"MATERNAL OPHTHALMIC ARTERY DOPPLER AT 19 TO 23+0 WEEKS AS PREDICTOR OF PRE-ECLAMPSIA - A DESCRIPTIVE OBSERVATIONAL STUDY."

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Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"MATERNAL OPTHALMIC ARTERY DOPPLER AT 19 TO 23+0 WEEKS AS PREDICTOR OF PRE -ECLAMPSIA- A DESCRIPTIVE OBSERVATIONAL STUDY",** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee.

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LIST ABBREVIATION

1. PE – Pre-eclampsia
2. PI – Pulsatility Index
3. PIERS – Pre-eclampsia Integrated and Estimated Risks
4. KIR – Killer cell Immunoglobulin-like Receptors
5. CVD – Cardiovascular Disease
6. PCOS – Polycystic Ovarian Syndrome
7. CDI – Color Doppler Imaging
8. PW – Pulsed Wave Doppler Ultrasonography
9. RI – Resistance Index
10. PR – Peak Ratio
11. MV – Mean Velocity
12. AUC – Area Under the ROC Curve
13. MCA – Middle Cerebral Artery
14. GPE – General Physical Examination
15. BP – Blood Pressure
16. PIH – Pregnancy-Induced Hypertension
17. LFT – Liver Function Tests

18. RFT – Renal Function Tests

19. LSCS – Lower Segment Cesarean Section

20. ANC – Antenatal Clinic

21. JNMC – Jawaharlal Nehru Medical College

22. HDP – Hypertensive Disorders in Pregnancy

23. MAP – Mean Arterial Pressure

24. PSV – Peak Systolic Velocity

25. SBP – Systolic Blood Pressure

26. DBP – Diastolic Blood Pressure

27. SGOT – Serum Glutamic-Oxaloacetic Transaminase

28. FGR – Fetal Growth Restriction

29. PPV – Positive Predictive Value

30. NPV – Negative Predictive Value

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF GRAPHS

ABSTRACT

Background: Pre-eclampsia (PE) is a major obstetric complication that can have severe maternal and fetal consequences. Identifying predictive markers early in pregnancy is crucial for timely intervention. This study evaluates the predictive value of maternal ophthalmic artery Doppler parameters at 19–23+0 weeks of gestation for pre-eclampsia risk.

Objective: To explore the relationship between ophthalmic artery Doppler parameters and the subsequent development of pre-eclampsia. To examine the potential value of maternal ophthalmic artery Doppler at 19 to 23 weeks+/- 3 days in the prediction of susbsequent development of pre-eclampsia

Methods: The descriptive observational study was conducted at KLE's Dr. Prabhakar Kore Hospital and Medical Research Centre from November 2023 to November 2024. Antenatal women aged 18–35 years with singleton live pregnancies at gestational age between 19 to 23+0 weeks were recruited using a convenient sampling technique. Women with pre-existing hypertension, congenital anomalies, cardiac diseases, thromboembolic disorders, or ocular conditions were excluded. After taking informed consent, ophthalmic artery Doppler was performed using a 5–10 MHz linear transducer, assessing systolic velocity peaks (PSV1, PSV2), pulsatility index (PI), and the PSV2/PSV1 ratio. Follow-up included clinical assessments in the second trimester and postpartum data collection via medical records and telephonic consultation.

Results: The study analyzed ophthalmic artery Doppler indices to predict preeclampsia The study found that abnormal ophthalmic artery Doppler findings were more common in women over 30 years, who accounted for 75% of all screen-positive cases, despite representing less than half the cohort. All positive cases occurred in the overweight BMI group (25–29.9), suggesting higher predictive relevance in this category. Additionally, only multiparous women screened positive, despite nulliparity being a known risk factor for PE, indicating potential cohort-specific patterns or confounders. These associations suggest that age, BMI, and parity may influence the predictive value of ophthalmic artery Doppler for PE/HDP. The PSV2/PSV1 ratio and PI for both right and left ophthalmic arteries demonstrated limited sensitivity but high specificity. The combination PSV2/PSV1 ratio and PI and showed an AUC of 0.57 ($p = 0.09$), 17.65% sensitivity and specificity of 97.14%, with a PPV of 75% and NPV of 70.8%. These findings indicate that while ophthalmic artery Doppler indices have high specificity, their low sensitivity limits their predictive utility for early identification of preeclampsia.

Conclusion: The research examined whether maternal ophthalmic artery Doppler at 19–23+0 weeks might predict pre-eclampsia. Ophthalmic artery Doppler shows high specificity with a PPV of 75% and an NPV of 70.8% for predicting pre-eclampsia, indicating better utility in confirming rather than excluding the condition. Compared to uterine artery Doppler, it performs better in positive prediction but is less effective in identifying true negatives.

Keywords: Ophthalmic Artery Doppler, Antenatal Screenings, Gestational Hypertension, Pulsatility Index, (PSV1, PSV2, PI, and the PSV2/PSV1 ratio) Systolic Velocity, Obstetric Doppler, High-Risk Pregnancy.

INTRODUCTION

The ophthalmic artery, due to its similarity to intracranial vasculature, plays a key role in Doppler imaging as an accessible pathway for assessing cerebral circulation[1]. It serves as a valuable diagnostic tool, particularly in obstetric applications[2]. Pre-eclampsia (PE), a hypertensive disorder in pregnancy, significantly affects maternal and fetal health, leading to complications like ocular issues[3]. Ophthalmic artery Doppler is a reliable, non-invasive screening marker for PE, offering advantages over traditional methods like mean arterial pressure, uterine artery Doppler, placental growth factor (PlGF), and soluble fms-like tyrosine kinase-1 (sFlt-1)[4]. Studies suggest that the ophthalmic artery's peak systolic velocity (PSV) ratio between 19–23 weeks of gestation predicts early-onset PE with high sensitivity and specificity[5,6].

Initially used for conditions like glaucoma[9], optic neuropathy, and cerebrovascular diseases[12,13], ophthalmic artery Doppler demonstrated its utility in maternal-fetal medicine by reflecting systemic vascular changes. Unlike uterine artery Doppler, which evaluates placental perfusion, ophthalmic artery Doppler assesses cerebral circulation, providing insights into maternal vascular maladaptation earlier in pregnancy. This tool is particularly relevant for cerebral symptoms of PE, such as headaches, visual disturbances, and seizures.

Advantages of Ophthalmic Artery Doppler

1.Early Detection: Changes in indices like PSV ratio and pulsatility index (PI) precede PE diagnosis.

2.Non-Invasiveness: It requires no blood sampling, offering a simple ultrasound-based approach.

3.Reliability Across BMI Variations: Unlike uterine Doppler, it is unaffected by maternal adiposity.

PE, diagnosed post-20 weeks of gestation through hypertension and organ damage[14], can result in severe complications like eclampsia, stroke, renal failure, and maternal death[15][16]. WHO notes that 99% of related deaths occur in low- and middle-income countries[17]. Patients with PE require rigorous monitoring for crises, neurological symptoms, and multi-organ complications[18],[19]. The 2013 ACOG guidelines emphasize overall well-being, eliminating strict proteinuria thresholds[21].

PE is classified into early-onset (<34 weeks) and late-onset (≥34 weeks) types, each with distinct mechanisms. Early-onset PE, linked to placental dysfunction, shows abnormal uterine Doppler findings and worse outcomes[22]. Late-onset PE stems from metabolic syndromes and endothelial dysfunction but is more prevalent. A systematic diagnosis approach differentiates eclampsia from other pregnancy-related conditions[24].

Prediction models like Pre-eclampsia Integrated and Estimated Risks (PIERS) improve decision-making within 48 hours of hospital admission[27]. This tool prioritizes risk-based management, accounting for complications like eclampsia, stroke, hepatic dysfunction, and myocardial infarction[28].

Ophthalmic artery Doppler's integration into PE screening shows promise, especially in resource-limited settings. Studies highlight its stable reference ranges and non-invasiveness for assessing cerebral hemodynamics altered by PE. Future research should focus on refining prediction models, establishing standardized gestational windows, and comparing its efficacy with uterine Doppler.

This study aims to validate ophthalmic artery Doppler between 19–23 weeks of gestation as an early predictor PE and or other hypertensive disorders in pregnancy and compare the conventional method i.e, uterine artery doppler. Reliable Doppler parameters could improve risk stratification, interventions, and reduce PE-related complications.

AIM AND OBJECTIVES

Aim:

To find out prediction of pre-eclampsia or / and other hypertensive-disorders in pregnancy with ophthalmic artery doppler and its comparison with uterine artery doppler.

Objective:

- Primary: To examine the potential value of maternal ophthalmic artery Doppler at 19 to 23 weeks+/- 3 days in the prediction of susbsequent development of pre-eclampsia

REVIEW OF LITERATURE

Pathophysiology of Pre-Eclampsia

Defective Trophoblast Invasion and Abnormal Spiral Artery Remodeling

The most prevalent cause of preeclampsia is the "two-stage model," which relates abnormal placental development to limited blood flow. Systemic maternal endothelial dysfunction follows placental perfusion loss[27]. Most of this placental perfusion reduction is attributable to development problems. Early pregnancy trophoblast penetration into spiral arteries is poor[28].

In the first trimester, extravillous trophoblasts penetrate spiral artery lumens and walls (Figure 2). Arterial walls lose smooth muscle and elastic layers and replace endothelial cells with trophoblasts[29]. Remodeling spiral arteries creates low-resistance veins[29]. This alteration ensures uterine and placental blood flow during pregnancy.

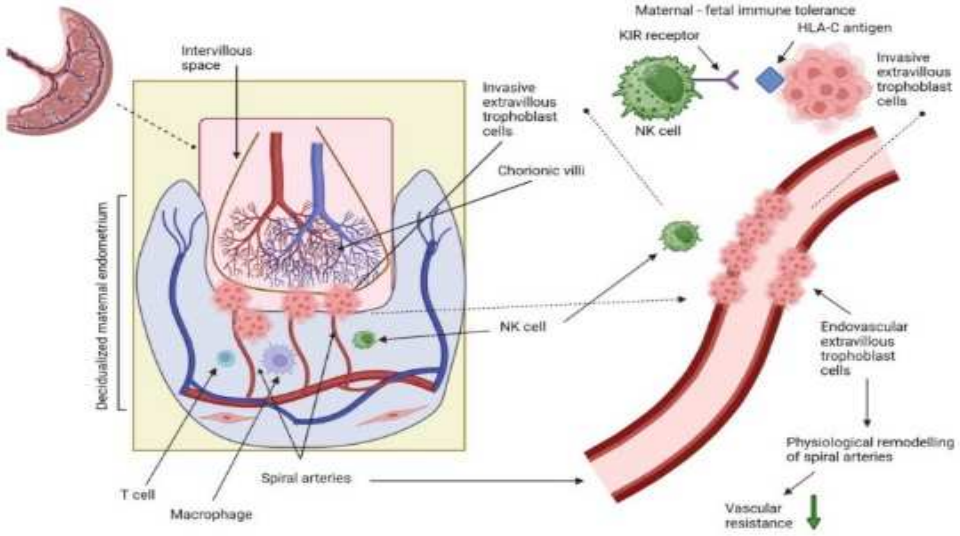


Fig 1. The physiological process of trophoblast invasion and remodeling of spiral arteries.

Preeclampsia (PE) and aberrant placentation owing to poor trophoblast invasion were initially linked in 1967 [30]. Women with PE have abnormal spiral artery wall remodeling for pregnancy. Figure 3 shows that insufficient remodeling hinders placental growth and may impair perfusion as early as the first half of pregnancy[31]. Further research shows that poor spiral artery remodeling affects placental blood flow substantially. Instead of reducing perfusion, the flow is more pulsatile and occurs under greater pressure[32].

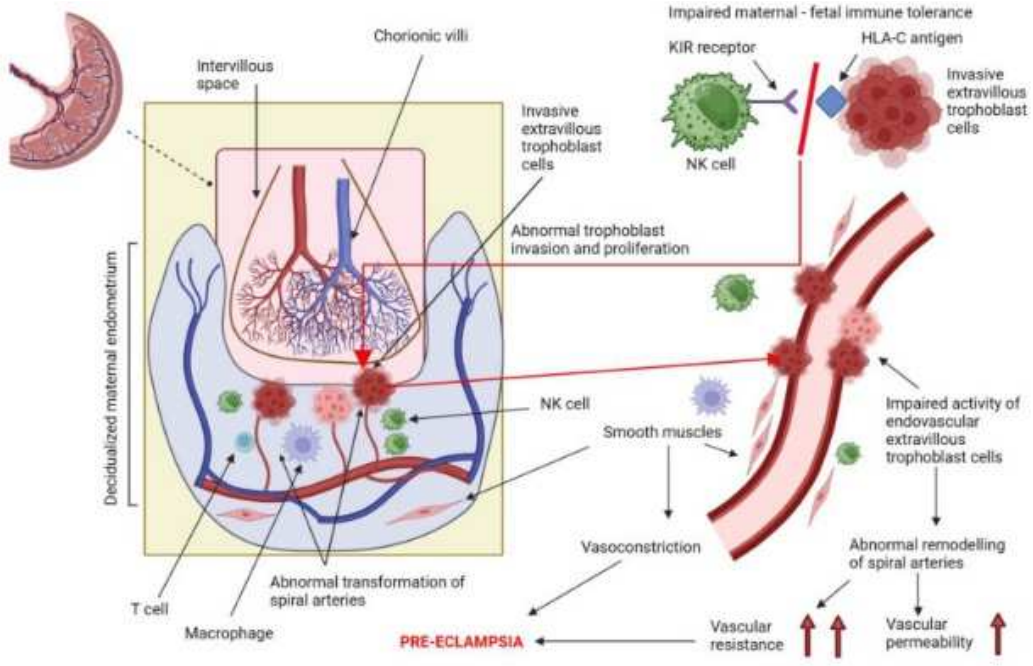


Fig 2. Abnormal placentation as a result of impaired trophoblast invasion.

Spiral artery remodeling depends on maternal uterine immune cells and embryonic cells, especially trophoblasts. Maternal immune cells such decidual NK, T, and macrophages are engaged[33]. HLA on extravillous trophoblasts (EVTs) and NK and T cells create maternal–fetal immunological tolerance. Trophoblast invasion into spiral arteries[34] is also aided by these interactions. Critical to these interactions is NK cell detection of trophoblast HLA-C by killer cell immunoglobulin-like receptors

(KIR)[35]. Placental problems may be reduced in future pregnancies due to the immune system's role.

Causes of Impaired Placental Perfusion

PE often begins with placental perfusion impairment, which causes systemic problems and maternal endothelial dysfunction. While defective trophoblast invasion is a well-recognized contributor, several other maternal and placental conditions play a role in compromising placental blood flow. These include primary vessel wall pathologies such as autoimmune diseases (e.g., lupus, scleroderma) and diabetes, which lead to vascular abnormalities. Additionally, dyslipidemia, hypercoagulability (especially in cases of anti-phospholipid syndrome), obesity-associated chronic inflammation, enlarged placentas with increased oxygen demand, and chronic hypertension are significant risk factors[36].

Acute Atherosis and Placental Perfusion

Acute atherosis, a pathological condition primarily associated with PE, affects the distal decidual segments of spiral arteries that fail to undergo normal remodeling[37]. This syndrome causes arterial foam cell deposition due to inflammatory, immunogenic, and hemodynamic mechanisms [38]. The prevalence of dyslipidemia in PE cases further exacerbates this pathology, leading to additional vascular compromise and increased placental hypoxia[39].

Other Pathologies Affecting Placental Blood Flow

Beyond structural abnormalities, maternal conditions such as diabetes and excessive placental size can negatively influence placental perfusion. These factors are more commonly associated with late-onset PE, as larger placentas are particularly

vulnerable to hypoxia and subsequently produce elevated levels of anti-angiogenic factors[40]. Such alterations in placental perfusion increase the risk of PE development by disrupting the maternal-fetal oxygen and nutrient exchange[41].

The Transition from Impaired Placental Perfusion to Systemic Endothelial Dysfunction

Overproduction of anti-angiogenic factors contributes to the progression from placental hypoxia to systemic maternal endothelial dysfunction. Hypoxic placentas emit soluble endoglin (sEng) and soluble fms-like tyrosine kinase 1 (sFlt-1), which are necessary for endothelial damage[42]. These factors inhibit normal vascular repair mechanisms and lead to the vascular complications observed in PE[43].

Anti-Angiogenic Factors and Their Role in PE Pathophysiology

Among the anti-angiogenic mediators implicated in PE, sFlt-1 and sEng are the most extensively studied.

The Role of Placental Hypoxia in PE Progression

The overproduction of anti-angiogenic factors, particularly sFlt-1, is likely a downstream effect of placental hypoxia. This angiogenic imbalance leads to systemic endothelial damage, reinforcing the progression from placental dysfunction to widespread maternal vascular complications.

The Second Stage of Preeclampsia: Maternal Endothelial Injury and Systemic Dysfunction

The clinical manifestations of PE, including hypertension, edema, thrombocytopenia, proteinuria, and neurological symptoms, are primarily driven by endothelial dysfunction[49]. The overexpression of sFlt-1 and sEng disrupts VEGF and PlGF signaling, resulting in pervasive vascular abnormalities and impaired endothelial repair mechanisms. The second stage of PE is defined by these pathophysiological changes, which emphasize the necessity of targeted therapeutic approaches to enhance maternal and fetal outcomes and reduce endothelial injury.

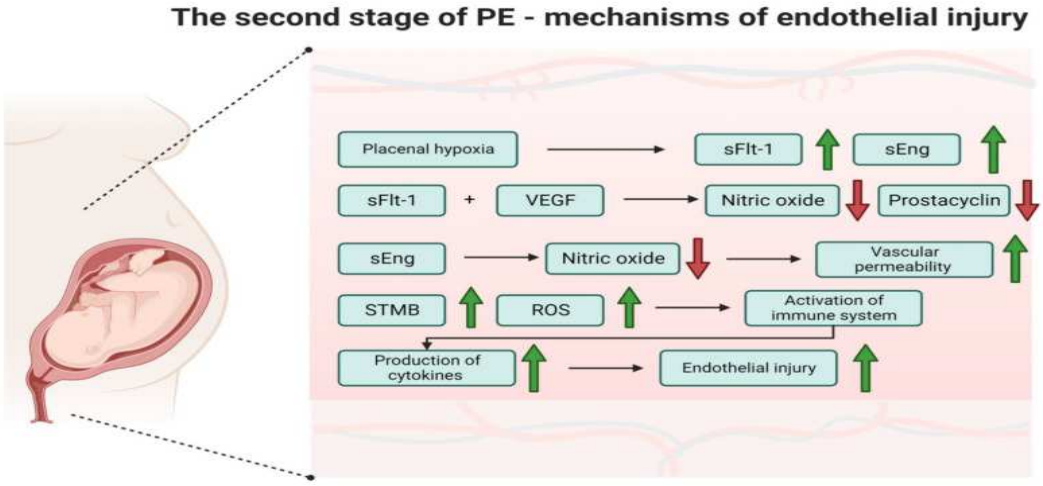


Figure 3. The second stage of pre-eclampsia—mechanisms of endothelial injury. Abbreviations: ROS—reactive oxygen species, sEng—soluble endoglin, sFlt-1—soluble fms-like tyrosine kinase 1, STMB—syncytiotrophoblast microparticles, VEGF—vascular endothelial growth factor

Maternal Endothelial Dysfunction in Preeclampsia: Mechanisms and Risk Factors

PE is a complicated illness that is essentially the consequence of immune system activation and anti-angiogenic molecules, which contribute to maternal endothelial dysfunction. soluble fms-like tyrosine kinase 1 disrupts VEGF signaling, causing vascular instability. Endothelial protection and NO generation need VEGF. Endothelial damage is worsened by soluble endoglin (sEng), which lowers NO bioavailability and increases vascular permeability [51]. Additionally, hypoxic placentas in PE release syncytiotrophoblast microparticles (STMBs) into maternal circulation, triggering immune activation and an increased production of reactive oxygen species (ROS), which contribute to vascular damage and inflammation[52].Several biomarkers indicate endothelial dysfunction in PE. Vascular cell adhesion molecule-1 (VCAM-1) and E-selectin serve as markers of endothelial activation, while hyaluronan (HA) and syndecan-1 (SDC-1) indicate degradation of the endothelial glycocalyx (EG), an essential protective layer. Elevated Endothelin-1 (ET-1), a potent vasoconstrictor, is associated with increased vascular resistance and hypertension in PE[53]. Furthermore, increased levels of circulating endothelial cells (CECs) and progenitor cells (CEPCs) indicate ongoing vascular damage and repair attempts, while flow-mediated dilation (FMD) serves as the gold standard for assessing endothelial function[54].

