on the use of Doppler ultrasound in low-risk or not chosen groups of pregnant women (Alfirevic et al., 2015). Routine umbilical vein Doppler ultrasound may benefit the mother and the unborn child in low-risk or unselected populations. Still, the authors found insufficient evidence to support their conclusion (Alfirevic et al., 2015). Since stillbirth rates are high in low- and middle-income countries (LMICs) and Doppler ultrasound is not routinely available, the WHO does not currently recommend everyday Doppler ultrasound for pregnant women without identifiable risk factors. However, the WHO guideline panel has said that the value of routine use of a single Doppler ultrasound assessment of the fetal blood vessels throughout the third trimester needs more rigorous evaluation (Moher et al., 2009; Organization, 2016).

**Methodology**

This study was conducted at the Gynaecology and Obstetrics Department PUMHS Nawabshah and comprised 110 pregnant females. Women who had active singleton pregnancies were included in this study. The patients also had regular blood pressure readings, a gestational age of more than 20 weeks, and frequent prenatal visits. All participants ranged in age from eighteen to thirty-six. Patients were randomly assigned to receive random follow-up samples. This study excluded individuals who had hypertension, a history of multiple pregnancies, proteinuria, heart issues, or any other kidney disease.

The WHO calculator was utilized to determine the sample size. A 22% poly/oligohydramnios fraction devoid of Doppler velocimetry was used as a benchmark. A 95% confidence interval was used overall. Everyone who participated was a patient of our hospital's Department of Obstetrics and Gynaecology. Each patient was made aware of the research and allowed to provide written consent. Every patient had a thorough medical history, including details about weight, gestational age, proteinuria, and high blood pressure. It was possible to determine the frequency of high-risk pregnancies using this comprehensive medical history. External results and participant Doppler velocimetry results were compared.

Two groups were formed from each participant. Those wearing ultrasound Dopplers were part of Group I. Individuals without an ultrasound Doppler were included in Group II. In Group A, participants were given waveform studies during their first visit. Tests and Doppler studies followed these. A continuous system was employed for the Doppler flow velocity analysis. With their faces up and

slanted sideways, the participants placed a wedge beneath one hip. This ratio of peak systolic (S) to extremely low systolic (D) Doppler shifting frequency was found using waves detected in the umbilical vein and a mother's uteroplacental. Questions regarding their most recent menstrual cycle were posed to determine the patients' gestational ages. Each participant was required to provide a blood sample to measure blood urea, blood sugar, serum creatinine, electrolytes, and total blood count. The data was analyzed using SPSS version 26. The chi-square test was employed to compare the outcomes. Less than 0.05 was the threshold for a significant p-value.

**Results**

Patient's mean age in group I was 26.12±6.39 years with a body mass index of 25.7±5.24 kg/m<sup>2</sup> and in group II mean age was 27.4±10.67 years with a body mass index of 26.13±5.57 kg/m<sup>2</sup>. Gestational age in group I was 37.15±8.38 weeks, and in group II was 36.9±7.43 weeks. Among all, 35 cases in Group I and 38 cases in Group II had poor socioeconomic status. (Table 1)

**Table 1: Pregnant females with detailed demographics**

Variables	Group I (55)	Group II (55)
Mean age (years)	26.12±6.39	27.4±10.67
Mean BMI (kg/m <sup>2</sup> )	25.7±5.24	26.13±5.57
Mean Gestational age (weeks)	37.15±8.38	36.9±7.43
<b>Socio-economic status</b>		
Poor	35 (63.6%)	38 (69.1%)
Middle	12 (21.8%)	11 (20%)
High	8 (14.5%)	6 (10.9%)

Frequency of C-section in group I was found in 30 (54.5%) and in group II was in 41 (74.5%) cases with p <0.004. Preterm deliveries were higher in group II in 26 (47.3%) cases than in group I in 15 (27.3%) cases. Abnormal amniotic fluid was higher in group I in 27 (49.1%) cases than in group II in 20 (36.4%). (Table 2)

The frequency of Pre-eclampsia and Pregnancy-induced hypertension was also higher in group II with a p-value <0.005. (Table 3)

