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Original Research Article

Correlation of Combined Methods of Gestosis Score and Doppler Velocimetric Uterine Artery Pulsatility Index for Prediction and Outcome of Hypertensive Disorders of Pregnancy: A Prospective Observational Study

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Abstract

Background: Hypertensive disorders of pregnancy (HDP) remain a major contributor to maternal and perinatal morbidity and mortality worldwide. Gestational hypertension, one of the common forms of HDP, presents significant diagnostic and prognostic challenges. Early recognition of women at increased risk is crucial for timely intervention, particularly in resource-constrained healthcare settings. The HDP-Gestosis score and uterine artery pulsatility index (UtA-PI) have emerged as simple and promising screening modalities for the early prediction of gestational hypertension.

Aim: To observe the predictability of gestosis score in detection of HDP in pregnant women and to correlate uterine artery doppler changes with development of HDP and its outcome.

Methods: The pregnant women <16 weeks of pregnancy were enrolled for the study period of 12months. After relevant gestosis scoring, history, general physical and obstetric examination was done. Necessity investigations were done and bilateral uterine artery Doppler velocimetry values were noted and persistent diastolic notching was observed beyond 24 weeks. The results were correlated with the subsequent development of HDP.

Results: The mean age, gestational age, and BMI of the enrolled women were 26.2 ± 4.8 years, 13.2 ± 3.14 weeks, and 26.5 ± 3.9 kg/m^2, respectively. The gestosis score was 1 in 21% of the participants, 2 41%) and ≥ 3 (at risk) in 38% of the women. HDP was developed in 26.3% participants. UtA-PI was 2.28 in participants who developed HDP. The sensitivity, specificity, positive predictive value (PPV), Negative predictive value (NPV) and diagnostic accuracy for predicting HDP of pregnancy using gestosis score >/=3 were 76.19%, 76.27%, 53.33%, 90% and 76.26% respectively. Similarly, sensitivity, specificity, PPV, NPV and diagnostic accuracy of combined tests (gestosis score >/=3 and UtA-PI) in prediction of HDP were 23.1%, 100%, 100%, 78.675 and 80% respectively.

Conclusion: The combined application of the Gestosis score and UtA-PI achieved a diagnostic accuracy of 76.26% in predicting that incorporating these screening methods into routine antenatal care may facilitate timely preventive interventions and contribute to reducing adverse obstetric and perinatal outcomes associated with hypertensive disorders of pregnancy.

Keywords: Gestosis Score, HDP, UtA-PI, Predictability, Doppler Velocimetry.

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Introduction

Hypertensive disorders of pregnancy (HDPs) are among the most frequently encountered medical complications during gestation, affecting approximately 4.6% of pregnancies worldwide.[1] Their prevalence is considerably higher in developing countries, ranging from 6.8% to 16.7%,[2] while studies from India estimate an incidence of nearly 10–13%.[3] HDP is diagnosed when a pregnant woman develops a systolic blood pressure (SBP) of ≥140 mmHg and/or a diastolic blood pressure (DBP) of ≥90 mmHg after 20 weeks of gestation. These disorders represent a major cause of maternal and perinatal morbidity and mortality across the globe. Maternal complications

associated with HDP include abruptio placentae, pulmonary edema, acute renal failure, cardiac rhythm abnormalities, obstetric hemorrhage, Hemolysis, Elevated Liver enzymes, and Low Platelet count (HELLP) syndrome, disseminated intravascular coagulation (DIC), and multiple organ dysfunction syndrome (MODS). Perinatal complications commonly include fetal growth restriction with late onset, medically indicated preterm birth, stillbirth, and low birth weight.[4]

Current research is primarily focused on identifying reliable predictors of HDP during early pregnancy so that women at increased risk can be recognized well in advance and appropriate preventive interventions can be initiated. To facilitate this objective, Dr. Gorakh Mandrupkar developed the HDP-Gestosis Score, which was subsequently refined by a committee comprising Dr. Alpesh Gandhi, Dr. Girija Wagh, Dr. Suchitra Pandit, and Dr. Sanjay Gupte. This scoring system serves as a practical clinical tool for screening women who are at risk of developing preeclampsia by assessing both existing and evolving maternal risk factors.5 Individual clinical risk factors are allotted scores of 1, 2, or 3 according to their relative significance. The cumulative score is obtained through detailed history taking and clinical examination. A total score of 3 or more identifies a woman as being at increased risk for preeclampsia, thereby guiding timely surveillance and management.[5]