The comparison between EOP and LOP has yielded conflicting results. Some studies report no significant difference in endothelial dysfunction between EOP and LOP[55], while others suggest more severe endothelial damage in EOP[56]. The two-stage theory of PE links placental hypo perfusion to maternal endothelial dysfunction, which is particularly relevant in EOP due to its stronger association with placental dysfunction. However, significant endothelial injury is also observed in LOP, where

systemic maternal factors play a greater role[57]. The sFlt-1/PlGF ratio has become a clinically valuable tool in guiding PE management, helping determine the need for hospitalization and delivery[58].Emerging research highlights a strong association between PE and cardiovascular disease (CVD), with both conditions sharing common risk factors such as chronic hypertension, diabetes, obesity, and autoimmune diseases like systemic lupus erythematosus (SLE)[59]. However, pregnancy-specific risk factors such as nulliparity, assisted reproductive technology (ART), and oocyte donation also contribute to PE risk[60]. Polycystic ovarian syndrome (PCOS) is a notable shared risk factor, increasing the likelihood of PE and CVD through insulin resistance, hyperglycemia, and endothelial dysfunction[61].

PE is linked to metabolic syndrome and endothelial dysfunction due to dyslipidemia, which is characterized by low HDL-C, high TGs, and an increased Apolipoprotein B/ApoA1 ratio[62]. Additionally, oxidative stress due to excessive ROS production leads to lipid peroxidation, vascular inflammation, and arteriosclerosis, further worsening PE pathology[63]. From an epidemiological perspective, PE was historically classified under "toxemia," but modern definitions recognize it as gestational hypertension (≥140/90 mmHg) with systemic involvement, no longer requiring proteinuria for diagnosis[64]. Recent discussions propose lowering the hypertension threshold to ≥130/80 mmHg to align with cardiovascular guidelines, but its impact on maternal and fetal outcomes remains under debate[65].In conclusion, preeclampsia is a multifactorial disorder involving anti-angiogenic factors, immune activation, dyslipidemia, and oxidative stress, with strong links to long-term cardiovascular disease. The sFlt-1/PlGF ratio has enhanced clinical care, and shared risk factors with CVD emphasize the necessity of early identification and intervention for maternal health.

Epidemiology of Preeclampsia

Preeclampsia (PE) was historically classified under "toxemia," a broad term for pregnancy-related conditions such as hypertension, proteinuria, and systemic disorders. It was only in the 1950s that PE and eclampsia were recognized as distinct disorders[66]. Eventually, ACOG and ISSHP defined PE as gestational hypertension (≥140/90 mmHg) with systemic involvement, removing proteinuria as a criteria [67,68]. This redefinition improved diagnostic accuracy but complicated comparisons with older epidemiological data. Recently, the AHA and ACC lowered hypertension thresholds to ≥130/80 mmHg, sparking debate over their application in pregnancy[69]. While stricter criteria might improve maternal health monitoring, they could also increase medical interventions without clear benefits[70]. Furthermore, distinguishing gestational hypertension from PE remains a challenge, as many cases of new-onset hypertension without proteinuria may still involve systemic dysfunction[77].Epidemiological studies face diagnostic inconsistencies, especially in large databases relying on hospital codes. In the U.S., 25% of PE cases were misclassified, while 53% were undiagnosed[71]. Similarly, in Denmark, 26% of recorded PE cases were incorrect, and 31% of true cases were missing[72]. Patient recall studies show high specificity (90–99%) but variable sensitivity (57–87%), as many women remain unaware of their PE diagnosis [73].

EOP is connected to placental malfunction and fetal development limitation, whereas LOP is linked to bigger newborns and systemic maternal variables[74,75]. Biomarker studies have been more successful in predicting EOP than LOP, further supporting this distinction[76].Several risk factors increase PE susceptibility, including chronic hypertension, diabetes, obesity, autoimmune diseases (e.g., SLE), and PCOS[63,64]. Additionally, infections like UTIs, malaria, HIV, and SARS-CoV-2

elevate PE risk[81,84]. Maternal age, BMI, and weight gain also contribute significantly[88,90].Overall, PE is a multifactorial disorder with diverse phenotypes, making diagnosis, classification, and risk prediction complex. Future research should refine biomarkers, diagnostic criteria, and risk stratification to improve early detection and intervention.

Doppler of Opthalmic artery

Preeclampsia is primarily associated with widespread arterial constriction, which includes the ocular region. This engagement is well-documented90. Narrowing retinal arterioles may cause scotomas, diplopia, diminished visual acuity, photopsia, retinal detachment, papilledema, retinal edema, and hemorrhages [91]. Hypertension, diabetes, ocular vascular obstruction, and drugs used to treat systemic or ocular disorders may affect ocular blood flow, making it crucial to assess [92].

The noninvasive and secure examination of orbital vessels has been significantly improved by the introduction of pulsed Doppler ultrasonography with real-time spectral analysis and CDI, which is crucial for the use of expectant women.

Anatomy and Physiology of Normal Orbital Vasculature

The first major internal carotid branch, the ocular artery, supplies orbital blood. Due to its low vascular resistance, this artery supplies the brain. The ocular artery may arise from the anterior connecting or middle meningeal arteries. From lateral posterior to medial anterior, it crosses the optic nerve where multiple essential branches arise, passing between the lateral rectus muscle and the optic nerve in the orbit. Central retinal, lacrimal, long and short posterior ciliary, muscular, supra-orbital, ethmoidal, and medial palpebral arteries are the primary ocular artery branches. Dorsal and supra-trochlear nasal arteries are terminal branches [93].

The uvea receives the majority of the 0.724 ml/min of blood flow that a normal eye receives, with only 2–5% of the flow passing the retina. This flow is pulsatile, resulting in cyclic intraocular pressure fluctuations. The retinal circulation is characterized by a uniform flow centrally and a sluggish flow peripherally, with an average rate of 0.033 ml/min. This is representative of terminal arterial systems. Both arterioles and venules exhibit similar flow rates, with faster flow in arterioles and larger diameters in venules. Metabolites from retinal cells may control local arteriolar responses. The embryologically and anatomically comparable ophthalmic and central retinal arteries operate similarly to small-caliber cerebral arteries [94]. The ocular artery feeds blood to the central nervous system during internal carotid artery obstruction. Anastomoses connecting external carotid artery branches like the superficial temporal with the supraorbital and supratrochlear and the facial with the dorsal nasal arteries do this [95].

Autoregulation is an organ's capacity to sustain blood flow despite perfusion pressure changes. Retinal autoregulation is effective up to 115 mm Hg mean arterial pressure[96]. Similarly, the ophthalmic artery's blood flow is self-regulated, which reduces its susceptibility to fluctuations in cerebral perfusion. The autonomic nervous system's participation in this process remains ambiguous. Autonomic nervous system receptors have been found in retinal arteries during extraocular travel, but not intraocular. The sympathetic nervous system influences blood flow via the uvea's autonomic receptors, reducing blood flow with cervical sympathectomise and increasing it with it [97].

Methods to Measure Ocular Blood Flow

There are numerous methods available for the examination of ocular blood flow, including experimental and clinical methods that are either noninvasive or minimally invasive. Fluorescein angiography is the most frequently employed clinical technique for the examination of vascular systems. Other methods include laser ophthalmoscopy and blue field entoptoscopy, which measure blood velocity in macular capillaries; videoangiography combined with indocyanine green injection, which evaluates the choriocapillaris flow; bidirectional laser Doppler velocimetry, which is used to study retinal vessel blood flow (and more recently, blood flow in the choroid and optic nerve); and tonography and oculo-oscillodynamography, which estimate the pulsatile component of total ocular blood flow based on intraocular pressure[98].

Numerous of these procedures are intrusive and, as a result, frequently inappropriate for pregnant women. Doppler ultrasonography provides noninvasive, focused information about orbital vasculature, making orbital hemodynamics insights previously required by contrast arteriography possible. For real-time blood flow spectrum analysis, this method employs two-dimensional B-mode ultrasonography, CDI, and PW. Convoluted vessels like the posterior ciliary arteries are tougher to assess for blood flow direction than the ophthalmic and central retinal arteries.

Doppler ultrasonography is superior at detecting blood flow velocity in vessels that cannot be seen. The spatial precision of this technique restricts vascular diameter measurement, however numerous indices from the pulsatile and continuous blood flow velocity waveform components may estimate flow resistance [99].

Examination Technique

The most extensively used and established method for evaluating ocular circulation is the combination of color Doppler imaging (CDI) and pulsed Doppler ultrasonography (PW). It has been widely used in humans to evaluate blood flow in a variety of regions, such as the carotid and cerebral arteries. Its application to ocular circulation is predicated on simple principles[100]. Furthermore, CDI is accessible in the majority of hospital settings worldwide. Doppler ultrasonography reliably evaluates retrobulbar blood flow in ophthalmic, central retinal, and nasal arteries. Additionally, CDI may detect restricted posterior ciliary arteries. PW measures peak systolic, end-diastolic, and time-averaged blood flow without volume flow [100].

The examination technique, initially described in 1989 by Erickson et al., focused on studying localized orbital diseases and has since been adopted by numerous researchers[101]. The procedure is regarded as straightforward and reproducible[102] ,VP, and it typically requires 10 to 15 minutes to complete for a unilateral examination. A small quantity of lubricant is used to apply linear array transducers directly over the closed eyelid, with frequencies ranging from 7 to 15 MHz. After 10 minutes of repose, the patient is put in lateral or dorsal decubitus. To avoid eye pressure artifacts, CDI includes putting the transducer horizontally relative to the eyeball and gently moving it up and down. Ultrasound scans through the eyelid parallel to the orbital vessels. Arteries have stronger flow direction and pulsatility than veins, which are either continuous or mildly pulsatile, according to CDI and PW.

The PW sample volume is positioned 15 mm beyond the optic disc, medial to the optic nerve, to quantify ophthalmic artery blood flow. At least five measurements are collected.

consecutive cardiac cycles, ensuring consistent waveform size and shape. The system software automatically calculates Doppler variables, including:

- **Resistance index (RI)**: RI=(PSV−EDV)/PSVRI = (PSV − EDV) / PSVRI=(PSV−EDV)/PSV
- **Pulsatility index (PI)**: PI=(PSV−mDV)/MVPI = (PSV − mDV) / MVPI=(PSV−mDV)/MV
- **Peak ratio (PR)**: Determined by dividing the velocity of the second, postsystolic peak by PSV[103].

Fig 4. Examination technique.

To maintain accuracy, the Doppler insonation angle must be kept below 60° and measured carefully. Achieving high spatial resolution for these examinations requires the use of high-frequency probes (10 to 15 MHz) and techniques like wideband Doppler or B-flow imaging.

Ocular artery Doppler velocimetry is routinely used in healthy pregnancies. The dicrotic ocular artery waveform (Fig above) has a steady ascent, moderately rounded systolic peak, and forward diastolic flow. This flow pattern has notches between proto- and meso-diastolic secondary elevations [104]. Initial studies described mean flow velocity in normal individuals[105]. Later studies examined pulsed-wave (PW) Doppler of the ophthalmic and central retinal arteries in the second and third trimesters [104]. These studies generally agreed on average flow velocity values[106], though there was some disagreement regarding the progression of pulsatility index (PI) and resistive index (RI) throughout pregnancy. The examination technique, initially described in 1989 by Erickson et al., focused on studying localized orbital diseases and has since been adopted by numerous researchers[101]. The procedure is considered reproducible[102], VP straightforward, and typically takes 10 to 15 minutes to complete for a unilateral examination. With a little gel, 7–15 MHz linear array transducers are put directly on the closed eyelid. After 10 minutes of rest, the patient is lateral or dorsal decubitus.

The PW sample volume is positioned 15 mm beyond the optic disc, medial to the optic nerve, to quantify ophthalmic artery blood flow. At least five cardiac cycles are measured to ensure waveform size and shape. Automatic Doppler variables are calculated by system software:

- **Resistance index (RI)**: RI=(PSV−EDV)/PSVRI = (PSV − EDV) / PSVRI=(PSV−EDV)/PSV
- **Pulsatility index (PI)**: PI=(PSV−mDV)/MVPI = (PSV − mDV) / MVPI=(PSV−mDV)/MV
- **Peak ratio (PR)**: Determined by dividing the velocity of the second, postsystolic peak by PSV[103].

Keep the Doppler insonation angle below 60° and measure carefully for accuracy. great-frequency probes (10–15 MHz) and wideband Doppler or B-flow imaging are needed for these exams to achieve great spatial resolution.

Ocular artery Doppler velocimetry is routinely used in healthy pregnancies. The dicrotic ocular artery waveform (Fig above) has a steady ascent, moderately rounded systolic peak, and forward diastolic flow. This flow pattern exhibits notched proto- and meso-diastolic secondary elevations[104]. Mean flow velocity in healthy persons was first studied[105]. Later investigations used pulsed-wave (PW) Doppler of the ophthalmic and central retinal arteries in the second and third trimesters [104]. These studies generally agreed on average flow velocity values[106], though there was some disagreement regarding the progression of pulsatility index (PI) and resistive index (RI) throughout pregnancy.

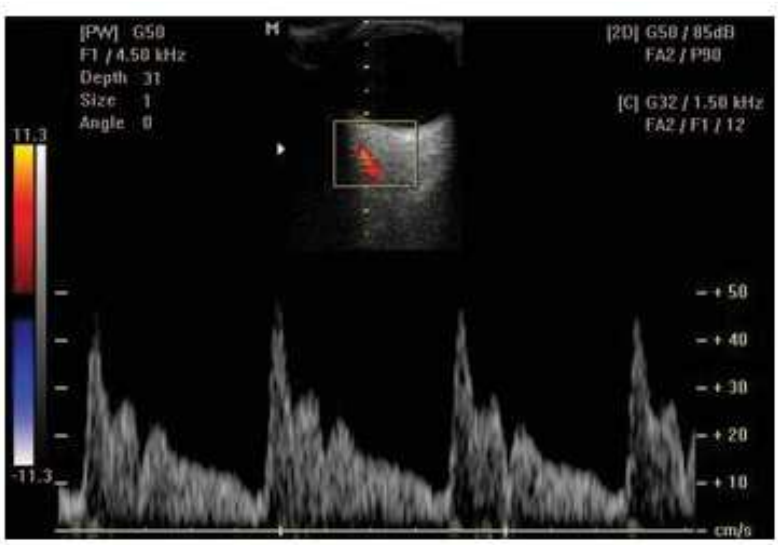


Fig 5. Blood flow velocity waveforms of the ophthalmic artery in a normal subject.

Subjects are later followed up for subsequent development of PE with appropreiate clinical examination and investigations

Recent investigations have shown that maternal ophthalmic artery Doppler may predict pre-eclampsia, providing new insights into its diagnostic accuracy and therapeutic value. In a prospective cohort study of 200 women, Elitsa Gyokova, Eleonora Hristova- Atanasova et al. (2024) found that high-risk patients had greater ophthalmic artery ratios ($p = 0.000$). The research found that ophthalmic artery Doppler, specifically the PSV2/PSV1 ratio, is better in predicting pre-eclampsia than PlGF and sFlt-1. Guru Yogendra Muthyal, Anil Kumar Sakalecha et al. (2024) showed lower resistivity index (RI) and pulsatility index (PI) in pre-eclamptic and eclamptic pregnancies than normotensive controls in an Indian case-control study. These findings imply ocular artery Doppler may identify pregnancy-related hypertension early.

Further supporting these findings, Raden Aditya Kusuma, Detty Siti Nurdiati et al. (2023) employed a Bayesian survival time model to predict pre-eclampsia in the first trimester, achieving a 100% detection rate for early-onset pre-eclampsia (<34 weeks) with an AUC of 0.981. The study highlighted the effectiveness of combining ophthalmic artery Doppler with established biomarkers for accurate prediction. Pulsatility index (PI) was strongly inversely related to mean arterial pressure in a cross-sectional investigation of ocular artery Doppler parameters and maternal blood pressure in pre-eclamptic pregnancies by Neha Kumari, Rajeev Kumar Ranjan et al. (2023). These findings show that ocular artery Doppler may detect and stratify pre-eclampsia early and non-invasively, but further study is required to maximize its therapeutic usage.

The suggested research, "Maternal Ophthalmic Artery Doppler at 19 to 23+0 weeks as a Prediction of Pre-eclampsia: A Descriptive Observational Study," is based on these results and evaluates its prediction accuracy. will lead the research at Jawaharlal Nehru Medical College, Belagavi. By integrating ophthalmic artery Doppler findings with existing predictive models, this study seeks to enhance early identification and risk stratification for pre-eclampsia, ultimately contributing to improved maternal and perinatal outcomes. The study will adhere to ethical guidelines, ensuring informed consent, confidentiality, and respect for patient autonomy.

Doppler Velocimetry of the Ophthalmic Artery in Diagnosing Preeclampsia

Ophthalmic artery blood flow indirectly reflects cerebral vascular hemodynamics, hence examining it may help diagnose central vascular dysfunction

diseases like preeclampsia. Endothelial dysfunction causes broad arteriolar vasoconstriction in pregnancy, which often causes eye symptoms.

Hata et al. established CDI and PW Doppler to examine the ocular artery in pregnancy in 1992[107]. Their and later research8,40 compared Doppler characteristics in nonpregnant, normotensive, and preeclamptic women. The ocular artery of women with moderate preeclampsia had lower pulsatility index (PI) and higher blood flow velocity, suggesting less vascular resistance, contrary to the first notion of vasoconstriction. Several research supports these conclusions.

Belfort et.al[108] observed a negative relationship between mean arterial pressure and resistive index (RI) in the ophthalmic and central retinal arteries in preeclampsia cases. Similarly, Ayaz et al[109]. identified low RI and PI in the ophthalmic artery of women with mild or moderate preeclampsia. Research by Ohno et.al[110] and Belfort et.al[108] found that patients experiencing visual disturbances (a precursor to eclampsia) exhibited lower PI and higher mean velocity (MV) in the ophthalmic artery. Initial vasoconstriction, endothelial injury, and decreased cerebrovascular autoregulation may diminish vascular resistance, increase blood flow, and cause retinal edema.

Doppler Velocimetry of the Ophthalmic Artery in Preeclampsia Diagnosis and Prediction

Diagnosis of Preeclampsia

Stein46 identified a cutoff point of 0.72 for diagnosing preeclampsia, achieving 81% sensitivity, 93% specificity, and an area under the ROC curve (AUC) of 0.93. Barbosa et al. recommended a decreased ophthalmic artery resistive index (RI) threshold of 0.56 for detecting posterior reversible encephalopathy, with an AUC of 0.81 ± 0.039 and odds ratio of 12.67. In women with preeclampsia, Giannina et al. found that distal arteriolar vasoconstriction maintained the central retinal artery peak

systolic velocity (PSV) for 6–12 weeks postpartum. In normotensive women, end-diastolic velocity (EDV) and mean velocity (MV) normalized, and RI and PI decreased to pre-pregnancy values, indicating vascular function returned to baseline. Theories regarding the orbital hyper per fusion and vasodilation observed in preeclampsia include:

1. **Autoregulatory Response:** A balance between systemic vasodilation and cardiac output stabilizes blood pressure initially, with disease progression causing vasoconstriction, increased resistance, and hypertension[111].

2. **Collateral Circulation:** Decreased orbital vascular resistance[112, 113] arises from collateral bed activation as a compensatory mechanism for hypertension.

3. **Microvasculature Spasms:** Central retinal artery vasospasms result in ischemia, prompting dilation of larger vessels like the ophthalmic artery due to vasodilator release and ischemic metabolite accumulation. This mechanism is akin to the cerebral "centralization" seen in acute fetal distress.