In group I, 30 cases had gestational diabetes, 16 cases had anemia, and obesity was found in 9 cases; in group II, 25 cases had gestational diabetes, 20 cases had anemia, and 10 cases had obesity. (Figure 1)

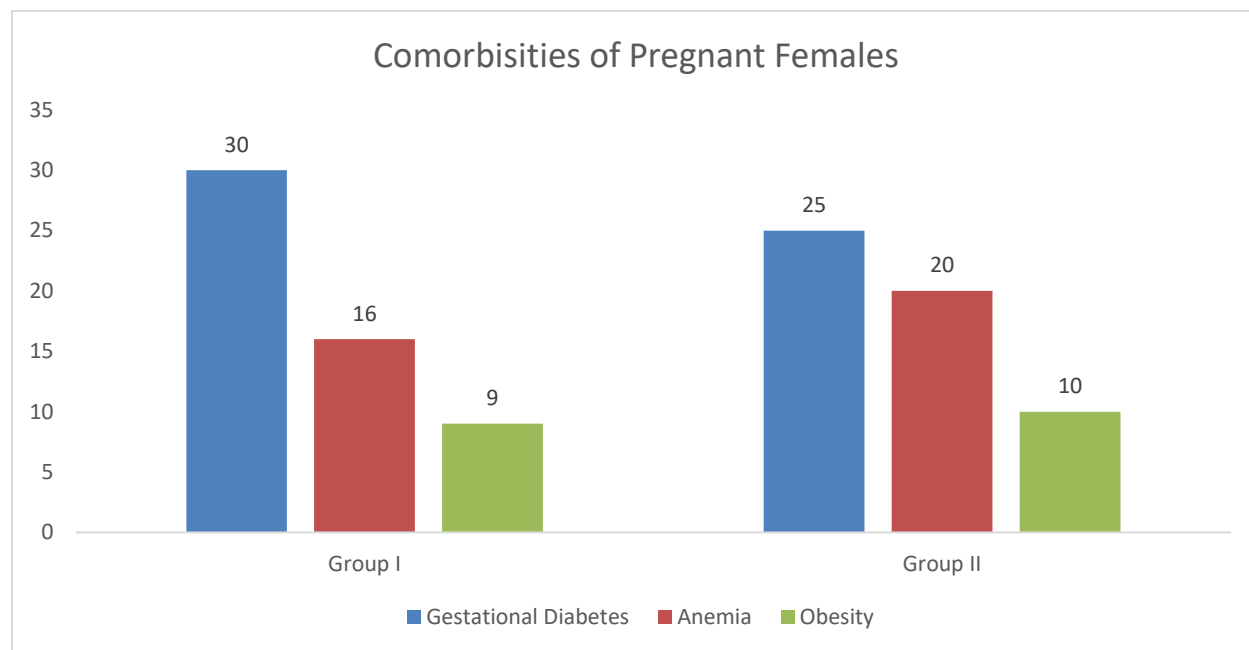
**Table 2: Analyzing and contrasting the results for both groups**

Variables	Group I (n=55)	Group II (n=55)
<b>C-section</b>		
Yes	30 (54.5%)	41 (74.5%)
No	25 (45.5%)	14 (25.5%)
<b>Preterm Deliveries</b>		
Yes	15 (27.3%)	26 (47.3%)
No	40 (62.7%)	29 (52.7%)
<b>Abnormal Amniotic Fluid</b>		
Yes	27 (49.1%)	20 (36.4%)
No	28 (50.9%)	35 (63.6%)

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**Table 3: Association of PIH and pre-eclampsia**

Variables	Group I (n=55)	Group II (n=55)
<b>Pre-eclampsia</b>		
Yes	17 (30.9%)	24 (43.6%)
No	38 (69.1%)	31(56.4%)
<b>PIH</b>		
Yes	13 (23.6%)	21 (38.2%)
No	42 (76.4%)	34 (61.8%)