The pathogenesis of HDP is closely associated with defective placental development, resulting in impaired uteroplacental perfusion. Consequently, Doppler ultrasonography of the uterine arteries has emerged as an important screening modality for evaluating uteroplacental blood flow. In non-pregnant women and during the first trimester of pregnancy, uterine artery Doppler waveforms typically demonstrate reduced end-diastolic flow along with the presence of an early diastolic notch. Under normal physiological conditions, this notch gradually disappears as pregnancy advances. However, persistence of the diastolic notch beyond 24 weeks of gestation or the presence of abnormal Doppler flow velocity indices suggests inadequate trophoblastic invasion of the spiral arteries, a pathological process that may ultimately predispose to the development of HDP.[6] HDPs remain an important contributor to maternal illness and death and are associated with considerable adverse obstetric and neonatal outcomes. Although several predictive approaches have been proposed, comprehensive and well-validated studies evaluating their diagnostic performance under routine clinical conditions remain limited. Therefore, the present study was undertaken to assess the relationship between the HDP-Gestosis score and uterine artery Doppler findings and to evaluate their effectiveness in predicting the subsequent development of hypertensive disorders of pregnancy.

Materials and Methods

Ethical Approval: The study was initiated after due permission from Institutional Ethical Committee and Review Board of Hassan Institute of Medical Sciences (HIMS), Hassan, Karnataka. A written informed consent was obtained from all the patients participated in the study.

Study Design and Patients: This is a prospective analytical study conducted with total of 80 participants who presented at the Department of Obstetrics and Gynaecology at Sri Chamarajendra Maternity Hospital, Hassan Institute of Medical Sciences, Hassan, over a period of 12 months.

Inclusion Criteria

Pregnant women with:

1. Age: >18years
2. Gestational age: </= 16 weeks
3. GESTOSIS risk score

Exclusion Criteria

Women with:

1. Early pregnancy with known comorbidities which are not included in Gestosis score components
2. Anomalous baby
3. Concurrent and/or coexisting cardiac, cardiovascular, autoimmune and renal diseases

Data Collection: Comprehensive baseline information was obtained from all enrolled participants, including age, gravida, parity, menstrual and obstetric history, marital status, history of polycystic ovarian disease, interpregnancy interval, previous medical illnesses, family history, current or past medication use, infertility treatment, and excessive gestational weight gain. All participants underwent a routine general physical examination according to institutional protocol. Body mass index (BMI) was calculated, and a detailed obstetric examination was performed and documented. The HDP-Gestosis score was calculated for each participant using the designated mobile application. Pregnant women with a Gestosis score of ≥3 were considered eligible and recruited for further evaluation. During routine antenatal visits, approximately 5 mL of peripheral venous blood was collected for laboratory investigations. These included a complete hemogram, HbA1c estimation, thyroid function tests, and antibody testing in women with suspected autoimmune disorders. Routine urine analysis was also performed. In addition, all participants underwent an oral glucose challenge test (OGCT), and HbA1c was reassessed after 20 weeks of gestation, together with any

additional investigations indicated on clinical grounds. Obstetric ultrasonography was scheduled according to the gestational age at registration. Depending on the stage of pregnancy, either a Nuchal Translucency (NT) scan or a Targeted Imaging for Fetal Anomaly (TIFFA) scan was performed between 16 and 18 weeks of gestation. Uterine artery Doppler assessment was initially carried out between 11 and 13+6 weeks to measure the uterine artery pulsatility index (UtA-PI), and the findings were documented. A repeat uterine artery Doppler examination was performed after 24 weeks of gestation to assess the persistence of the diastolic notch. The HDP-Gestosis score was generated using the mobile application, which stratifies the risk of HDPs into three categories: mild risk (score 1), moderate risk (score 2), and high risk (score ≥3). The cumulative Gestosis score for each participant was recorded based on the predefined scoring components (Box I).

Risk factor	*Score*
Woman born as small for gestational age	1
Maternal anemia	1
Age older than 35 years	1
Age younger than 19 years	1
Obesity (BMI >30)	1
Nulligravida	1
Short duration of paternity (cohabitation)	1
Family history of PE	1
Family history (H/O) of cardiovascular disease	1
Polycystic ovary syndrome	1
Interpregnancy interval of more than 5 years	1
Assisted reproductive (IVF/ICSI)	1
Treatment	
Maternal hypothyroidism	1
Chronic vascular disease (dyslipidemia)	1
Excessive weight gain during pregnancy	1
MAP >85	1
Gestational diabetes mellitus	2
Obesity (BMI >40)	2
Multiple pregnancy	2
Hypertensive disease during previous pregnancy	2
Pregestational diabetes mellitus	3
Chronic hypertension	3
Mental disorders (e.g., schizophrenia)	3
Inherited/acquired thrombophilia	3
Maternal chronic kidney disease	3
Autoimmune disease (SLE/APLAS/RA)	3
Assisted reproductive (OD) treatment	3

Box 1: HDP-Gestosis score

Criteria and Standards in subjects' selection as follows

Hypertensive disorders of pregnancy: [5]

Gestational hypertension: Blood pressure =/> 140/90 mmHg, detected beyond 20 weeks of gestation and returns to normal within 42ndpostpartum day and is not associated with any other features of preeclampsia.