DOPPLER OF THE ORBITAL VESSELS IN PREGNANCY

Values of the 5th and 95th Doppler indices of the OA in normal pregnancy

	RI		PI		PSV		PDV		EDFV		PR	
GA	5th	95th	5th	95th	5th	95th	5th	95th	5th	95th	5th	95th
20	0.67	0.91	1.32	2.66	25.90	37.90	10.57	20.30	3.20	9.60	0.33	0.62
21	0.63	0.88	1.30	2.58	26.35	43.60	11.40	24.00	3.48	11.10	0.36	0.62
22	0.64	0.88	1.22	2.52	26.22	45.87	12.08	25.83	3.75	11.83	0.38	0.63
23	0.64	0.87	1.18	2.48	26.54	47.47	11.96	27.20	4.03	12.57	0.39	0.64
24	0.63	0.87	1.17	2.38	26.62	50.40	12.45	29.50	4.30	13.74	0.41	0.65
25	0.61	0.85	1.16	2.35	25.52	49.23	12.91	30.00	4.57	15.05	0.39	0.65
26	0.65	0.83	1.19	2.34	25.73	50.40	11.46	28.60	4.85	15.60	0.38	0.65
27	0.67	0.83	1.19	2.33	24.77	50.40	10.60	28.00	5.20	15.70	0.37	0.65
28	0.66	0.83	1.19	2.30	24.00	51.50	11.25	28.10	4.85	15.30	0.37	0.65
29	0.64	0.84	1.16	2.25	25.05	52.60	12.20	29.67	4.60	16.12	0.38	0.67
30	0.64	0.85	1.14	2.29	26.10	54.60	12.97	30.90	4.87	17.50	0.40	0.68
31	0.63	0.85	1.12	2.33	27.00	51.47	12.86	31.95	4.92	17.54	0.41	0.70
32	0.62	0.86	1.08	2.37	27.90	49.60	12.70	27.45	4.90	15.74	0.40	0.71
33	0.61	0.86	1.04	2.31	26.03	45.20	11.82	27.30	4.53	13.80	0.39	0.71
34	0.63	0.86	1.06	2.25	25.80	45.00	11.23	26.90	4.17	13.50	0.37	0.68
35	0.63	0.84	1.06	2.16	24.42	44.80	10.58	26.58	4.15	14.60	0.37	0.66
36	0.62	0.82	1.09	2.07	22.67	44.60	10.45	25.85	4.80	15.00	0.38	0.71
37	0.60	0.81	1.01	1.98	23.80	47.13	10.47	26.10	5.30	16.73	0.38	0.73
38	0.58	0.79	0.94	1.86	24.74	52.20	10.20	40.70	6.00	21.70	0.39	0.77
39	0.71	0.77	1.50	1.75	25.40	45.50	12.70	24.70	6.80	13.00	0.45	0.66

While PI and PR are valuable indicators of ocular vascularization, PR is particularly useful for assessing preeclampsia severity. A higher PR correlates with increased arterial wave reflection from distal circulatory resistance or enhanced arterial wall stiffness. However, interpreting these indices is challenging due to complex interactions, including endothelial dysfunction, systemic hypertension, and peripheral autoregulatory failure. Polska et al[114], cautioned that RI and other Doppler indices reflect impedance rather than true resistance, as demonstrated by discrepancies between Doppler RI and resistance measured by laser Doppler velocimetry.

Prediction of Preeclampsia

Preeclampsia's multifactorial nature makes it unlikely that a single test could reliably predict the condition. Instead, combining multiple biomarkers may better identify at-risk individuals, allowing for early intervention and enhanced monitoring. Most research on predictive markers for preeclampsia involves small, third-trimester studies, with limited prospective data focusing on severe or early-onset cases. Lower RI and PI in the middle cerebral artery (MCA) could predict preeclampsia with 80% sensitivity and 75% specificity in previously normotensive women. These findings suggest altered cerebral autoregulation precedes clinical symptoms. However, Williams and Moutquin, in a second-trimester study, reported poor sensitivity (10–15%) for MCA Doppler variables in predicting preeclampsia[115].

No study has examined the prognostic efficacy of orbital vascular Doppler investigations, particularly the ophthalmic artery, for preeclampsia. Prospective studies early in pregnancy are required to assess their prognostic power.

Sapantzoglou et al. (2021) examined the role of ophthalmic artery Doppler parameters, including the second-to-first peak systolic velocity ratio (PSV ratio), in predicting pre-eclampsia (PE) at 19–23 weeks' gestation. The study found that the PSV ratio was significantly elevated in PE, particularly early-onset PE. Combining ophthalmic Doppler with maternal factors and biomarkers improved the detection rate for both preterm (from 56.1% to 80.2%) and term PE (from 33.8% to 46.0%). Uterine artery Doppler parameters, especially UtA-PI, are commonly used for early-onset PE prediction. Combining both ophthalmic and uterine artery Doppler may enhance prediction accuracy, suggesting that ophthalmic artery Doppler could be a valuable addition to early PE screening, although further studies are needed[132] .

A prospective study by Sarno et al. (2020) assessed the second-to-first peak systolic velocity ratio (PSV ratio) in ophthalmic artery Doppler at 35–37 weeks. They found that the average PSV ratio from both eyes improved the detection rate of PE by 25% (50% for any PE) and 26.3% (57.9% for imminent PE), suggesting its value in predicting imminent PE.In comparison, opthalmic artery Doppler indices measured between 19 to 23 weeks (such as the pulsatility index and resistance index) are well-established for early-onset PE prediction. The present study bridges this by comparing ophthalmic artery Doppler with uterine artery Doppler, incorporating fetomaternal outcomes and defined period of gestation. This broader approach aims to refine predictive accuracy and improve early detection and management of hypertensive disorders in pregnancy[133].

Gibbone et al. (2021) examined the relationship between ophthalmic artery Doppler indices, particularly the PSV ratio, and maternal cardiovascular parameters, finding weak associations with most indices except mean arterial pressure (MAP) and

a modest link to left ventricular mass in preeclamptic women. They suggested ophthalmic artery Doppler might provide insights into vascular resistance and cardiac adaptations in PE.The present study bridges this gap by comparing ophthalmic artery Doppler with uterine artery Doppler, assessing fetomaternal outcomes. Unlike Gibbone et al., which focused on cardiovascular indices, the current study offers a broader evaluation of Doppler methods, enhancing predictive accuracy for hypertensive disorders and improving early detection of preeclampsia.[130.]

Azim et al. (2022) demonstrated the utility of ophthalmic artery Doppler at 35–37 weeks in identifying fetal growth restriction (FGR), highlighting changes in the PSV2/PSV1 ratio as predictive markers. In contrast, the present study evaluated ophthalmic Doppler at 19–23 weeks for early prediction of pre-eclampsia (PE) and related outcomes. While Azim et al. emphasized its role in late gestational monitoring, the current study supports its use as an early screening tool for hypertensive disorders. Together, these studies affirm the Doppler's value across gestation for risk assessment[129].

The study by Kusuma et al. (2023) used a Bayesian survival time model to predict early and preterm preeclampsia (PE), achieving high detection rates with ophthalmic artery Doppler and biomarkers, though it called for further validation. The present study addresses this gap by comparing ophthalmic artery Doppler with uterine artery Doppler, the conventional method, to assess fetomaternal outcomes and enhance predictive accuracy. This comparison aims to validate the effectiveness of ophthalmic artery Doppler in a clinical setting, improving early detection and management of hypertensive disorders in pregnancy[118].

O'Gorman et al. (2017) developed a first-trimester multivariable model combining maternal factors, biochemical markers, and uterine artery Doppler, achieving high sensitivity and specificity for early PE prediction. In contrast, the present study assessed ophthalmic artery Doppler alone at 19–23 weeks, showing high specificity but low sensitivity. While O'Gorman's approach is comprehensive but resource-intensive, the present study proposes a simpler, ultrasound-based method suitable for wider clinical use[140].

MATERIALS AND METHODS

Study Design: Descriptive Observational study

Study Period: November 2023-November 2024

Study Place: KLE's Dr. Prabhakar Kore Hospital and Medical Research Centre during the study period

Study population: Antenatal women coming to OPD for safe confinement from 19-23 weeks period of gestation using convenient sampling technique (selecting participants who are readily accessible to the investigator and willing to participate)

Source of data: Interview, Medical records of patients admitted in labour room for delivery.

Selection criteria

Inclusion Criteria:

- Women >18 years < 40 years
- Singleton live gestation
- Gestational age between 19 to 23+0 weeks

Exclusion Criteria:

- Chronic hypertensive and gestational hypertension.
- Diagnosed congenital anomalies.
- Known case of Cardiac diseases.
- Known case of thromboembolic disorders on tab.ecosprin (>=150mg)
- Ocular conditions like infections, trauma, tumors
- Women not willing for the study

Formula used for sample size calculation is,

$$\frac{n=p\,(100-p)Z^2}{E^2}$$

When n is the sample size, p is the proportion or prevalence of a state or condition, E is the percentage maximum error, and Z is the confidence level. According Gibbone, 2.7 % of patients had PE at 19 -23 weeks. Considering this, at 95% of confidence level and 5% of maximum error, the sample size is given by,

$n=2.7 \times (100-2.7) \times 1.96^2/5^2$

$n=40.35 \approx 41$

Hence, the minimum sample size required is 41.

DATA COLLECTION:

- After obtaining approval from ethics committee. (Annexure) and CTRI registration **(CTRI/2024/03/064446)**, antenatal women attending outpatient department were screened using convenient sampling technique.
- After fulfilling the selection criteria, eligible participants were explained about the study and informed consent was taken.
- A detailed history, clinical findings and relevant investigations were noted as per pre-approved study related proforma. (Annexure 2)

PROCEDURE:

- **History**: Detailed history including *obstetric history, past history, family history, socio-economic history* and *personal history* was taken from the enrolled and consented pregnant women.
- **Examination**:General physical examination ,systemic examination

Scan was performed after applying conduction gel, a 5-10 MHz linear transducer is gently positioned transversely across her closed upper eyelid. Color Doppler located the ocular artery, which is above and medial to the optic nerve hypoechoic band. Pulsed wave Doppler records 3–5 identical waveforms. Angle of insonation adjusted at <20 degrees, the sample gate was at 2mm to cover the vessel, and set the depth at 3-4mm. Used a 50Hz high pass filter and 125Hz pulse repetition frequency.

To minimize any potential adverse effects on the eyes, the duration of the examination of each eye was for few seconds.

- The waveforms from the ophthalmic artery was characterized by 2 peaks in systole

  The following 4 indices are used for analysis

  1.first peak systolic velocity (PSV1)

  2. second peak systolic velocity (PSV2)

  3. Pulsatility index (PI)

  4.PSV2/PSV1

Doppler Parameter	Criteria[132,133]	Implication
Peak Systolic Velocity (PSV)	PSV ratio (PSV2/PSV1) > 1.5	**Screen positive** which indicates abnormal flow patterns associated with pre-eclampsia
Pulsatility Index (PI)	PI value > 1.5	**Screen positive** -Indicates increased resistance and may correlate with higher risk of pre-eclampsia

Follow-up Plan done based on ISSHP criteria

ISSHP Definition of Preeclampsia

ISSHP CRITERIA

Criteria	**Details**
Definition	Preeclampsia is gestational hypertension (SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg) occurring at or after 20 weeks' gestation, accompanied by ≥1 new-onset condition.
New-onset Conditions	
• Proteinuria	Presence of protein in urine
• Other maternal organ dysfunction	
- Abnormal kidney function	Creatinine > 90 µmol/L (1 mg/dL)
- Liver involvement	Elevated transaminases (ALT or AST > 40 IU/L), with or without right upper quadrant or epigastric abdominal pain
- Neurological complications	Eclampsia, altered mental status, blindness, stroke, clonus, severe headaches, persistent visual scotomata
- Hematological complications	Platelet count < 50,000/µL, disseminated intravascular coagulation, hemolysis
• Uteroplacental dysfunction	Fetal growth restriction, abnormal umbilical artery (UA) Doppler, or stillbirth

First follow up (Any Time from 28 Weeks to Term)

- General Physical Examination (GPE) to assess overall maternal health.
- Blood Pressure (BP) Monitoring: BP measured on the left arm, Two readings taken 4 hours apart.
- Pregnancy-Induced Hypertension (PIH) Profile: Platelet count, Lactate Dehydrogenase (LDH) Uric acid, Liver Function Tests (LFT), Renal Function Tests (RFT)Urine routine and microscopy
- Mean uterine artery PI obtained from the medical reports available

Second Follow-Up (Post-Delivery via Medical Records and Telephonic Conversation by the investigator)

PREGANANCY OUTCOME

- Presence of Pre-eclampsia (PE) or Hypertensive disorders of pregnancy
- Gestational Age at Delivery: Full-term or pre-term
- Mode of Delivery:

a) If vaginal delivery: Induced or spontaneous, Use of instruments (if any) and

b) Cesarean Section (LSCS): Indication for surgery

PERINATAL OUTCOME

- Still birth
- Live birth
- Birth weight of the baby
- NICU admission

STATITICAL ANALYSIS

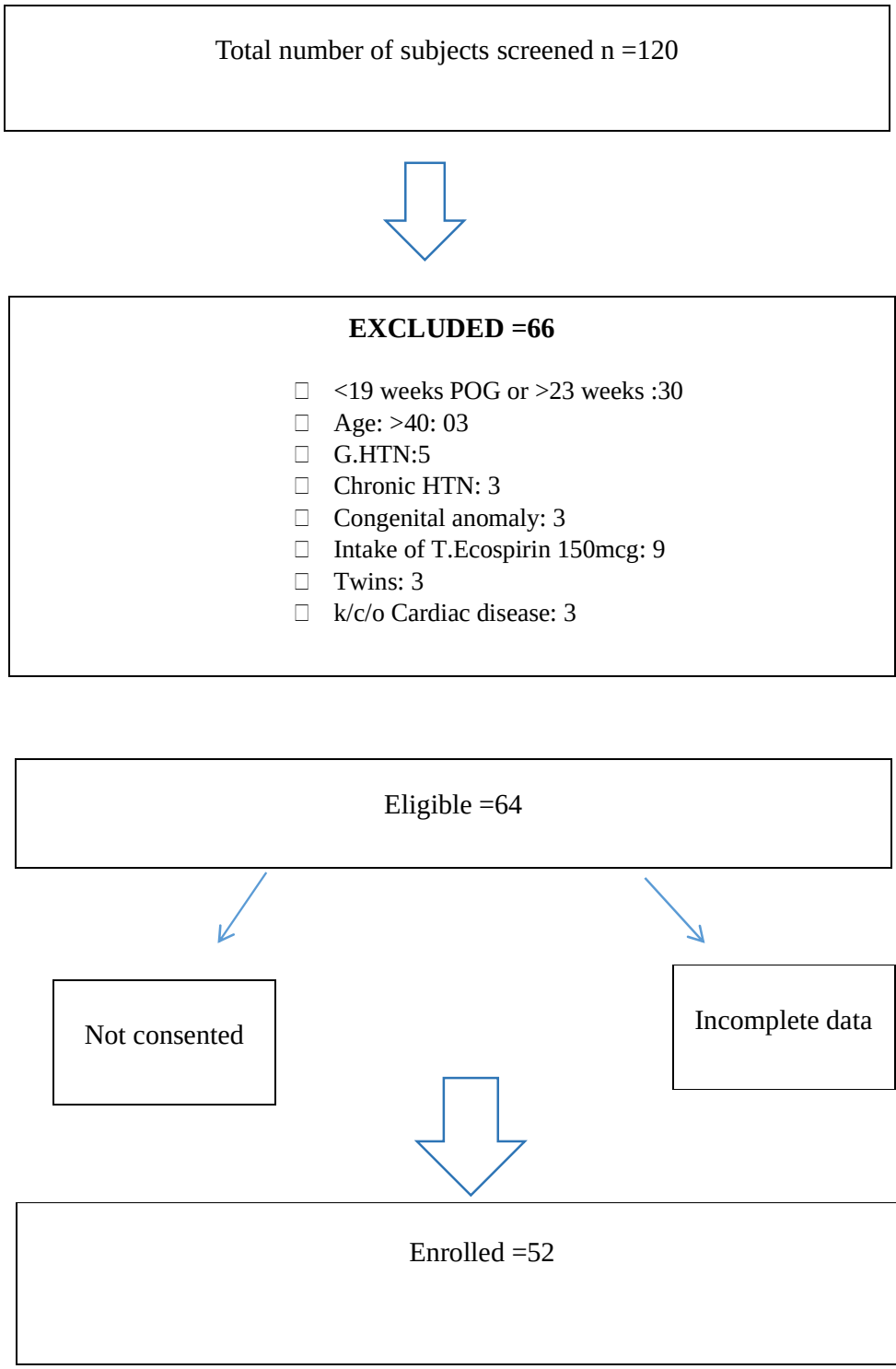
- Normality assessment using histograms, Q-Q plots, and Shapiro-Wilk tests

- Mann-Whitney U test for non-normally distributed data- Independent sample t-tests for normally distributed data

- Regression analysis to control for confounding factors

- Chi-square or Fisher's exact tests for qualitative variables- Statistical significance set at $p < 0.05$

RESULTS


Total number of subjects screened n =120
EXCLUDED =66
<19 weeks POG or >23 weeks :30
Age: >40: 03
G.HTN:5
Chronic HTN: 3
Congenital anomaly: 3
Intake of T.Ecospirin 150mcg: 9
Twins: 3
k/c/o Cardiac disease: 3
Eligible =64
Not consented
Incomplete data
Enrolled =52

Demographic information of the studied patients

Table 1: Age distribution of the studied patients

Age	No.	%	Screen positive for PE/HDP n=4	%	Screen positive for PE/HDP N= 48	%
<20	0	0	0	0	0	0
20-30	32	61.5	1	25	31	59.6%
>30	20	38.46	3	75	17	32.6

Fig. 1: Age distribution of studied participants

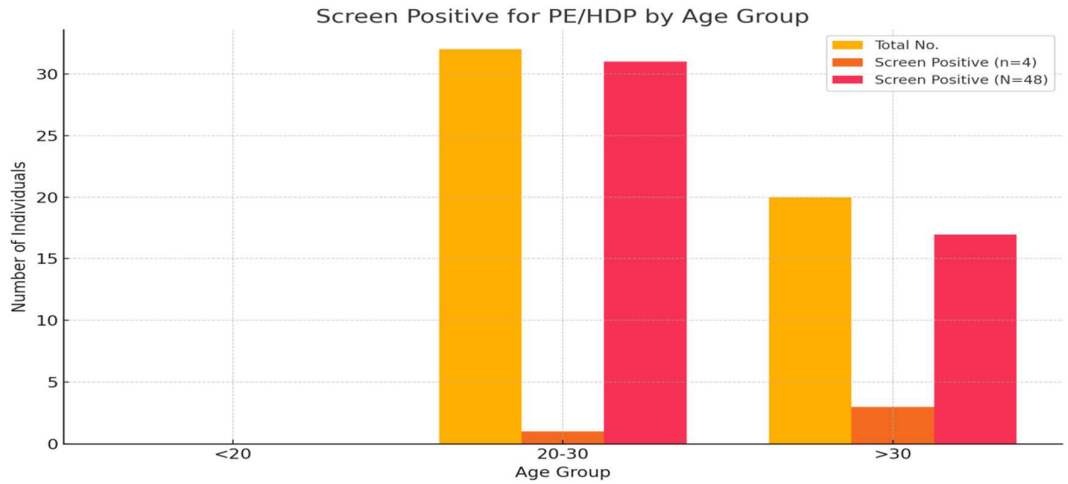


Table 1 illustrates Age Distribution in Ophthalmic Artery Doppler Screening for Prediction of Hypertensive Disorders in Pregnancy (HDP) and Pre-eclampsia (PE) In the study titled *"Maternal Ophthalmic Artery Doppler at 19 to 23+0 Weeks as Prediction of Pre-eclampsia: A Descriptive Observational Study,"* age-related trends were observed in screening outcomes. Participants aged >30 years, despite comprising only 38.5% of the cohort, accounted for 75% (3 out of 4) of screen-positive cases, indicating a higher risk or greater predictive yield of ophthalmic artery Doppler in this age group. In contrast, the 20–30 years group made up the majority (61.5%) of

participants but contributed only 25% of screen positives, suggesting a relatively lower risk. No participants were under 20 years, limiting analysis in that age bracket. Among screen-negative cases (n=48), the majority (59.6%) were from the 20–30 years group, while only 32.6% were from those aged >30, further supporting the age-related risk stratification suggested by Doppler findings.