**Figure 1: Frequency of other diseases in pregnant females**

### Discussion

The results demonstrated the superiority of Doppler velocimetry in the umbilical cord over ultrasonography in identifying unfavorable pregnancy outcomes and fetal well-being assessments. It's interesting to note that other authors' earlier research on the subject had overlooked how age affected pregnancy (Hartung et al., 2005). In this study, we looked into the connection between UAPI variations and a three-fold improvement in the capacity to forecast elevated risks for four out of the five markers associated with unfavorable reproductive outcomes. Statistical significance was not reached despite a 50% increase in the risk of respiratory distress syndrome. Doppler velocimetry has been shown to predict reproductive outcomes in fetuses with a confirmed diagnosis of IUGR through several studies that employed various vasculatures and reported improvements in fetal wellbeing (Groom et al., 2009; Sebire et al., 2001). In our study, patients' mean age in group I was  $26.12 \pm 6.39$  years with a body mass index of  $25.7 \pm 5.24$  kg/m<sup>2</sup> and in group II, the mean age was  $27.4 \pm 10.67$  years with a body mass index of  $26.13 \pm 5.57$  kg/m<sup>2</sup>. Previous studies presented the same findings as our study (Messawa et al., 2012). Gestational age in group I was  $37.15 \pm 8.38$  weeks, and in group II was  $36.9 \pm 7.43$  weeks. Significant findings were obtained when gestational age modifications were taken into account. The tendency to end the pregnancy early to prevent intrauterine fetal death is widely recognized in cases of placental abruption and fetal hemodynamic

abnormalities. The correlation between Doppler changes and declining gestational age thus shows that the prognosis for reproductive outcomes declines with decreasing pregnancy duration. This emphasizes how difficult it can be to predict pregnancy outcomes when analyzing the relationship between gestational age and Doppler changes (Groom et al., 2009; Messawa et al., 2012; Sebire et al., 2001).

Frequency of C-section in group I was found in 30 (54.5%) and in group II was in 41 (74.5%) cases with  $p < 0.004$ . Preterm deliveries were higher in group II in 26 (47.3%) cases than in group I in 15 (27.3%) cases. Abnormal amniotic fluid was higher in group I in 27 (49.1%) cases than in group II in 20 (36.4%). The Doppler signals that this most recent study with typical results aligns with previous research findings and findings from ongoing studies conducted at various institutions. Furthermore, our study did not find a statistically significant distinction in the rates between atypical results and normal pregnancies (Williams et al., 2003). This has significant ramifications, including the potential—contrary to other studies' recommendations—that Doppler imaging of uterine arteries may not be a reliable method of identifying pregnancies with adverse results, such as placental abruption. In other words, some factors might affect our destiny. The discrepancy can be ascribed to the limited sample size, which influenced the outcomes, underscoring the significance of possessing a sufficiently large sample size to corroborate our discoveries (Norman et al., 1992; Shah et al., 2017).

The issues this study points out align with findings from other investigations. The study discovers that blood pressure disorders weren't the primary cause among this cohort, which is an intriguing departure from previous research (Nkosi et al., 2019). This implies that isolated hypertension may not be as crucial in placental abruption as it is in normal pregnancies, which would explain any discernible variations in uterine symptoms. Hypertensive disorders, on the other hand, usually appear later in the pregnancy as well as are more severe; these conditions have been linked to coagulation disorders, diabetes mellitus, and other maternal conditions. One of the more common issues was identifying a restriction on intrauterine growth (Ome-Kaius et al., 2017).

## Conclusion

Doppler studies played a significant role in managing high-risk pregnancies and improving perinatal and neonatal outcomes. However, using other fetal well-being tests already well-established in clinical practice at each institution affects the role of Doppler studies in late pregnancy.

## Declarations

### Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

### Ethics approval and consent to participate

Approved by the department Concerned.

### Consent for publication

Approved

### Funding

Not applicable

## Conflict of interest

The authors declared absence of conflict of interest.

## Author Contribution

### AASMA NAZ

Conception of Study, Development of Research Methodology Design, Study Design,, Review of manuscript, final approval of manuscript

### MUTHIRA MOHAMMAD YASEEN

Data entry and Data analysis, drafting article

### NISAR AHMED SOOMRO

Study Design, Review of Literature

### HUMERA SHAIKH

Data acquisition, analysis.

### MUNAZA TASNEEM

Coordination of collaborative efforts.

### LUBNA HAMEED

Supervision, funding acquisition.

### KIRAN AAMIR

Manuscript revisions, critical input.

### AAMIR RAMZAN

Data entry and Data analysis, drafting article.

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