Table 2: BMI distribution of the studied patients

BMI Category	**Count**	**Percentage**	**Screen positive for PE/HDP n=4**	%	**Screen negative for PE/HDP n=48**	**%**
Overweight (25-29.9)	27	55.1	4	100	23	44.2%
Normal Weight (18.5-24.9)	19	32.6	0	0	19	36.5%
Obesity (Class I) (30-34.9)	5	10.2	0	0	5	0.96%
Extreme Obesity (Class III)>=40	1	2.04	0	0	1	0.019%

Fig. 2: BMI distribution of studied participants

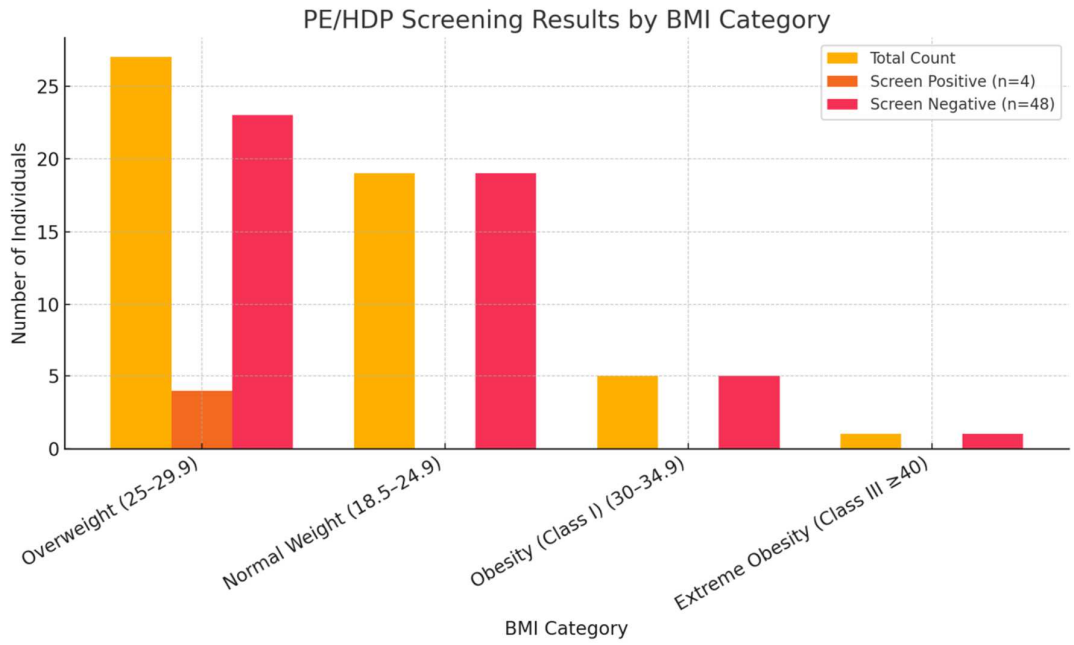


Table 2 illustrates that all participants who screened positive for abnormal ophthalmic artery Doppler parameters (elevated PSV2/PSV1 ratio and PI) predicting hypertensive disorders in pregnancy (HDP) and pre-eclampsia (PE) in the study *"Maternal Ophthalmic Artery Doppler at 19 to 23+0 Weeks as Prediction of Pre-eclampsia"* were from the overweight BMI category (25–29.9), which comprised 55.1% of the cohort but accounted for 100% of positive cases. No positives were observed in normal weight, obesity class I, or extreme obesity groups. Among screen negatives, 44.2% were overweight, with the rest distributed across other BMI categories, suggesting higher predictive relevance of Doppler findings in the overweight group.

Table 3: Distribution of patients according to Para status

PARA	No.	%	Screen positive for PE/HDP n=4	%	Screen negative for PE/HDP n=48	%
Nulliparous	12	23	0	0	12	23
Multiparous	40	76.9	4	100	36	69.2
Grand Total	**52**	**100.00**	**4**	**100**	**48**	**100**

Fig. 3: Distribution of patient according to Paramus status

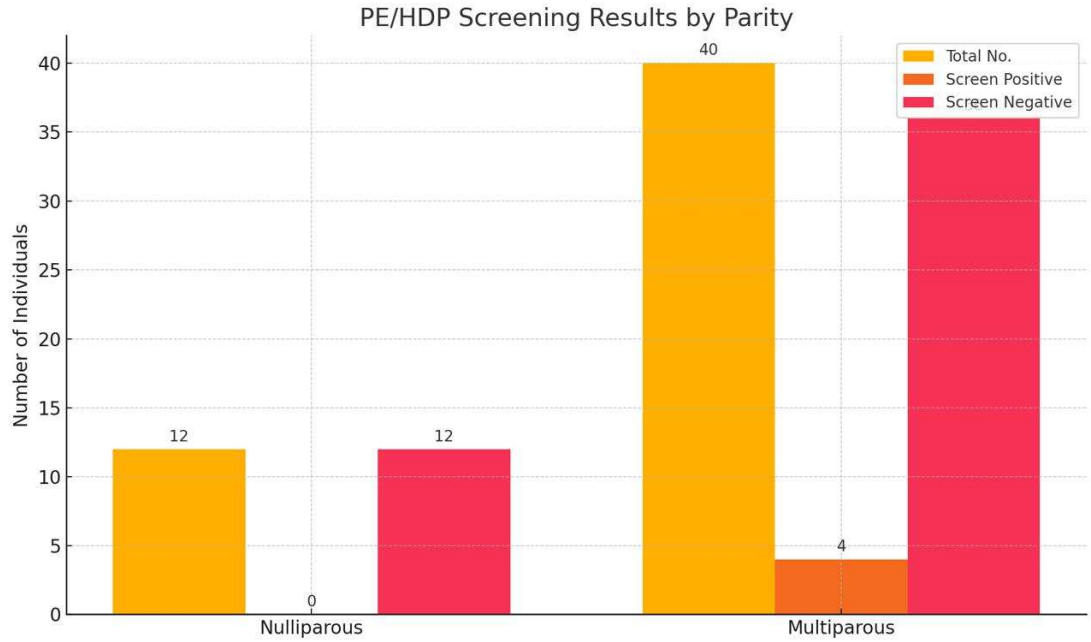


Table 3 The table illustrates the results of ophthalmic artery Doppler screening—elevated PSV2/PSV1 ratio and pulsatility index (PI)—to predict hypertensive disorders in pregnancy (HDP) and pre-eclampsia (PE) in the study titled *"Maternal Ophthalmic Artery Doppler at 19 to 23+0 Weeks as Prediction of Pre-eclampsia: A Descriptive Observational Study,"* categorized by parity. Of 52 participants, 18 were nulliparous and 34 multiparous. All four screen-positive cases were multigravida,

representing 100% of positives despite making up 76.9% of the cohort. No primigravida screened positive. Among the 48 screen-negative cases, both groups were represented—12 nullparous and 40 multiparous—suggesting a potential association between multiparity and abnormal Doppler findings.

Table 4: Distribution of BP measurements

BP measurement	Mean	SD
SystolicBP	123.30	9.62
DiastolicBP	79.34	8.58
MAP	91.48	9.25
PR	86.80	4.96
Foetal HR	147.67	8.82

Table 4 provides the descriptive statistics for vital signs and fetal heart rate. The mean systolic blood pressure (BP) is 123.30 mmHg (SD = 9.62), while the mean diastolic BP is 79.34 mmHg (SD = 8.58). The mean mean arterial pressure (MAP) is 91.48 mmHg (SD = 9.25). The mean pulse rate (PR) is 86.80 bpm with an SD of 4.96, which is within the normal range for adults. The mean fetal heart rate (Foetal HR) is 147.67 bpm (SD = 8.82), which is within the typical range for fetal heart rate in pregnancy.

Table 5: Doppler findings of the study population

	PSV1	PSV2	PSV2/PSV1	PI	RI
RIGHTEYE(a)	37.53+ 10.28	26.17+ l2.14	1.84+ 1.47	1.64+0.43	0.68 +0.16
RIGHTEYE(b)	32.07 1 2.84	22.66 10.b4	1.7l 1.05	1.62 0.52	0.67 0.12
AVERAGE	34.28 10.47	24.12 9.23	1.68 1.00	1.61 0.42	0.695 0.177
LEFTEYE(a)	32.43+ 13.28	24.79 15.15	1.53 0.59	1.65 0.35	0.67 0.14
LEFTEYE(b)	33.12 12.14	21.15 13.45	1.96 1.37	1.60 0.42	0.67 0.13
AVERAGE	32.52 10.24	22.12 12.42	1.69 0.56	1.64 0.25	0.65 0.13

Comparison of Doppler Findings and Blood Pressure Parameters

Table 5 presents the Doppler findings of the study population, with measurements from both the right and left eyes. The average peak systolic velocity (PSV) for the right eye is 34.28 (PSV1) and 24.12 (PSV2), with a PSV2/PSV1 ratio of 0.68 and a pulsatility index (PI) of 1.00. For the left eye, the corresponding values are 32.52 for PSV1 and 22.12 for PSV2, with a PSV2/PSV1 ratio of 0.65 and a PI of 0.56. These measurements show slight differences between the eyes, with the right eye having slightly higher PSV and PI values on average.

Table 6: **Blood Pressure Parameters of Study Population**

Parameter	Mean	Median	Minimum	Maximum
SBP1	124.53+/-7.07	126.00	110.00	134.00
SBP2	125.12+/-10.06	128.00	78.00	134.00
DBP1	82.73+/-9.57	80.00	70.00	128.00
DBP2	83.02+/-6.71	82.00	70.00	92.00
MAP	98.81+/-10.44	98.50	87.00	129.00

In **Table 6**, the blood pressure parameters are summarized. The mean systolic blood pressure (SBP) is 124.53 for the first measurement (SBP1) and 125.12 for the second (SBP2), indicating a slight increase from the first to the second measurement. Diastolic blood pressure (DBP) values also reflect a similar pattern, with a mean of 82.73 for DBP1 and 83.02 for DBP2. The mean mean arterial pressure (MAP) is 98.81, reflecting an overall indication of the average arterial pressure within the studied population.

When comparing these two tables, it is evident that the Doppler findings (related to the blood flow velocities and pulsatility index) and blood pressure parameters both contribute important insights into vascular health. The right eye shows a higher PSV and PI, which could reflect a higher degree of vascular resistance or altered blood flow in that region. Conversely, the blood pressure measurements indicate that the study population, on average, is experiencing moderate systolic and diastolic pressures, consistent with general population norms for adults.

These findings together suggest that while Doppler measurements of ocular blood flow provide valuable insights into the circulatory status of the eye, the blood pressure parameters

OPHTHALMIC ARTERY DOPPLER ANALYSIS

The term **"screen positive"** refers to participants exhibiting abnormal ophthalmic artery Doppler indices, specifically characterized by an elevated peak systolic velocity (PSV) ratio (PSV2/PSV1) and increased pulsatility index (PI), in either eye which suggest altered vascular resistance indicative of potential hypertensive disorders or pre-eclampsia in pregnancy.

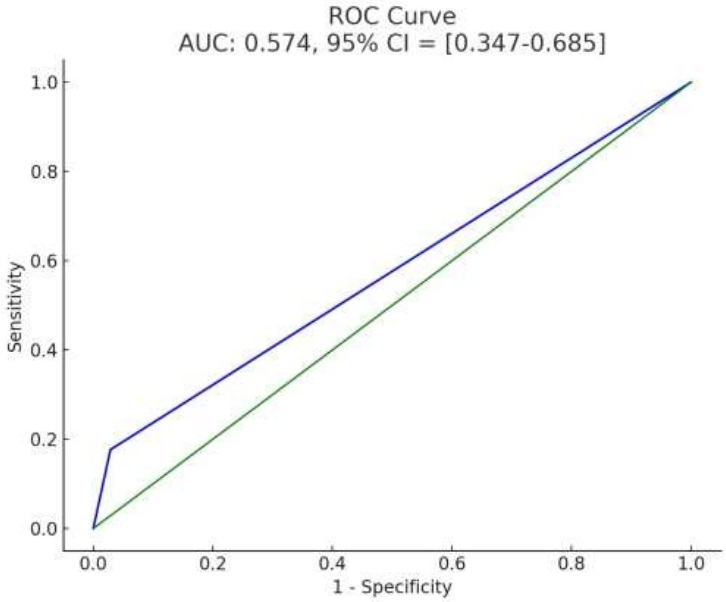
Total screen positive with ophthalmic artery	4
Total screen negative with ophthalmic artery	48

Table 7 Diagnostic Performance of Ophthalmic artery doppler for Predicting preeclampsia and /or other hypertensive disorders in pregnancy

Combination of two parameters [PSV1/PSV2 and Pi]	Condition Positive (Development of PE or and HDP)	Condition Negative (No Development of PE or and HDP)
Screen Positive (Abnormal Doppler)	3	1
Screen Negative (Normal Doppler)	14	34

AUC	0.57
p value	0.09
Sensitivity	17.65%
Specificity	97.14
PPV	75%
NPV	70.8%

Fig. 4: Area under curve of diagnostic performance of ophthalmic artery doppler with development of PE/HDP



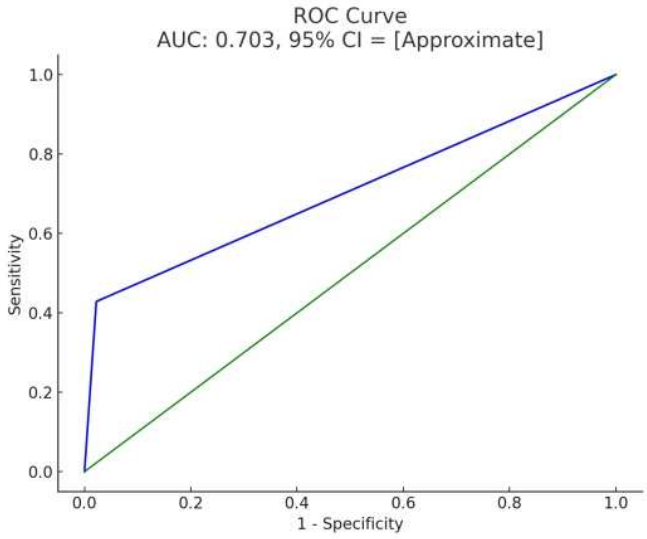
The data evaluates the diagnostic utility of combined ophthalmic artery Doppler parameters (PSV2/PSV1 ratio and PI in either eye) in predicting preeclampsia and /or other hypertensive disorders in pregnancy Among 52 participants, the test showed **low sensitivity (17.65%)** but **high specificity (97.14%)**, with an **AUC of 0.57** and a **non-significant p-value (0.09)**. While the **PPV was 75%** and **NPV 70.8%**, indicating moderate predictive values, the low sensitivity limits its effectiveness as a standalone screening tool

Table 8 Distribution of ophthalmic artery doppler parameter with FGR

Combination of two parameters [PSV2/PSV1 and Pi]	Condition Positive (FGR)	Condition Negative (No FGR)
Screen Positive (Abnormal Doppler)	3	1
Screen Negative (Normal Doppler)	4	44

AUC	70.3
p value	0.0059
Sensitivity	42.86%
Specificity	97.98%
PPV	75%
NPV	91.67%

Fig. 5: Area under curve of diagnostic performance of ophthalmic artery doppler with FGR



Since fetal growth restriction (FGR) is one of the diagnostic criteria for hypertensive disorders of pregnancy according to the ISSHP classification, the occurrence of FGR as a perinatal outcome was evaluated in both screen-positive and screen-negative

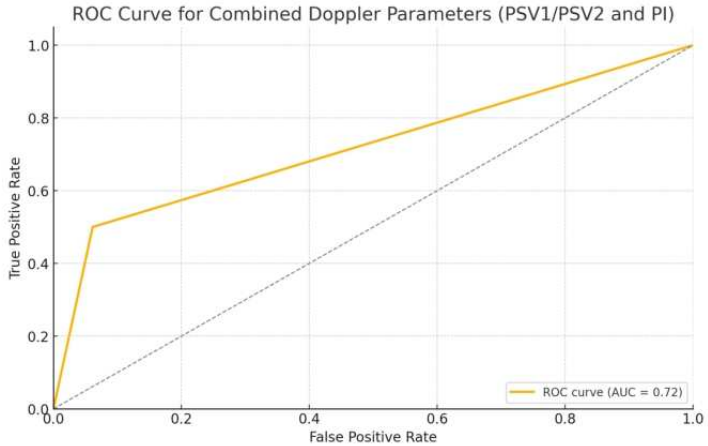
groups. The table 23 shows that ophthalmic artery Doppler (PSV2/PSV1 and PI) has high specificity (97.98%) and moderate sensitivity (42.86%) for detecting fetal growth restriction (FGR). With an AUC of 70.3 and a significant p-value (0.0059).

Table 9 Distribution of combined ophthalmic artery doppler parameter with NICU admission

Combination of two parameters [PSV2/PSV1 and Pi]	NICU admission	No NICU admission
Screen Positive (Abnormal Doppler)	1	3
Screen Negative (Normal Doppler)	1	46

AUC	0.72
p value	0.152
Sensitivity	50%
Specificity	93.9%
PPV	25%
NPV	97.97%

Fig. 6: Area under curve of diagnostic performance of ophthalmic artery doppler with NICU admission



The combination of PSV2/PSV1 and PI shows moderate accuracy in predicting NICU admission, with 50% sensitivity, 93.9% specificity, and a high NPV (97.9%), making it useful for ruling out risk. However, the PPV is low (25%), and the AUC of 0.72 reflects fair performance. The result is not statistically significant ($p = 0.152$).

Table: 10 Diagnostic Performance of Ophthalmic artery doppler of each parameter for Predicting preeclampsia and /or other hypertensive disorders in pregnancy, FGR and NICU admission

Parameter	PSV2/PSV1 Left	PSV2/PSV1 Right	Left PI	Right PI
AUC	0.516	0.619	0.547	0.625
p value	0.849	0.157	0.575	0.136
Sensitivity	33.34%	50.00%	50.00%	75.00%
Specificity	95.91%	96.00%	43.18%	48.94%
PPV	33.34%	33.33%	7.41%	11.11%
NPV	95.91%	97.96%	90.48%	95.83%

The table shows that right-sided Doppler parameters, especially Right PI (AUC 0.625, sensitivity 75%), have better diagnostic performance compared to left-sided measures. Right PSV2/PSV1 also showed good specificity (96%) and moderate AUC (0.619). In contrast, Left PI and Left PSV2/PSV1 had low AUCs and poor predictive value. Although none of the results were statistically significant, right-sided indices, particularly PI, appear more promising for identifying risk.

UTERINE ARTERY DOPPLER ANALYSIS

Total screen positive with uterine artery doppler	3
Total screen negative with uterine artery doppler	49

Table 11: Diagnostic Performance of Uterine artery Pi and development for Predicting preeclampsia/HDP

	Developed Pre-eclampsia/HDP	Not developed Pre-eclampsia/HDP
Screen Positive (Abnormal Doppler)	1	2
Screen Negative (Normal Doppler)	3	45

AUC	0.425
p value	0.372
Sensitivity	25.0%
Specificity	95.74
PPV	33.33%
NPV	93.75%

Fig. 7: Area under curve of diagnostic performance of uterine artery doppler with development PE/HDP

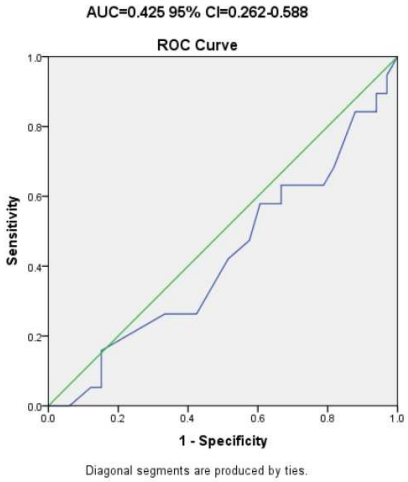


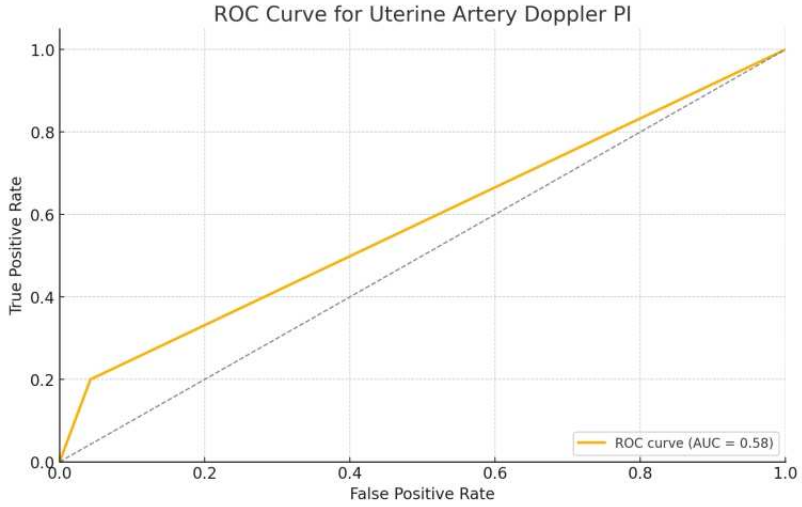
Table 11 illustrates the diagnostic performance of Uterine artery PI for predicting preeclampsia (PE) demonstrates an AUC of 0.425, suggesting a poor ability to differentiate between PE-positive and PE-negative cases. The sensitivity is low at 25%, indicating that the test correctly identifies only 25% of the actual positive cases. However, the specificity is high at 95.74%, meaning it effectively identifies the majority of PE-negative cases. The PPV is 33.33%, and the NPV is 93.75%, suggesting the test is more reliable in identifying individuals who do not have preeclampsia.

Table 12 Diagnostic performance of ophthalmic artery Doppler with FGR

Uterine Artery doppler Pi	Condition Positive (FGR)	Condition Negative (No FGR)
Screen Positive (Abnormal Doppler)	1	2
Screen Negative (Normal Doppler)	4	45

AUC	0.58
p value	0.266
Sensitivity	20%
Specificity	95.7%
PPV	33.33%
NPV	91.8%

Fig. 8: Area under curve of diagnostic performance of Uterine artery Doppler with FG



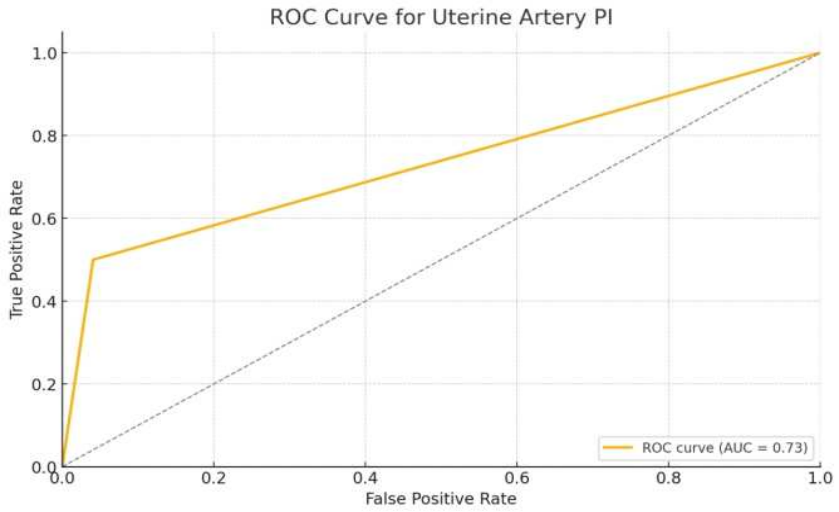
Since fetal growth restriction (FGR) is one of the diagnostic criteria for hypertensive disorders of pregnancy according to the ISSHP classification, the occurrence of FGR as a perinatal outcome was evaluated in both screen-positive and screen-negative groups. Uterine artery Doppler PI shows high specificity (95.7%) and NPV (91.8%), making it useful for ruling out FGR. However, its low sensitivity (20%) and PPV (33.3%) indicate poor ability to detect true cases. The association with FGR is not statistically significant (p = 0.266), and the AUC of 0.58 reflects poor predictive accuracy. Overall, it has limited value as a screening tool for

Table 13 Distribution of combined Uterine artery doppler parameter with NICU admission

Uterine Artery Pi	NICU admission	No NICU admission
Screen Positive (Abnormal Doppler)	1	2
Screen Negative (Normal Doppler)	1	47

AUC	0.73
p value	0.115
Sensitivity	50%
Specificity	96%
PPV	33.3%
NPV	97.9%

Fig. 9: Area under curve of diagnostic performance of Uterine artery Doppler with NICU admission



Uterine artery PI shows moderate accuracy in predicting NICU admission, with a sensitivity of 50% and specificity of 96%. Its high NPV (97.9%) suggests it is useful for ruling out NICU need, though the PPV is low (33.3%). The AUC of 0.73 reflects fair discriminative ability, but the p-value (0.115) indicates the result is not statistically significant.

Table 14 COMPARISON BETWEEN OPTHALMIC ARTERY DOPPLER AND UTERINE ARTERY DOPPLER

Parameter	Uterine Artery Doppler (PE/HDP)	Ophthalmic Artery Doppler (PE/HDP)	Uterine Artery Doppler (NICU)	Ophthalmic Artery Doppler (NICU)	Ophthalmic Artery Doppler (FGR)	Uterine Artery Doppler (FGR)
AUC	0.425	0.57	0.73	0.72	0.703	0.58
p value	0.372	0.09	0.115	0.152	0.0059	0.266
Sensitivity	25.00%	17.65%	50%	50%	42.86%	20%
Specificity	95.74%	97.14%	96%	93.90%	97.98%	95.70%
PPV	33.33%	75%	33.30%	25%	75%	33.33%
NPV	93.75%	70.80%	97.90%	97.97%	91.67%	91.80%

The table 14 presents a comparative overview of the diagnostic performance of uterine artery and ophthalmic artery Doppler parameters across three clinical outcomes: preeclampsia/hypertensive disorders of pregnancy (PE/HDP), NICU admission, and fetal growth restriction (FGR)

Table 15: Distribution of Liver Function Tests, LDH and platelet

Parameter	Mean	Median	Minimum	Maximum
Platelet	219.56+/-55.58	231.00	122.00	348.00
LDH	220.26+/-90.67	215.00	100.00	520.00
Uricacid	4.34+/- 0.73	4.40	2.20	6.10
SGOT	20.73+/-12.73	16.00	8.00	55.00
SGPT	17.17+/-6.83	14.00	9.00	34.00
ALP	111.36+/-36.17	120.00	40.00	190.00
S.Albumin	4.21+/-1.031	4.00	3.00	7.00
A:G	1.25+/-0.28	1.20	1.00	2.70

in **Table 15** offer a broader view of systemic vascular health. A deeper correlation between ocular Doppler findings and systemic blood pressure might reveal important relationships, especially in populations at risk for hypertension or pre-eclampsia.

Table 15 presents the distribution of blood components and enzymes among the study participants. The average platelet count is 219.56 (SD = 55.58), with a median of 231.00, which indicates a fairly typical platelet count within the normal reference range. The minimum platelet count recorded is 122, and the maximum is 348. Similarly, the average lactate dehydrogenase (LDH) level is 220.26 (SD = 90.67), with a median of 215.00, reflecting a broad range from 100.00 to 520.00. The mean uric acid level is 4.34 (SD = 0.73), which is within the expected range for healthy adults, with a minimum value of 2.20 and a maximum of 6.10. The mean serum glutamic-oxaloacetic transaminase (SGOT) is 20.73 (SD = 12.73), with values ranging from 8.00 to 55.00, and the mean serum glutamic-pyruvic transaminase (SGPT) is 17.17 (SD = 6.83), reflecting normal liver enzyme levels in most participants. Finally, the mean alkaline phosphatase (ALP) level is 111.36 (SD = 36.17), with a range from 40.00 to 190.00, suggesting variability but generally within the normal range for this enzyme.

- **Serum albumin** has a mean value of 4.21 g/dL, with a standard deviation of 1.03. The median is 4.00 g/dL, indicating that the majority of the study population have albumin levels within a relatively narrow range (3.00-7.00 g/dL). Serum albumin is a key protein that plays a role in maintaining oncotic pressure and protein balance in the body.

- The **A: G ratio**, which compares the levels of albumin to globulin in the serum, has a mean value of 1.25 with a standard deviation of 0.28. The ratio ranges from 1.00 to 2.70, with a median of 1.20. This ratio is significant as an altered A: G can indicate various health conditions, including liver disease or kidney dysfunction

Table 16: Distribution of Renal function test

Parameter	Mean	Median	Minimum	Maximum
S. screatinine	0.68+0.18	0.70	0.33	1.00

Table 16: Distribution of Renal function test

- **Serum creatinine**, a marker for kidney function, shows a mean of 0.68 mg/dL with a standard deviation of 0.18. The median is 0.70 mg/dL, and it ranges from 0.33 to 1.00 mg/dL. Elevated creatinine levels can indicate impaired kidney function, but in this case, the values are generally within the normal reference range for healthy individuals.

DISCUSSION

Table 1 demonstrate an apparent association between maternal age and the likelihood of screening positive for abnormal Doppler parameters.

Among the 52 participants, the highest proportion of abnormal Doppler findings was observed in women aged >30 years, where 3 out of 20 participants (15%) were screen positive, accounting for 75% of all Doppler-positive cases. In contrast, the 20–30-year age group, despite comprising the majority of the study population (61.5%), accounted for only one positive screen (3.1% of that group; 25% of total positives). Notably, there were no participants below 20 years of age, limiting interpretation in that subgroup.

Table 2 The study found that all participants who screened positive for abnormal ophthalmic artery Doppler parameters predicting PE/HDP were from the overweight BMI group (25–29.9), despite this group comprising only 55.1% of the cohort. No positive cases were observed in normal weight or obese categories, suggesting that Doppler screening may have greater predictive relevance among overweight pregnant women, highlighting the potential for BMI-targeted risk assessment.

Table 3 in this study, all screen-positive cases for PE/HDP were observed in multiparous women, while none were detected among nulliparous participants. Although nulliparity is a known risk factor for pre-eclampsia, this finding may reflect sample-specific characteristics or unmeasured confounders. The association between multiparity and abnormal ophthalmic artery Doppler findings suggests a potential predictive value in this subgroup, warranting further investigation in larger cohorts.

Study	Gestational Age (GA) at Assessment	Method	Sensitivity	Specificity	PPV	NPV	AUC	Statistical Significance	Remarks
Present Study	19–23 weeks	Ophthalmic artery Doppler (PSV2/PSV1 & PI only)	17.65%	97.14%	75 %	70.8 %	0.57	p = 0.09 (statistically not significant)	Limited predictive value; no biomarkers used
Sarno et al., 2021	35–37 weeks	Ophthalmic artery Doppler + maternal & biochemical markers	~50%(after calculating not specified in study)	~90%(after calculating not specified in study)	-	-	Significantly higher	Statistically significant	Strong performance when combined with markers
Sapantzoglou et al.	19–23 weeks	Ophthalmic artery Doppler + maternal & biochemical markers	-	-	-	-	Improved vs. Doppler alone	Statistically significant	Multimodal approach outperforms Doppler alone

This table describes Table 7 in the present study, using ophthalmic artery Doppler parameters (PSV2/PSV1 and PI) at 19–23 weeks, shows high specificity (97.14%) and PPV (75%), making it effective in confirming risk when abnormal. However, its low sensitivity (17.65%), poor AUC (0.57), and lack of statistical significance (p = 0.09) limit its value as a screening tool. Unlike the studies by Sarno et al. and Sapantzoglou et al., which combined Doppler with maternal and biochemical markers to achieve higher predictive performance, the present study relied solely on Doppler indices, which may explain the reduced sensitivity and overall discriminative power. The findings suggest that Doppler indices may better

confirm than detect PE and /or other HDP and should be used alongside other assessments.

Parameter	PRESENT STUDY	Abdel Azim et al., 2022
Gestational Age at Evaluation	19–23+0 weeks	35–37 weeks
Study Type	Descriptive observational (n=52)	Prospective observational (n=2287)
Main Doppler Parameters Studied	PSV2/PSV1 ratio, PI, MAP	PSV1, PSV2, PSV ratio, MAP MoM, PlGF MoM
FGR Association	3 of 7 FGR cases had abnormal Doppler	Elevated PSV ratio delta in FGR & SGA, higher MAP MoM, lower PlGF MoM
PSV1 Observation	Not individually assessed	Reduced in SGA without hypertension
PSV2 Observation	Not individually assessed	Increased in hypertensive cases
Sensitivity / Specificity for FGR	Sensitivity 42.86%, Specificity 97.98%	Not directly stated, diagnostic trends noted
AUC for FGR Prediction	0.703	Not reported, but showed linear associations
Correlation with MAP / PlGF	MAP included, PlGF not assessed	Significant correlation with both MAP and PlGF
Clinical Implication	Useful early screening tool, high specificity	Reflects vascular adaptation and fetal growth status

This table describes **Table 8** in the present study Ophthalmic artery Doppler (PSV2/PSV1 and PI) at 19–23 weeks shows high specificity (97.14%) but low sensitivity (17.65%) for predicting PE/HDP, with limited screening value (AUC 0.57, p = 0.09). In contrast, Sarno et al. and Sapantzoglou et al. achieved better results using combined Doppler, maternal, and biochemical markers. However, for FGR, the Doppler shows stronger performance with moderate sensitivity (42.86%), high specificity (97.98%), AUC of 0.703, and significant p-value (0.0059), the test reliably rules out FGR when normal (NPV: 91.67%) and has good predictive value when

abnormal (PPV: 75%). Overall, it is a statistically significant and specific tool for identifying FGR, though some cases may be missed due to limited sensitivity.

Study	Focus	Key Findings	Implications	Conclusion
Present Study (Ophthalmic Doppler)	Prediction of NICU admission using PSV2/PSV1 and PI	AUC: 0.72; Sensitivity: 50%; Specificity: 93.9%; PPV: 25%; p = 0.152	Moderate predictive accuracy; limited statistical significance; suggests broader placental dysfunction	Doppler useful but limited alone; better in integrated models
Ness & Sibai (2006)	Shared vascular pathophysiology of PE and FGR	Vascular changes in PE and FGR reflect systemic and placental dysfunction	Supports vascular basis for Doppler changes; highlights need for integrated assessment	Reinforces pathophysiological rationale for Doppler use in obstetric risk prediction

This table describes **Table 9** in the present study showed that ophthalmic artery Doppler (PSV2/PSV1 and PI) has moderate predictive value for NICU admission (AUC 0.72, sensitivity 50%, specificity 93.9%), but limited statistical significance (p = 0.152) and low PPV (25%). Compared to Ness and Sibai (2006), who emphasized the shared vascular pathophysiology of FGR and PE, these findings suggest that Doppler changes may reflect broader placental dysfunction. However, the limited sensitivity highlights the need for integrated approaches that better capture the multifactorial nature of these conditions.

Aspect	Present Study	Poon et al., 2011 / O'Gorman et al., 2017
Study Focus	Prediction of PE/HDP using uterine artery PI alone	Early prediction of PE using Doppler + biomarkers + maternal factors
Gestational Age	19–23 weeks	11–13 or 19–24 weeks
Method	Uterine artery Doppler (PI only)	Uterine artery Doppler + biochemical + maternal history
Sensitivity	25.0%	Not specified
Specificity	95.74%	Not specified
PPV	33.33%	Not specified
NPV	93.75%	Not specified
AUC	0.425	>0.8
Statistical Significance	p = 0.372 (not significant)	Statistically significant
Key Insight	High specificity but poor sensitivity and overall performance	Multimodal screening significantly improves predictive performance

This table describes **Table 11** In this study, uterine artery PI showed limited predictive value for preeclampsia or HDP, with low sensitivity (25%), high specificity (95.74%), a modest PPV (33.33%), NPV (93.75%), and poor overall performance (AUC 0.425, p = 0.372). In contrast, studies by Poon et al. and O'Gorman et al. demonstrated significantly better predictive accuracy using a combined approach of uterine artery Doppler, maternal risk factors, and biochemical markers, achieving AUCs >0.8. These findings highlight that uterine artery PI alone, especially when

measured in the second trimester, may be insufficient for reliable screening, reinforcing the need for multimodal prediction strategies.

Study	Focus	Key Findings	Implications	Conclusion
Present Study (Uterine Artery Doppler)	Prediction of FGR using uterine artery Doppler PI at 19–23 weeks	AUC: 0.58; Sensitivity: 20%; Specificity: 95.7%; PPV: 33.3%; NPV: 91.8%; p = 0.266	High specificity but low sensitivity; limited standalone predictive value for FGR	Better at ruling in FGR than ruling it out; Doppler alone may not suffice
Melchiorre et al. (2008)	Second trimester uterine artery Doppler for adverse outcomes	Abnormal PI associated with higher risk of FGR and PE; improved detection	Supports use of uterine Doppler in mid-trimester screening protocols	Validated uterine Doppler as early risk indicator
Bower et al. (2010)	Uterine artery Doppler and perinatal outcome	Uterine artery notching and elevated PI linked to increased adverse outcomes	Confirms utility in identifying pregnancies at risk for growth complications	Uterine Doppler helps stratify risk but benefits from combination with other markers

This table describe **Table 12** in the present study found that uterine artery Doppler PI at 19–23 weeks had high specificity (95.7%) but low sensitivity (20%) for predicting FGR, with limited overall accuracy (AUC = 0.58, p = 0.266). This suggests its value lies more in confirming than excluding FGR. In contrast, Melchiorre et al. (2008) and Bower et al. (2010) reported stronger associations between abnormal PI and adverse outcomes, supporting its role in mid-trimester risk stratification. These findings highlight the need for combined screening approaches to improve early detection**.**

Aspect	Present Study	Melchiorre et al., 2008 / Bower et al., 2010
Study Focus	Prediction of NICU admission using uterine artery PI	NICU admission and Prediction of adverse neonatal outcomes
Gestational Age	19–23 weeks	Second and third trimester
Method	Uterine artery Doppler (PI only)	Uterine artery Doppler + fetal growth or maternal risk factors
Sensitivity	50%	Higher than Doppler alone
Specificity	96%	Not speficied
PPV	33.3%	Not speficied
NPV	97.9%	Not specified
AUC	0.73	>0.8
Statistical Significance	p = 0.115 (not significant)	Statistically significant
Key Insight	Fair predictive value; high NPV; moderate utility for ruling out risk	Multimodal approach improves predictive accuracy for neonatal outcomes

This table describe **Table 13** In this study, uterine artery PI showed fair predictive value for NICU admission, with sensitivity of 50%, specificity of 96%, PPV of 33.3%, NPV of 97.9%, and an AUC of 0.73, though not statistically significant (p = 0.115). These findings align with studies like Melchiorre et al. and Bower et al., which reported improved predictive performance when uterine artery Doppler was combined with fetal growth assessment or maternal risk factors. While

PI alone offers good specificity and NPV, its moderate sensitivity highlights the need for multimodal approaches to better predict adverse neonatal outcomes. Early detection. However, both methods exhibited limitations in terms of predictive accuracy when used independently

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Study / Parameter	AUC	Sensitivity	Specificity	PPV	NPV	Statistical Significance
Present Study - Uterine Doppler (PE/HDP)	0.425	25.00%	95.74%	33.33%	93.75%	p = 0.372
Present Study - Ophthalmic Doppler (PE/HDP)	0.57	17.65%	97.14%	75%	70.80%	p = 0.09
Present Study - Ophthalmic Doppler (NICU)	0.72	50%	93.90%	25%	97.90%	p = 0.152
Present Study - Uterine Doppler (NICU)	0.73	50%	96%	33.30%	97.90%	p = 0.115
Present Study - Ophthalmic Doppler (FGR)	0.703	42.86%	97.98%	75%	91.67%	p = 0.0059
Present Study - Uterine Doppler (FGR)	0.58	20%	95.70%	33.33%	91.80%	p = 0.266
Sarno et al. (2021)	Not specified	50–57.9%	~90%	Improved	Improved	Yes
Sapantzoglou et al.	Improved	Higher than Doppler alone	Higher than Doppler alone	Improved	Improved	Yes
Poon et al. (2011)	High	High	High	Not stated	Not stated	Yes
O'Gorman et al. (2017)	High	High	High	Not stated	Not stated	Yes

This table describe **Table 14** ophthalmic artery Doppler demonstrated a slightly better overall diagnostic performance than the uterine artery Doppler, with a higher AUC (0.57 vs. 0.425) and a p-value closer to statistical significance (0.09 vs. 0.372). Although both modalities showed low sensitivity (17.65% and 25.00%, respectively), they exhibited high specificity, particularly the ophthalmic artery Doppler (97.14% vs. 95.74%). The positive predictive value (PPV) was notably higher for the ophthalmic artery Doppler (75% vs. 33.33%), indicating greater reliability when a test result is positive. Conversely, the uterine artery Doppler showed superior negative predictive value (NPV) at 93.75% compared to 70.80%, suggesting it is more effective in ruling out disease. Overall, while both Doppler methods have limited sensitivity and diagnostic accuracy, the ophthalmic artery Doppler may be more useful in confirming disease, uterine artery Doppler, on the other hand, consistently offers better NPV, making it more reliable for ruling out disease or adverse outcomes like NICU admission. Overall, the ophthalmic Doppler adds value as a confirmatory tool, particularly in high-risk populations, while uterine Doppler is more helpful for broader screening.

PSV2/PSV1 Ratio (Right and Left): Showed high specificity (95–97%) but low sensitivity (33.34–50%), limiting its use as a standalone screening tool. It is more suited for confirmatory rather than predictive purposes.

Pulsatility Index (PI): PI values, including uterine artery PI, demonstrated limited diagnostic performance. Uterine artery PI had particularly poor results with sensitivity of 25% and AUC of 0.425, reinforcing that it is insufficient alone for early PE prediction.

Uterine Artery PI Performance: Emerged as the least effective parameter, with both low sensitivity and low AUC, suggesting a need to re-evaluate its role as a first-line screening tool, especially when not used alongside other markers.

Combined Parameters (PSV2/PSV1 and PI): The combination showed high specificity (97.14%) but very low sensitivity (17.65%), with AUC 0.57 and non-significant p-value (0.09). Despite limited screening utility, the high PPV (75%) indicates that abnormal findings are clinically meaningful and may be valuable in confirming risk in selected patients.

Clinical Implications:

Early Prediction of Pre-eclampsia:

The study suggests that maternal ophthalmic artery Doppler, particularly the PSV2/PSV1 ratio, can be a valuable non-invasive tool for early prediction of pre-eclampsia. Its high specificity (96% for the right ophthalmic artery) makes it a reliable marker for identifying women at low risk, while its moderate sensitivity (50%) indicates potential for detecting at-risk cases.

Incorporating ophthalmic artery Doppler into routine antenatal care could help identify high-risk women earlier, allowing for timely interventions such as closer monitoring, lifestyle modifications, or prophylactic treatments (e.g., low-dose aspirin).

Complementary Role to Uterine Artery Doppler:

Ophthalmic artery Doppler demonstrated better sensitivity compared to uterine artery Doppler, which had low sensitivity (25%) despite high specificity (95.74%). This suggests that ophthalmic artery Doppler could serve as a complementary or even alternative tool, especially in cases where uterine artery Doppler results are inconclusive.

Correlation with Disease Severity:

Abnormal ocular artery PI and PSV2/PSV1 ratio values were related with increased MAP, suggesting a relationship between Doppler results and hypertension disease severity. This could help clinicians stratify risk and tailor management strategies based on disease severity.

Non-Invasive and Accessible Tool:

Ophthalmic artery Doppler is non-invasive and relatively easy to perform, making it a practical addition to routine antenatal screening, particularly in resource-limited settings where advanced biomarkers (e.g., PlGF, sFlt-1) may not be readily available.

Study Implications:

Need for Larger, Multi-Center Studies:

The results are limited by the small sample size (n=52) and single-center design. Ophthalmic artery Doppler needs larger, multi-center investigations to confirm its diagnostic efficacy and set clinical standards.

Integration with Biomarkers:

Combining ophthalmic artery Doppler with other biomarkers (e.g., PlGF, sFlt-1) could enhance predictive accuracy. Future research should explore integrated models that combine Doppler parameters with biochemical and clinical markers to develop a comprehensive risk assessment tool.

Exploration of Severe Pre-eclampsia Cases:

This study lacks severe pre-eclampsia patients, making it difficult to evaluate ophthalmic artery Doppler's diagnostic performance. Future studies should include a broader spectrum of pre-eclampsia severity to evaluate the tool's effectiveness across different disease stages.

Longitudinal Studies:

Longitudinal studies could help determine the optimal gestational age for ophthalmic artery Doppler measurements and assess its predictive value over time. It would reveal pre-eclampsia development and the value of repeated assessments.

Improved Maternal and Perinatal Outcomes:

Ophthalmic artery Doppler may detect pre-eclampsia risk early, lowering maternal and perinatal mortality. This is crucial in low-resource situations where pre-eclampsia is a major risk factor.

Cost-Effective Screening:

Ophthalmic artery Doppler is a cost-effective and accessible tool that could be integrated into antenatal care programs, especially in settings with limited access to advanced diagnostic technologies. This could help bridge gaps in pre-eclampsia screening and management.

Enhanced Risk Stratification:

By improving risk stratification, ophthalmic artery Doppler could help allocate resources more efficiently, ensuring that high-risk women receive appropriate care while reducing unnecessary interventions for low-risk women.

Pre-eclampsia may be predicted early using maternal ophthalmic artery Doppler, according to the study. Its high specificity and moderate sensitivity, particularly for the PSV2/PSV1 ratio, make it a valuable addition to existing screening methods. More study is required to confirm these results, improve diagnostic criteria, and integrate it with additional biomarkers. Ophthalmic artery Doppler might enhance maternal and perinatal outcomes by detecting and treating pre-eclampsia early if verified.

STRENGTH OF THIS STUDY

- **Comprehensive Evaluation:** The study assessed multiple diagnostic parameters (Doppler indices, perineonatal outcomes), offering a well-rounded view of preeclampsia prediction.

- **Detailed Doppler Analysis:** Inclusion of right and left PSV2/PSV1 ratios and average PI values provided nuanced insights into vascular changes associated with preeclampsia.

- **Observer Bias:** All Doppler assessments were performed by a single sonologist, enhancing consistency.

- **Non-invasive Focus:** Emphasizes practical, low-risk screening tools suitable for routine antenatal care, especially in low-resource settings.

Overall, the strengths of this study lie in its comprehensive evaluation of various diagnostic parameters, its focus on non-invasive techniques, and its thorough statistical analysis, which together provide valuable insights for improving preeclampsia prediction and management.

LIMITATION OF WORK:

1.Small Sample Size: With only 52 participants, generalizability is limited.

2.Single-Center Design: Findings may not reflect broader populations or clinical settings.

These limitations should be considered when interpreting the results, and further studies with larger, diverse populations and long-term follow-ups are needed to confirm the findings.

SUMMARY

This study conducted at KAHER's Jawaharlal Nehru Medical College (JNMC), Belagavi, aimed to evaluate the role of maternal ophthalmic artery Doppler parameters specifically the PSV2/PSV1 ratio and pulsatility index (PI) in predicting preeclampsia (PE) and hypertensive disorders in pregnancy (HDP) during 19–23+0 weeks of gestation, based on ISSHP criteria. and compared the diagnostic performance with that of uterine artery Doppler, the conventional method.

The present study evaluated the role of maternal ophthalmic artery Doppler between 19 and 23+0 weeks of gestation in predicting preeclampsia (PE), hypertensive disorders of pregnancy (HDP), fetal growth restriction (FGR), and neonatal outcomes such as NICU admission. Among the 52 participants, the highest proportion of Doppler-positive cases was found in women aged over 30 years, who accounted for 75% of all screen-positive cases, despite representing only 38.5% of the cohort. All screen-positive cases were observed among overweight women (BMI 25–29.9), while none were detected in normal weight, obese, or extremely obese categories. Similarly, all four screen-positive participants were multiparous,

suggesting parity and BMI as possible influencing factors for abnormal Doppler findings.

The ophthalmic artery Doppler analysis showed Combined Doppler parameters (PSV1/PSV2 ratio and PI of either eye) had high specificity (97.14%) and positive predictive value (PPV) of 75% for predicting PE/HDP, but low sensitivity (17.65%) and a non-significant AUC of 0.57, indicating limited standalone screening utility. For predicting FGR, however, the same combination of parameters showed improved performance with an AUC of 0.703, sensitivity of 42.86%, specificity of 97.98%, and a statistically significant p-value of 0.0059. The prediction of NICU admission also showed moderate accuracy with an AUC of 0.72 and specificity of 93.9%, though statistical significance was not achieved.

In contrast, uterine artery Doppler parameters demonstrated limited predictive value. The pulsatility index alone had a low sensitivity of 25% and an AUC of 0.425 for detecting PE/HDP, with high specificity (95.74%) but no statistical significance. Its performance for FGR and NICU admission prediction was similarly limited, though specificity and NPV remained high. Overall, the study highlighted that while ophthalmic artery Doppler—particularly right-sided PI—may serve as a specific tool for confirming risk, its low sensitivity makes it inadequate as a sole screening modality. The findings reinforce the importance of multimodal screening approaches combining Doppler studies with maternal risk factors and biochemical markers, which have shown superior predictive performance in external studies.

CONCLUSION

The findings from the study indicate that ophthalmic artery Doppler demonstrates high specificity and low sensitivity in predicting pre-eclampsia, with a positive predictive value (PPV) of 75% and a negative predictive value (NPV) of 70.8%. This suggests that individuals who screen positive using ophthalmic artery Doppler parameters are at a significantly elevated risk of developing pre-eclampsia. However, its ability to reliably exclude the condition among screen-negative individuals is comparatively limited. When compared to uterine artery Doppler (pulsatility index), the ophthalmic Doppler shows superior performance in positive prediction but inferior predictive ability in identifying true negatives, indicating its stronger utility in confirming rather than ruling out the risk of pre-eclampsia.

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ANNEXURE I:

KAHERs JNMC
BELAGAVI

From ,

REG. NO. BJ0122014

Junior Resident ,

Department of Obstetrics and Gynecology,

JNMC Belagavi.

To ,

The Chairman ,

Ethical committee,

JNMC,

Belagavi,

Subject : Regarding ophthalmic artery Doppler imaging reporting done for the study: Maternal Ophthalmic artery Doppler at 19 to 23+0 weeks as predictor of pre-eclampsia :Descriptive Observational Study

Respected Sir /Madam,

I , Dr Shivanand Bubanale (Professor and head of the department ophthalmology at JNMC) writing to provide a detailed report regarding the imaging finding related to the ophthalmic artery Doppler study done for the dissertation of] REG. NO. BJ0122014 , junior resident at department of Obstetrics and Gynecology ,for prediction of pre-eclampsia done under the guidance of Department of Obstetrics and gynecology ,JNMC)

Upon evaluation , the ophthalmic artery was successfully identified ,and arterial flow was clearly noted . The acquired images demonstrated well-defined vascular structures ,confirming the presence of flow within the artery . Additionally the overall quality of images is satisfactory , allowing for accurate interpretation and analysis

Kindly do the needful

Thanking you,

Date: 13/03/2025

Place : Belagavi

Yours Sincerely

Dr. Shivanand C. Bubanale
Consultant
KMC Reg. No. 56642
Dept of Ophthalmology
KLES Dr. Prabhakar Kore Hospital
& MRC, Belagavi

ANNEXURE II:

INFORMED CONSENT

KAHER's Jawaharlal Nehru Medical College (JNMC), Belagavi

"Maternal Ophthalmic Artery Doppler at 19 to 23 +0 weeks as a Prediction of Pre-eclampsia: A Descriptive Observational Study"

You are asked to participate in the "Maternal Ophthalmic Artery Doppler at 19 to 23+0 weeks as a Prediction of Pre-eclampsia" study. This research will assess the accuracy of ophthalmic artery Doppler, a non-invasive technique, in predicting pre-eclampsia risk in pregnant women. Early identification is essential for managing pre-eclampsia, which may harm both mother and child.

This study examines whether ophthalmic artery Doppler measurements taken between 19 and 23+0 weeks of pregnancy may indicate pre-eclampsia risk.

What Will Happen During the Study?

If you agree to participate, the following will occur:

1. **Screening**: You will be screened to ensure you meet the eligibility criteria for the study.
2. **Doppler Assessment**: A trained healthcare professional will perform an ophthalmic artery Doppler test. This is a painless and non-invasive procedure where a small ultrasound probe is gently placed on your closed eyelid to measure blood flow in the ophthalmic artery. The procedure takes only a few minutes and does not harm your eyes.
3. **Follow-Up**: Your pregnancy outcomes will be monitored to determine if you develop pre-eclampsia.

Possible Benefits of Participating

- You will not receive any direct medical benefits from participating in this study.
- However, the information gathered from this study may help improve the early detection of pre-eclampsia in future pregnancies, benefiting other women.

Possible Risks of Participating

- There are no known risks associated with the ophthalmic artery Doppler test. It is a safe and non-invasive procedure.
- The ultrasound probe will be gently placed on your closed eyelid, and the procedure will be completed in a few seconds to minimize any discomfort.

Voluntary Participation

Your participation in this study is entirely voluntary. You are free to decide whether or not to participate. If you choose to participate, you can withdraw from the study at any time without affecting your regular medical care.

Privacy and Confidentiality

All information collected during the study will be kept strictly confidential. Your identity will not be revealed in any reports or publications. The data will be coded and used only for research purposes.

Financial Incentives

You will not receive any payment for participating in this study.

Publication of Results

The results of this study may be published in scientific journals or presented at conferences. However, your identity will remain confdential, and only aggregated data will be used.

Contact Information

If you have any complaints or concerns about your rights as a study participant, you may contact:

- Dr. Harsha Hegde, Chairperson, Institutional Ethics Committee, JNMC Phone: 0831-2473777 (Extension 4052)

CONSENT STATEMENT

By signing the consent form, you confirm that:

- You have read and understood the information provided.
- You voluntarily agree to participate in the study.
- You were given the opportunity to ask questions, and they were answered to your satisfaction.

Thank you for considering participation in this study. Your contribution will help advance medical knowledge and improve care for pregnant women.

Name of the Participant: _____

Signature/Left Thumb Impression: _____

Date: _____

PROFORMA

SCREENING FORM

Participant information :

Screening number:

OP number:

Date of screening(dd-mm-yyyy):

First name :

Middle name :

Last name :

Husband's name:

Age (years). :

Address: H.no. -

Street -

Taluka-

District-

Phone number 1:

Phone number 2:

Eligibility –

Yes- 1, No - 2

Screening form

Date of screening –

(dd/mm/yyyy)

1) Is POG between 19 to 23 Yes No

LMP –

EDD -

USG 1st trimester EDD –

Actual gestational age –

2) Inclusion criteria :

1. Singleton Live Gestation. ☐

2. Women age >18years < 35 years ☐

If eligible, consent to be taken.

3) Exclusion criteria:

- Hypertensive disorders in pregnancy Yes. ☐ No ☐

If Yes on any treatment

- Ocular infections/trauma Yes ☐ No ☐
- known cardiac diseases Yes. ☐ No ☐
- Diagnosed Congenital Anomalies.
- Thromboembolic disorders on T. Ecospirin (>75mcg) Yes ☐ No ☐

Eligibility

Is the eligible for the study? Yes. ☐ No ☐

Enrollment:

Was women enrolled in the study? Yes. ☐ No ☐

Note:

POG: Period of Gestation

Data collection instrumentation

Date of Examination

Enrollment number

Obstetric history:

Married Life (years) :

Consanguinity : (YES - 1, NO - 2)

If yes,

Degree of consanguinity :

Obstetric score :

Gravida Para Live Abortion

LMP: EDD : POG:

Past History : YES – 1 , NO – 2

a. Known case of Diabetes mellitus :

If yes, Duration (in years) :

Treatment received :

b. Known case of Hypertension :

If yes, Duration (in years) :

Treatment received :

d. Known case of Cardiac disorder :

If yes, Duration (in years) :

Treatment received :

General physical examination- at admission

Height (in centimetres)

Weight (in kilogram)

BMI (Yes – 1, No – 2)

Pedal Oedema

Blood pressure (mmHg) systolic – ☐☐☐

diastolic - ☐☐☐

MAP ☐☐☐

Pulse rate (beats per minute) -

Systemic examination :

Per Abdomen: Uterine size (in weeks) : ☐☐☐☐

Presentation : ☐☐☐☐☐☐☐☐☐☐

Fetal Heart rate : ☐☐☐ beats per minute

Cardiovascular examination :

Respiratory examination:

DOPPLER FINDING:

	PSV1	PSV2	PSV1/PSV2	PI	RI
Right(a)					
Right(b)					
Average					
Left (a)					
Left (b)					
Average					

RIGHT UTERINE ARETERY Pi	**LEFT UTERINE ARETERY Pi**	**MEAN UTERINE ARETERY Pi**

PROVISIONAL DIAGNOSIS

FOLLOW UP DATA COLLECTION

Date of Examination ☐☐ ☐☐ ☐☐☐☐

Enrollment number ☐☐ ☐☐ ☐☐☐☐

LMP: EDD: POG:

GENERAL PHYSICAL EXAMINATION

General condition:

Pallor ; Icterus ; Edema

BP READINGS 4 HOURS APART

SBP1: DBP1:

SBP2: DBP2:

MAP(Mean Arterial blood pressure)

Per Abdomen: Uterine size (in weeks) : ☐☐☐☐

Presentation : ☐☐☐☐☐☐☐☐☐☐

Fetal Heart rate : ☐☐☐ beats per minute

Cardiovascular examination

Respiratory examination

INVESTIGATIONS

Platelet	LDH	Uric Acid	SGOT	SGPT	ALP	S. Albumin	A:G	S.Creatinine	Urine albumin	

INFERENCE:

2nd FOLLOW UP TILL /AFTER DELIVERY

(Via case papers /telephonic conversation)

Enrollment number

INSTITUTIONAL DELIVERY/HOME DELIVERY:

TERM/PRE-TERM :

MODE OF DELIVERY:

-If NVD: Spontaneous /Induced

Usage of Instrument: YES ☐ ☐ NO

-If LSCS INDICATION

BIRTH WEIGHT

DEVELOPMENT OF PRE-ECLAMPSIA/G.HTN:

SL_no	screening number	Enrollment number	Age	POG_19_to_23	LMP	EDD	USG_1st_EDD	Actual_GA	Singleton_live_gestation	Age_18_to_35	Gravida	Para	Live	Abortion	Menarche	DM	Duration_DM	HTN	Duration_HTN	Cardiac_disorder	Duration_cardiac_disorder	Hypothyroidism	Past_surgeries	
1	OA 04	1		22 weeks 2 days	07-12-2024	28-09-2024	29-09-2024	22weeks 2 days	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	cervicle encerlage +appendicectomy	no
2	OA 05	2	26	21 weeks 6 days	26-09-2023	03-07-2024	06-07-2024	21 weeks 6 days yes	yes	yes	1				13	no	-	no	-	no	-	no	no	no
3	OA 06	3	30	23 weeks	31-12-2023	06-10-2024	07-10-2024	23 weeks	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	no	no
4	OA 07	4	31	20 weeks 6 days	01-10-2024	16-10-2024	31-10-2024	20 weeks 6 days	yes	yes	2	1	1	0	13	no	-	no	-	no	-	no	no	no
5	OA 09	5	22	22 weeks 5 days	26-09-2024	10-07-2024	12-07-2024	22 weeks 5 days	yes	yes	3	2	1	DEATH :1	13	no	-	n0	-	no	-	no	no	n0
6	OA 10	6	32	21 weeks 3 days	24-12-2023	29-09-2024	01-10-2024	21 weeks 3 days	yes	yes	2	0	0	1	14	no	-	no	-	no	-	no	no	no
7	OA 12	7	24	20 weeks 4 days	19-10-2023	25-07-2024	27-07-2024	20 weeks 4 days	yes	yes	1	0	0	0	13	no	-	no	-	no	-	no	no	no
8	OA 14	8	22	22 weeks 3 days	07-01-2024	13-10-2024	13-10-2024	22weeks 3 days	yes	yes	2	0	0	1	14	no	-	no	-	no	-	no	no	no
9	OA 16	9	20	20 weeks 4 days	19-10-2024	25-07-2024	25-07-2024	20 weeks 4 days		yes	2	1	1	0	14	no	-	no	-	no	-	no	no	no
10	OA 17	10	26	21 weeks 4 days 7-10-2024	07-10-2024	28-06-2024	26-06-2024	21 weeks 4 days	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	no	no
11	OA 18	11	32	22 weeks 3 days	24-12-2023	29-09-2024	01-10-2024	22weeks 3 days	yes	yes	2	1	1		13	no	-	no	-	no	-	n0	n0	no
12	OA 19	12	30	21 weeks 1 day	24-12-2023	29-09-2024	30-09-2024	21 weeks 1 day	yes	yes	3	1	1	1	14	no	-	no0	-	no	-	no	no	no
13	OA 20	13	28	20 weeks	09-01-2024	15-10-2024	20-10-2024	20 weeks	yes	yes	1	0	0	0	14	no	-	no	-	no	-	no	no	no
14	OA 21	14	25	21 weeks 4 days 7-10-2024	11-01-2024	17-10-2024	22-10-2024	21 weeks 4 days	yes	yes	4	1	1	2	14	no	-	no	-	no	-	no	yes(prev lscs)	no
15	OA 22	15	34	22 weeks	06-01-2024	12-10-2024	10-10-2024	22 weeks	yes	yes	1	0	0	0	14	no	-	no	-	no	-	no	no	no
16	OA 23	16	34	21 weeks 1 day	29-11-2023	09-04-2024	12-04-2024	21 weeks 1 day	yes	yes	4	1	0	2	13	no	-	no	-	no	-	no	yes(prev lscs)	no
17	OA 24	17	32	21 weeks 2 days	20-02-2024	29-07-2024	30-11-2024	21 weeks 2 days	yes	yes	3	2	2	0	14	no	-	no	-	no	-	no	yes;prev 2 LSCS	no
18	OA 25	18	33	22 weeks	09-01-2024	15-10-2024	16-10-2024	22 weeks	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	yes(prev lscs)	no
19	OA 26	19	33	21 weeks 1 day	19-12-2023	24-09-2024	20-09-2024	21 weeks 1 day	yes	yes	3	0	0	2	14	no	-	no	-	no	no	yes on thyronorm 50 mcg	no	no
20	OA 27	20	34	20 weeks 4 days	19-10-2024	25-07-2024	25-07-2024	20 weeks 4 days		yes	2	1	1	0	14	no	-	no	-	no	-	no	yes(prev lscs)	no
21	OA 28	21	26	19 weeks	09-10-2024	02-06-2023	09-32-2025	19 weeks	yes	yes	2	1	1	0	13	no	-	no	-	n0	-	no	yes(prev lscs)	
22	OA 29	22	33	23 weeks	09-08-2024	16-05-2025	17-07-2025	23 weeks	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	no	no
23	OA 30	23	30	21 weeks 4 days 7-10-2024	06-10-2023	29-06-2024	25-06-2024	21 weeks 3 days	yes	yes	1	0	0	0	14	no	-	no	-	no	-	no	no	no
24	OA 32	24	25	22 weeks 3 days	24-12-2023	29-09-2024	01-10-2024	22weeks 3 days	yes	yes	2	1	1	0	13	no	-	no	-	no	-	n0	n0	no
25	OA 33	25	28	21 weeks 1 day	24-12-2023	29-09-2024	30-09-2024	21 weeks 1 day	yes	yes	3	1	1	1	14	no	-	no	-	no	-	no	no	no
26	OA 34	26	29	20 weeks	09-01-2024	15-10-2024	20-10-2024	20 weeks	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	yes(prev lscs)	no
27	OA 35	27	31	22 weeks 2 days	28-12-2024	14-10-2024	29-09-2024	20weeks 2 days	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	no	no
28	OA 40	28	28	21 weeks 6 days	26-09-2023	03-07-2024	06-07-2024	21 weeks 6 days yes	yes	yes	1	0	0	0	13	no	-	no	-	no	-	no	no	no
29	OA 41	29	30	23 weeks	31-12-2023	06-10-2024	07-10-2024	23 weeks	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	no	no
30	OA 42	30	23	22 weeks 2 days	01-06-2024	03-08-2025	02-08-2024	22weeks 2 days	yes	yes	2	1	1	0	13	no	-	no	-	no	-	no	no	no
31	OA 44	31	31	22 weeks 5 days	26-09-2024	10-07-2024	12-07-2024	22 weeks 5 days	yes	yes	2	2	1	0	13	no	-	n0	-	no	-	no	no	n0
32	OA 48	32	28	21 weeks 1 day	01-09-2024	08-06-2025	09-06-2025	21 weeks 1 day	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	n0	n0
33	OA 50	33	34	19 weeks 3 days	24-09-2024	10-06-2024	20-06-2024	19 weeks 3 days	yes	yes	4	2	2	1	13	no	-	no	-	n0	-	no	yes;prev 2 LSCS	no
34	OA 52	34	21	21 weeks 5 days	28-08-2024	24-06-2-2024	25-06-2024	21 weks 5 days	yes	yes	1	0	0	0	14	no	-	no	-	no	-	no	no	no
35	OA 56	35	24	21 weeks 3 days	30-08-2024	06-06-2024	05-06-2024	21 weeks 3 days	yes	yes	1	0		0	14	no	-	no	-	no	-	no	no	no
36	OA 57	36	28	19 weeks 2 days	07-10-2024	02-06-2023	07-02-2025	19 weeks	yes	yes	2	1	1	0	13	no	-	no	-	n0	-	no	yes(prev lscs)	
37	OA 58	37	33	21weeks	02-09-2024	09-06-2025	10-06-2025	21 weeks	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	no	no
38	OA 60	38	27	21 weeks 3 days	24-12-2023	29-09-2024	01-10-2024	21 weeks 3 days	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	no	no
39	OA 61	39	25	20 weeks 4 days	19-10-2023	25-07-2024	27-07-2024	20 weeks 4 days	yes	yes	3	2	2	0	13	no	-	no	-	no	-	no	no	no
40	OA 62	40	33	19 weeks	07-01-2024	13-10-2024	13-01-2024	19 weeks	yes	yes	2	0	0	1	13	no	-	no	-	no	-	no	no	no
41	OA 66	41	30	21 weeks 1 day	01-09-2024	08-06-2025	09-06-2025	21 weeks 1 day	yes	yes	1	0	0	0	14	no	-	no	-	no	-	no	n0	n0
42	OA 68	42	29	19 weeks 3 days	24-09-2024	10-06-2024	20-06-2024	19 weeks 3 days	yes	yes	3	0	0	1	13	no	-	no	-	n0	-	no	yes;prev 2 LSCS	no
43	OA 74	43	31	21 weeks 5 days	28-08-2024	24-06-2-2024	25-06-2024	21 weks 5 days	yes	yes	1	0	0	0	14	no	-	no	-	no	-	no	no	no
44	OA 75	44	29	21 weeks 3 days	30-08-2024	06-06-2024	05-06-2024	21 weeks 3 days	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	no	no
45	OA 76	45	27	19 weeks 2 days	07-10-2024	02-06-2023	07-02-2025	19 weeks	yes	yes	2	1	1	0	13	no	-	no	-	n0	-	no	yes(prev lscs)	
46	OA 77	46	34	21weeks	02-09-2024	09-06-2025	10-06-2025	21 weeks	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	no	no
47	OA 78	47	27	21 weeks 3 days	24-12-2023	29-09-2024	01-10-2024	21 weeks 3 days	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	no	no
48	OA 86	48	30	20 weeks 4 days	19-10-2023	25-07-2024	27-07-2024	20 weeks 4 days	yes	yes	3	1	1	1	13	no	-	no	-	no	-	no	no	no
49	OA87	49	34	20 weeks 6 days	19-11-2023	25-08-2024	28-08-2024	20 weeks 6 days	yes	yes	1	0	0	0	13	no	-	no	-	no	-	no	no	no
50	OA 90	50	32	21weeks	02-09-2024	09-06-2025	10-06-2025	21 weeks	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	no	no
51	OA 98	51	29	20 weeks	09-01-2024	15-10-2024	20-10-2024	20 weeks	yes	yes	2	1	1	0	14	no	-	no	-	no	-	no	yes(prev lscs)	no
52	OA 101	52	24	21 weeks 3 days	30-08-2024	06-06-2024	05-06-2024	21 weeks 3 days	yes	yes	1	0		0	14	no	-	no	-	no	-	no	no	no

Height	Weight	BMI	Pallor	Icterus	Pedal_odedma	Systolic_BP	Diastolic_BP	MAP	PR	Uterine_size_in_weeks	Presentation	Foetal_HR	PSV1_RIGHT_A	PSV2_RIGHT_A	PSV2/PSV1 RIGHT_A	PI_RIGHT_A	RI_RIGHT_A	PSV1_RIGHT_B	PSV2_RIGHT_B	PSV2/PSV1_RIGHT_B	PI_RIGHT_B	RI_RIGHT_B
158	60	27	absent	absent	absent	120	70	86.6	78	20	unstable	138	41.09	8.62	0.2	1.55	0.17	43.1	8.33	0.19	1.92	0.61
162	70	28	absent	absent	absent	130	90	103	92	20	unstable	156	42.24	16.6	0.39	1.48	0.83	20.98	10.32	0.49	2.11	0.73
161	60	24	absent	absent	absent	120	70	86	90	22	breech	160	35.06	20.07	0.57	1.17	0.67	35	20.69	0.59	1.2	0.41
158	69	28	absent	absent	absent	110	72	84	76	20	unstable	162	32.18	11.21	0.34	1.86	0.79	21.26	13.26	0.6	1.7	0.72
152	60	26	absent	absent	absent	120	74	89	90	22	unstable	154	21.24	13.93	1.52	2.29	0.74	30.64	14.63	0.47	2.12	0.78
160	60	24	absent	absent	absent	128	74	86	86	20	unstable	152	42.48	26.81	0.6	1.42	0.73	44.57	26.12	0.58	1.3	0.7
156	64	29	absent	absent	absent	130	80	96	90	20	transverse	158	40.05	16.02	0.4	2.62	0.91	16.02	9.05	0.56	2	0.8
162	64	25.6	absent	absent	absent	122	74	90	96	20	breech	148	35.34	37.93	1.07	2.18	0.83	14.37	6.61	0.45	2	0.9
160	60	24	absent	absent	absent	128	74	86	86	20	unstable	152	42.48	26.81	0.63	1.42	0.73	44.57	26.12	0.58	1.3	0.7
150	42	19	absent	absent	absent	120	90	100	80	20	unstable	152	34.2	32.47	0.94	1.95	0.63	22.7	27.01	1.2	1.9	0.62
164	70	28	absent	absent	absent	100	72	81	88	22	transverse	140	47.7	14.66	0.3	1.98	0.43	47.7	19.57	0.4	1.98	0.81
154	65	29.5	absent	absent	absent	130	92	104	84	20	breech	138	39.94	44.25	1.1	1.64	0.8	41.38	45.98	1.1	1.74	0.78
160	64	25.6	absent	absent	absent	134	82	98	88	20	untable	134	52.69	55.75	1.05	1.59	0.72	20.11	12.93	0.64	1.64	0.61
146	80	40.8	present	absent	absent	122	78	92	96	20	transverse	145	42.24	5.17	0.12	3	0.91	42.67	47.41	1.11	1.02	0.62
148	69	32	absent	absent	absent	112	74	87	84	22	breech	148	19.25	19.83	1.03	1.37	0.7	17.24	17.82	1.03	1.61	0.7
144	68	34	absent	absent	absent	100	60	73	96	22	breech	144	16.67	18.10	1.08	0.77	0.52	18.39	20.4	1.1	0.72	0.5
160	66	26	absent	absent	absent	110	74	86	88	22	transverse	136	21.55	25.86	1.2	1.23	0.69	25	9.2	0.36	0.69	0.57
162	66	25	absent	absent	absent	120	80	93	76	22	breech	144	19.53	31.03	1.5	2.03	0.75	12.53	31.83	2.5	2.82	0.75
166	70	25.9	absent	absent	absent	130	86	100	80	20	transverse	134	32.05	37.36	1.16	1.6	0.74	27.01	32.76	1.2	1.42	0.7
160	60	24	absent	absent	absent	128	74	86	86	20	unstable	152	42.48	26.81	0.63	1.42	0.73	44.57	26.12	0.6	1.3	0.7
154	65	29.5	absent	absent	Pedal_odedma	130	90	103.3	90	20	unstable	148	19.53	31.03	1.58	2.03	0.75	12.53	31.83	0.39	2.82	0.75
160	60	24	absent	absent	absent	128	74	86	86	20	unstable	152	42.48	26.81	0.63	1.42	0.73	44.57	26.12	0.58	1.3	0.7
148	42	20	absent	absent	absent	120	90	100	90	20	unstable	152	34.3	32.48	0.94	1.95	0.63	22.7	27	1.1	1.9	0.62
164	70	28	absent	absent	absent	100	72	81	88	22	transverse	140	47.7	14.66	0.3	1.98	0.43	47.7	19.57	0.41	1.98	0.81
145	66	31.4	absent	absent	absent	130	92	104	84	20	breech	138	39.94	44.25	1.1	1.64	0.8	41.38	45.98	1.1	1.74	0.78
160	64	25.6	absent	absent	absent	134	82	98	88	20	untable	134	52.69	55.75	1.05	1.59	0.72	20.11	12.93	0.64	1.64	0.61
158	60	27	absent	absent	absent	120	70	86.6	78	20	unstable	138	41.09	8.62	0.2	1.55	0.17	43.1	8.33	0.19	1.92	0.61
162	70	28	absent	absent	absent	130	90	103	92	20	unstable	156	42.24	16.6	0.39	1.48	0.83	20.98	10.32	0.49	2.11	0.73
161	60	24	absent	absent	absent	120	70	86	90	22	breech	160	35.06	20.07	0.57	1.17	0.67	35	20.69	0.59	1.2	0.41
158	69	28	absent	absent	absent	110	72	84	76	20	unstable	162	21.55	9.77	0.45	0.93	0.55	21.26	6.90	0.32	0.93	0.21
166	70	25.9	absent	absent	absent	130	86	100	80	20	transverse	134	32.05	37.36	1.16	1.42	0.66	44.57	26.12	0.58	1.3	0.7
162	58	23.2	absent	absent	absent	140	70	83	84	20	untable	138	49.1	34.43	0.7	1.18	0.66	44.23	35.17	0.79	1.4	0.67
160	58	23.2	absent	absent	absent	138	90	96	84	20	unstable	160	41.7	27.8	0.66	1.52	0.72	33	21.2	0.64	0.72	0.7
158	60	27	absent	absent	absent	146	92	99	88	20	unstable	160	39.3	17.4	0.45	2.25	0.74	52.9	22.9	0.43	1.68	0.8
160	55	22	absent	absent	absent	130	90	103	90	20	unstable	140	36.2	16.5	0.45	40.2	2.33	17.2	38.2	2.22	2.05	0.9
145	66	31.4	absent	absent	Pedal_odedma	130	90	103	90	20	unstable	148	56.7	34.8	0.6	1.34	0.9	44.5	23.6	0.5	1.7	0.77
160	68	27.2	absent	absent	absent	122	84	92	86	20	unstable	140	47	22.98	0.48	1.62	0.78	47.1	20.2	0.42	1.64	0.79
160	60	24	absent	absent	absent	128	74	92	86	20	unstable	152	42.48	26.81	0.63	1.42	0.73	44.57	26.12	0.58	1.3	0.7
156	64	29	absent	absent	absent	130	80	96	90	20	transverse	158	40.05	16.02	0.4	2.62	0.91	16.02	9.05	0.56	2	0.8
162	64	25.6	absent	absent	absent	122	74	90	96	20	breech	148	35.34	37.93	1.07	2.18	0.83	14.37	6.61	0.45	2	0.9
162	58	23.2	absent	absent	absent	120	70	70	84	20	untable	138	49.1	34.43	0.7	1.18	0.66	44.23	35.17	0.8	1.4	0.67
160	58	23.2	absent	absent	absent	110	90	96	84	20	unstable	160	41.7	27.8	0.66	1.52	0.72	33	21.2	0.64	0.72	0.7
158	60	27	absent	absent	absent	114	92	99.3	88	20	unstable	160	39.3	17.4	0.44	2.25	0.74	52.9	22.9	0.43	1.68	0.8
160	55	22	absent	absent	absent	128	90	103	90	20	unstable	140	41.09	8.62	0.2	1.2	1.55	52.2	43.1	1.2	0.19	1.92
145	66	31.4	absent	absent	Pedal_odedma	122	90	103.3	90	20	unstable	148	56.7	34.8	0.6	1.34	0.77	44.5	23.6	0.53	1.7	0.77
160	68	27.2	absent	absent	absent	126	84	96	86	20	unstable	140	47	22.98	0.48	1.62	0.78	47.1	20.2	0.42	1.64	0.79
160	60	24	absent	absent	absent	130	74	86	86	20	unstable	152	42.48	26.81	0.63	1.42	0.73	44.57	26.12	0.58	1.3	0.7
156	64	29	absent	absent	absent	132	80	96	90	20	transverse	158	40.05	16.02	0.4	2.62	0.91	16.02	9.05	0.56	2	0.8
162	70	28	absent	absent	absent	116	70	85	90	18	unstable	152	38.79	10.92	0.28	2.17	0.82	34.48	4.89	0.14	2.1	0.8
160	68	27.2	absent	absent	absent	126	84	96	86	20	unstable	140	47	22.98	0.48	1.2	88	44.23	35.17	0.8	1.4	0.67
160	60	24.6	absent	absent	absent	134	82	98	88	20	untable	134	52.69	55.75	1.05	1.59	0.72	20.11	12.93	0.64	1.64	0.61
160	55	22	absent	absent	absent	130	90	103	90	20	unstable	140	36.2	16.5	0.45	0.2	2.33	17.2	38.2	2.22	2.05	0.9

PSV1_RIGHT_AVG	PSV2_RIGHT_AVG	PSV2/PSV1_RIGHT_AVG	PI_RIGHT_AVG	RI_RIGHT_AVG	PSV1_LEFT_A	PSV2_LEFT_A	PSV2/PSV1_LEFT_A	PI_LEFT_A	RI_LEFT_A	PSV1_LEFT_B	PSV2_LEFT_B	PSV2/PSV1_LEFT_B	PI_LEFT_B	RI_LEFT_B	PSV1_LEFT_AVG	PSV2_LEFT_AVG	PSV2/PSV1_LEFT_AVG	PI_LEFT_AVG	RI_LEFT_AVG	1st FOLLOW AT POG	SBP1	SBP2
42.09	8.4	0.2	1.7	0.39	21.55	19.25	0.89	1.56	0.34	18.39	18.97	1.03	1.03	0.44	19.97	19.11	0.95	1.2	0.39	37 WEEKS 3 DAYS	110	118
31.61	13.46	0.41	1.79	0.78	18.1	9.92	0.54	1.25	0.68	20	10.2	0.51	1.3	0.74	19.05	10.06	0.5	1.27	0.71	36 weeks 5 days	132	128
35.03	20.38	0.58	1.18	0.54	31.9	16.68	0.52	1.4	0.73	33.33	14.66	0.43	1.34	0.56	32.6	15.67	0.48	1.37	0.64	31 weeks 3 days	110	112
26.72	12.2	0.45	1.78	1.51	20.69	11.21	0.54	1.08	0.68	28.74	12.2	0.42	1.8	0.46	24.7	17.3	0.7	1.44	0.57	28 weeks 6 days	120	118
25.94	14.28	0.55	2.2	0.74	50.15	34.15	0.68	1.5	0.74	21.24	13.93	0.65	1.33	0.62	35.6	24.06	0.67	1.4	0.68	40 WEEKS 4 DAYS	120	122
43.52	26.46	0.6	1.36	0.71	38.31	16.72	0.43	1.76	0.77	37.49	16.89	0.45	1.83	0.79	37.9	16.8	0.44	1.79	0.78	38 weeks	130	134
28.03	12.5	0.44	2.3	0.8	14.63	7.66	0.52	1.61	0.73	36.22	14.28	0.39	2.55	0.85	25.4	10.97	0.43	2.08	0.79	38 weeks	122	130
24.8	22.27	0.89	2.09	0.86	18.97	20.69	1.09	1.94	0.69	16.07	7.07	0.43	1.9	0.79	17.52	13.88	0.79	1.92	0.74	35 WEEKS 6 DAYS	120	116
43.52	26.46	0.6	1.36	0.71	38.31	16.72	0.43	1.76	0.77	37.49	16.89	0.45	1.83	0.79	37.9	16.8	0.44	1.79	0.78	38 weeks 4 days	130	134
22.7	27.01	1.2	1.9	0.62	28.45	29.74	1.04	1.92	0.62	30.63	16.67	0.54	1.46	0.74	31.69	12.79	0.4	1.4	0.99	38 weeks	128	130
47.7	17.11	0.35	1.98	0.62	13.22	4.60	0.34	1.31	0.31	13.79	7.23	0.52	1.31	0.69	13.5	5.9	0.43	1.31	0.5	35 weeks4 days	118	120
40.66	45.11	1.1	1.69	0.79	19.83	26.17	1.3	1.98	0.81	50.29	6.9	0.13	2.45	0.69	35.06	16.52	0.47	2.2	0.75	39 weeks 6 days	132	128
35.4	34.34	0.97	1.61	0.67	20.98	13.79	0.65	1.61	0.74	20.11	12.93	0.64	1.64	0.38	20.5	13.36	0.65	1.64	0.56	36 WEEKS	120	122
42.4	26.6	0.62	2.01	0.7	29.31	31.03	1.05	1.86	0.77	50	56.9	1.1	0.87	0.57	36	12.3	0.34	1.7	0.9	39 WEEKS	132	90
18.26	18.8	1.02	1.49	0.7	36.78	37.64	1.02	1.78	0.75	36.21	37.64	1.03	1.74	0.6	36.4	37.64	1.02	1.72	0.67	39 weeks 2 days	128	130
17.53	19.24	1.09	0.74	0.5	27.87	31.03	1.11	1.15	0.52	60.34	62.07	1.02	1.93	0.55	44.1	46.55	1.05	1.54	0.5	35 weeks 6 days	122	130
23.27	17.53	0.75	0.96	0.63	35.92	40.80	1.1	1.91	0.77	50	47.13	0.9	1.58	0.74	42.96	43.96	1.02	1.74	0.75	36 weeks 2 days	126	130
16.03	31.43	1.96	2.4	0.75	60.63	62.2	1.03	2.38	0.52	23.5	26.15	1.1	1	0.73	42.06	44.1	1.04	1.69	0.62	34 weeks	128	124
29.53	35.06	1.22	1.5	0.7	41.69	45.69	1.09	2.21	0.78	35.63	37.07	1.04	2	0.79	38.66	41.38	1.07	2.1	0.78	36 WEEKS	130	134
43.52	26.46	0.6	1.36	0.71	38.31	16.72	0.43	1.76	0.77	37.49	16.89	0.45	1.83	0.79	37.9	16.8	0.44	1.79	0.78	36 WEEKS	130	134
16.03	31.43	1.96	2.4	0.75	60.63	62.2	1.02	2.38	0.52	23.5	26.15	1.1	1	0.73	42.06	44.1	1.04	1.69	0.62	32 weeks	126	122
43.52	26.46	0.6	1.36	0.71	38.31	16.72	0.43	1.76	0.77	37.49	16.89	0.45	1.83	0.79	37.9	16.8	0.44	1.79	0.78	28 WEEKS	130	134
22.7	27.01	1.1	1.9	0.62	28.45	29.74	1.04	1.92	0.62	30.63	16.67	0.54	1.46	0.74	31.69	12.79	0.4	1.4	0.99	28 WEEKS 1 DAY	128	130
47.7	17.11	0.35	1.98	0.62	13.22	4.60	0.34	1.31	0.31	13.79	7.23	0.52	1.31	0.69	13.5	5.9	0.43	1.31	0.5	34 weeks	118	120
40.66	45.11	1.1	1.69	0.79	19.83	26.17	1.3	1.98	0.81	50.29	6.9	0.13	2.45	0.69	35.06	16.52	0.47	2.2	0.75	32 weeks	132	128
35.4	34.34	0.97	1.61	0.67	20.98	13.79	0.65	1.61	0.74	20.11	12.93	0.64	1.64	0.38	20.5	13.36	0.65	1.64	0.56	32 weeks	120	122
42.09	8.4	0.19	1.7	0.39	21.55	19.25	0.89	1.56	0.34	18.39	18.97	1.03	1.03	0.44	19.97	19.11	0.95	1.2	0.39	35 weeks4 days	110	118
31.61	13.46	0.42	1.79	0.78	18.1	9.92	0.54	1.25	0.68	20	10.2	0.51	1.3	0.74	19.05	10.06	0.52	1.27	0.71	35 weeks 3 days	132	128
35.03	20.38	0.58	1.18	0.54	31.9	16.68	0.5	1.4	0.73	33.33	14.66	0.43	1.34	0.56	32.6	15.67	0.48	1.37	0.64	34 weeks	110	112
21.4	8.3	0.38	0.93	0.38	20.69	11.21	0.54	1.08	0.68	28.74	12.2	0.42	1.8	0.46	24.7	17.3	0.7	1.44	0.57	28 WEEKS	120	118
43.52	26.46	0.6	1.36	0.71	38.31	16.72	0.43	1.76	0.77	37.49	16.89	0.45	1.83	0.79	37.9	16.8	0.44	1.79	0.78	35 weeks 3 days	110	118
46.66	34.82	0.74	1.3	0.6	43.88	33.43	0.76	1.47	0.71	44.23	35.17	0.79	1.21	0.72	44.05	34.3	0.77	1.34	0.71	28 WEEKS	120	120
37.3	24.5	0.65	0.72	0.75	41.09	26.17	0.63	0.72	0.74	36.99	20.8	0.56	1.43	0.7	38.99	23.4	0.66	1.5	0.7	28 weeks 1 day	130	130
46.1	20.15	0.43	1.78	0.77	55	28.9	0.52	1.78	0.83	57.1	26.1	0.45	1.81	0.8	56.05	27.3	0.48	1.79	0.8	28 WEEKS	110	120
53.71	26.08	0.48	1.98	0.8	49.8	26.07	0.52	2.16	2	51.75	26.07	0.5	2	0.88	51.75	26.07	0.5	2	0.88	28 weeks	130	132
44.5	23.3	0.52	1.75	0.78	45.2	22.2	0.49	1.74	0.78	44.5	23.3	0.52	1.75	0.86	45.2	22.2	0.49	1.74	0.9	28 weeks 2 day	130	130
47.3	21.59	0.45	1.6	0.7	39.45	21.59	0.54	1.74	0.76	41.09	22.29	0.54	1.84	0.79	40.27	21.29	0.52	1.79	0.7	29 weeks	134	134
43.52	26.46	0.6	1.36	0.71	38.31	16.72	0.43	1.76	0.77	37.49	16.89	0.45	1.83	0.79	37.9	16.8	0.44	1.79	0.78	32 weeks	130	134
28.03	12.5	0.44	2.3	0.8	14.63	7.66	0.51	1.61	0.73	36.22	14.28	0.39	2.55	0.85	25.4	10.97	0.43	2.08	0.79	35 weeks	122	130
24.8	22.27	0.89	2.09	0.86	18.97	20.69	1.09	1.94	0.69	16.07	7.07	0.43	1.9	0.79	17.52	13.88	0.79	1.92	0.74	38 weeks 5 days	120	116
46.66	34.82	0.74	1.3	0.6	43.88	33.43	0.76	1.47	0.71	44.23	35.17	0.79	1.21	0.72	44.05	34.3	0.77	1.34	0.71	34 weeks	120	120
37.3	24.5	0.65	0.72	0.75	41.09	26.17	0.63	0.72	0.74	36.99	20.8	0.56	1.43	0.7	38.99	23.4	0.6	1.5	0.7	34 weks	130	130
46.1	20.15	0.43	1.78	0.77	55	28.9	0.52	1.78	0.83	57.1	26.1	0.45	1.81	0.8	56.05	27.3	0.48	1.79	0.8	36 weeks 2 days	110	120
35.03	20.38	0.58	0.58	1.18	0.54	31.9	16.68	0.5	0.76	41.09	22.29	0.54	1.84	0.79	40.27	21.29	0.52	1.74	0.9	35 WEEKS 6 DAYS	110	120
44.5	23.3	0.52	1.75	0.78	45.2	22.2	0.49	1.74	0.78	16.07	7.07	0.43	1.9	0.79	17.52	13.88	0.79	1.92	0.8	36 weeksn	130	130
47.3	21.59	0.45	1.6	0.7	39.45	21.59	0.54	1.74	0.76	41.09	22.29	0.54	1.84	0.79	40.27	21.29	1.89	1.79	0.7	35 WEEKS 6 DAYS	134	134
43.52	26.46	0.6	1.36	0.71	38.31	16.72	0.43	1.76	0.77	37.49	16.89	0.45	1.83	0.79	37.9	16.8	0.44	1.79	0.78	36 weeks	130	134
28.03	12.5	0.44	2.3	0.8	14.63	7.66	0.52	1.61	0.73	36.22	14.28	0.39	2.55	0.85	25.4	10.97	0.44	2.08	0.79	34 weeks	122	130
36.6	7.9	0.21	2.1	0.8	21.84	19.25	0.88	1.19	0.58	8.05	4.6	0.57	1.19	0.5	14.9	11.9	1	1.19	0.5	31 WEEKS 6 DAYS	126	128
46.66	34.82	0.74	0.6	43.88	33.43	0.76	1.47	0.71	39.45	21.59	0.54	0.86	0.79	1.21	0.72	44.05	34.3	0.77	1.34	34 WEEKS	120	120
35.4	34.34	0.97	1.61	0.67	20.98	13.79	0.65	1.61	0.74	20.11	12.93	0.64	1.64	0.38	20.5	13.36	0.65	1.64	0.56	32 weeks	120	122
53.71	26.08	0.48	1.98	0.8	49.8	26.07	0.52	2.16	2	51.75	26.07	0.5	2	0.88	51.75	26.07	0.5	2	0.88	28 weeks	120	122

DBP1	DBP2	MAP	Platelet	LDH	Uric acid	SGOT	SGPT	ALP	S.Albumin	A:G	S.screatinine	Urine Albumin	Development of pre-eclampsia	Mean Uterine artery Pi	Term/Pre-term	Mode of delivery	if mode is Vaginal delivery induced/spontaneous	if LSCS indication	birth weight	NICU ADMISSION
80	84	92.6	254	334	4	32	17	123	3	1.2	0.6	traces	no	0.77	term	emgLSCS	-	prev lscs not w/f VBAC	2.3Kgs	no
90	90	129	162	204	4	14	18	60	6	1	0.6	traces	no	0.9	pre-term	emgLSCS	-	early onset FGR iwth increased reistance	2.2kgs	no
70	70	87	197	182	2.2	19	13	123	3.5	1.3	0.44	negative	no	0.68	term	NVD	spontaneous	-	2.8kgs	no
80	78	92	124	216	3.9	23	9	121	3.4	1.3	0.4	traces	no	1.13	term	elective LSCS	-	CDMR	2.8kgs	no
80	82	110	178	256	4.8	18	18	40	5	1.1	1.08	traces	no	0.62	term	emgLSCS	-	failed induction	2.9kgs	no
84	82	99	178	215	4.6	10	14	120	4.3	1.4	0.7	traces	no	1.2	term	elective LSCS	-	CDMR	2.8kgs	no
86	80	96	256	206	4	12	10	116	5.4	1.2	0.7	negative	no	0.98	term	NVD	spontaneous	-	3kgs	no
80	74	90	259	203	4	9	14	40	5.4	1.3	0.63	traces	no	0.95	term	NVD	Induced	-	3.1kgs	no
84	82	99	178	215	4.6	10	14	120	4.3	1.4	0.7	traces	no	0.86	term	NVD	spontaneous	-	3.2kgs	no
90	92	102	195	520	4.4	11	14	102	5.8	1.2	1	1+	no	0.69	term	NVD	spontaneous	-	2.8kgs	no
72	72	87	271	302	4	8	11	90	4.4	1.2	0.7	negative	no	0.99	term	emgLSCS	-	severe oligo	2.6kgs	no
90	92	102	189	102	3.8	16	13	78	5.2	1.2	0.96	traces	no	0.87	pre-term	emgLSCS	-	breech in labour	2.5kgs	no
80	82	110	290	201	4	46	18	186	3.3	1	0.7	traces	no	1.02	term	emgLSCS	-	failed induction	3.2kgs	no
138	86	103	146	320	3	22	10	190	3.1	1	0.33	negative	YES	0.48	pre-term	emgLSCS	-	prev LSCS in labour not w/f VBAC	1.47Kgs	yes(preterm+VLBW)
80	86	98	306	271	6.1	55	29	92	3.3	1.2	0.69	traces	no	0.69	term	-	ventouse delivery		3.1kgs	no
80	90	96	333	231	5	43	22	90	3.4	1	0.78	traces	no	0.83	term	elective LSCS	-	prev lscs with fetal macrosomia	3.1kgs	no
80	86	98	243	100	4.4	24	34	87	4	1	0.9	negative	no	1.03	term	elective LSCS	-	Prev 2 LSCS	3.5Kgs	no
90	88	101	246	139	5	43	24	167	3.5	1.2	0.41	traces	yes	1.02	term	elective LSCS	-	fetal macrosomia	3.1kgs	no
84	82	104	231	215	4.6	10	14	120	4.3	1.4	0.7	traces	no	0.87	term	elective LSCS	-	CDMR	3.16kgs	no
84	82	99	178	215	4.6	10	14	120	4.3	1.4	0.8	traces	no	0.89	term	emgLSCS	-	oligo	2.4kgs	no
70	88	88	246	139	5	43	24	167	3.5	1.2	0.61	negative	no	0.67	term	emgLSCS	-	failed induction	3kgs	no
84	82	99	178	215	4.6	10	14	120	4.3	1.4	0.65	traces	no	0.9	term	NVD	spontaneous	-	3.3kgs	no
90	92	102	195	520	4.4	11	14	102	5.8	1.2	1	1+	yes	0.68	term	emgLSCS	-	failed induction	2.4kgs	no
72	72	87	271	302	4	8	11	90	4.4	1.2	0.9	negative	no	1.8 POSITIVE	term	emgLSCS	-	CPD in labour	2.7kgs	no
90	92	102	189	102	3.8	16	13	78	5.2	1.2	0.85	traces	no	1.01	term	emgLSCS	-	prev lscs in labour not w/f VBAC	2.4kgs	no
80	82	93	290	201	4	40	17	185	3.3	1	0.7	traces	no	1.01	term	emgLSCS	-	prev LSCS in labour not w/f VBAC	3.6kgs	no
80	84	92.6	250	330	4	33	18	123	3	1.2	0.6	traces	no	1	term	elective LSCS	-	CDMR	3kgs	no
90	90	123	153	205	5	16	19	63	7	1	0.8	traces	no	0.68	term	NVD	spontaneous	-	3.1kgs	no
70	70	87	200	197	2.2	20	14	122	3.5	1.2	0.5	negative	no	0.9	term	emgLSCS	-	fetal distress	2.9kgs	no
80	78	92	122	217	4	20	10	124	3.6	1.5	0.37	traces	no	0.76	term	emgLSCS	-	fetal distress	2.6kgs	no
80	84	92.6	250	330	4	33	18	128	3	1.2	0.61	negative	no	1.04	pre-term	emgLSCS	-	prev LSCSin labour not w/f VBAC	2.9KGS	no
80	70	90	190	200	3.9	20	23	112	3.8	1	0.98	traces	no	0.87	Term	emgLSCS	-	OLIGO	2.4kgs	no
90	92	121	233	200	4.9	20	29	122	3.8	1	0.9	negative	no	0.89	term	emgLSCS	-	fetal distress with MSL	2.9kgs	no
80	70	88.33	266	219	4.5	18	20	48	3.2	1.5	0.5	negative	no	0.67	term	NVD	spontaneous	failed induction	2.6kgs	no
90	96	104.3	218	183	18	12	3.2	40	3.5	1.3	0.5	traces	no	0.9	term	NVD	spontaneous		2.6kgs	no
90	92	121	152	222	4.6	20	24	44	3.8	1.2	0.9	traces	no	0.68	term	elective LSCS	-	CDMR	2.8kgs	no
88	86	104	348	160	4.3	11	12	69	3.1	2.7	0.6	negative	no	1.7 POSITIVE	term	NVD	spontaneous	-	2.9kgs	no
84	82	99	178	214	4.4	10	14	120	4.3	1.4	0.7	traces	no	1.01	term	NVD	spontaneous		2.7kgs	no
86	80	96	256	300	4.2	12	10	116	5.4	1.2	0.7	negative	no	1.01	term	NVD	spontaneous	-	2.9kgs	no
80	74	90	259	203	4	9	14	40	5.4	1.3	0.63	traces	no	1	term	NVD	spontaneous	-	3kgs	no
80	70	90		230	4.6	20	24	44	3.8	1.2	0.9	traces	no	0.68	term	elective LSCS	-	prev lscs not w/f VBAC	2.8kgs	no
90	92	121	233	200	4.9	20	29	122	3.8	1	0.9	negative	no	0.9	term	emgLSCS	-	oligo	3kgs	no
80	70	88.33	266	219	5.4	18	20	48	3.2	1.5	0.5	negative	no	0.76	term	elective LSCS	-	GDM with fetal macrosomia	3.2kgs	no
80	70	88.33	266	219	5.4	18	20	48	3.2	1.5	0.5	negative	no	1.04	term	elective LSCS	-	CDMR	3.1kgs	no
90	92	121	152	330	4.6	20	24	44	3.8	1.2	0.9	traces	no	0.8	pre-term	emgLSCS	-	oligo	2.3Kgs	no
88	86	104	348	172	5.3	11	12	69	3.1	2.7	0.6	negative	no	0.44	term	emgLSCS	-	failed induction	2.7kgs	no
84	82	99	178	215	4.6	10	14	120	4.3	1.4	0.7	traces	no	0.72	term	emgLSCS	-	fetal distress with MSL	3.6kgs	no
86	80	96	256	206	4	12	10	116	5.4	1.2	0.7	negative	no	0.6	term	emgLSCS	-	failed induction	2.7kgs	no
82	86	101	361	200	3	20	13	180	3.4	1	0.34	traces	yes	1.5 POSITIVE	pre-term	emgLSCS	-	prolonged PPROM	1.8kgs	yes(preterm+VLBW)
80	70	90	225	230	4.6	20	24	44	3.8	1.2	0.9	traces	no	0.68	term	elective LSCS	-	prev lscs not w/f VBAC	2.8kgs	no
80	82	93	290	201	4	40	17	185	3.3	1	0.7	traces	no	1.01	term	emgLSCS	-	prev LSCS in labour not w/f VBAC	3.6kgs	no
80	86	96	218	183	18	12	3.2	40	3.5	1.3	0.5	traces	no	0.9	term	NVD	spontaneous		2.6kgs	no