Chronic Hypertension: Known case of hypertension or a case of hypertension detected before 20 weeks of gestation in absence of neoplastic trophoblastic disease and multiple pregnancies.

Preeclampsia: Defined as de novo blood pressure (BP) elevations (SBP of 140 mm Hg or more or DBP of 90 mm Hg or more on two separate occasions at least 4 hours off from each other) after 20 weeks of pregnancy combined with proteinuria (300 mg or more per 24 hours of urine sample or protein/creatinine ratio of 0.3 mg/dL or more or dipstick reading of 2+).More recently, atypical variant of preeclampsia is recognized which is accompanied by neurological, hematological, hepatic, renal manifestations or fetal growth restriction, in absence of proteinuria.

Eclampsia: It is occurrence of seizures in association with preeclampsia.

Superimposed Preeclampsia: It is the occurrence of preeclampsia in women with chronic hypertension.

(Blood pressure reading should be reconfirmed after 4-6 hours before classifying a patient in particular group.)

Preeclampsia can be further classified as non-severe and severe. It can also be classified as early onset and late onset as below.

Non-severe Preeclampsia: Blood pressure =/>140/90 mm Hg and =/<160/110 mm Hg

No premonitory symptoms and normal HDP laboratory parameters.

Severe Preeclampsia: Blood pressure > 160/110 mm Hg with/without premonitory* symptoms with / without abnormal# HDP laboratory parameters#.

Or

Blood pressure >/=140/90 mm Hg with premonitory*symptoms and /or abnormal# HDP laboratory parameters.6 {*Premonitory symptoms: Headache, blurring of vision, vomiting, right upper quadrant pain, sudden excessive weight gain and severe edema.} and {#Abnormal HDP lab: Low platelets, elevated liver enzymes, elevated serum creatinine, and abnormal coagulation profile.}

Early Onset Preeclampsia: Onset of proteinuric hypertension is before 34 weeks of pregnancy. The maternal complications are more severe. Low birth weight, fetal growth restriction and iatrogenic prematurity are common.

Late Onset Preeclampsia: Onset of proteinuria hypertension is after 34 weeks of pregnancy.

The maternal complications are less severe. Low birth weight and fetal growth restriction is less common.

Statistical Analysis: Data were entered in Microsoft Excel 2021 and statistical analysis was done using IBM Statistical Software for Social Sciences (SPSS) version 22.

Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV), and diagnostic accuracy of HDP Gestosis score and combined gestosis score and UtA-PI in predicting development of HDP was calculated.

Categorical variables were represented in the form of percentages, and frequencies. Continuous variables were presented as descriptive statistics (Mean and Standard deviation).$p \leq 0.05$ was considered statistically significant.

Results

The study population had a mean maternal age of 26.2 ± 4.8 years, with enrollment occurring at a mean gestational age of 13.2 ± 3.14 weeks. Participants were predominantly primigravidae (65.1%), with a mean BMI of 26.5 ± 3.9 kg/m², while average systolic and diastolic blood pressures remained within the normotensive range.

Regarding obstetric characteristics, 41.0% of participants had a gestosis score of 2 and 38.0% had a score ≥3, indicating that a substantial proportion exhibited moderate-to-high gestosis risk. Most pregnancies (71.0%) reached term (>37 weeks), whereas 17.0% and 12.0% resulted in late preterm (34–37 weeks) and early preterm (<34 weeks) deliveries, respectively (Table 1).

Table 1: Demographic, maternal, and obstetric characteristics

Variable	Values
Age, years	26.2 ± 4.8
Gestational age, weeks	13.2 ± 3.14
BMI, kg/m^2	26.5 ± 3.9
SBP, mmHg	119.3 ± 10.8
DBP, mmHg	76.9 ± 7.8
Parity	
Primi, n (%)	52 (65.0)
Multi, n (%)	28 (35.0)
Gestosis score	
Score 1, n (%)	17 (21.0)
Score 2, n (%)	33 (41.0)
Score ≥3, n (%)	30 (38.0)
Period of gestation (weeks)	
>37, n (%)	57 (71.0)
34–37, n (%)	13 (17.0)
<34, n (%)	10 (12.0)

Values were expressed as mean ± standard deviation (SD) unless otherwise stated

BMI, Body mass index; SBP, Systolic blood pressure; DBP, Diastolic blood pressure. During the follow-up, HDP developed in 21 (26%) participants. Among 21 participants who developed HDP, 5 (6.25%) participants belong to Gestosis score <3 and 16 (20%) participants belong to Gestosis score >3(Figure 1).

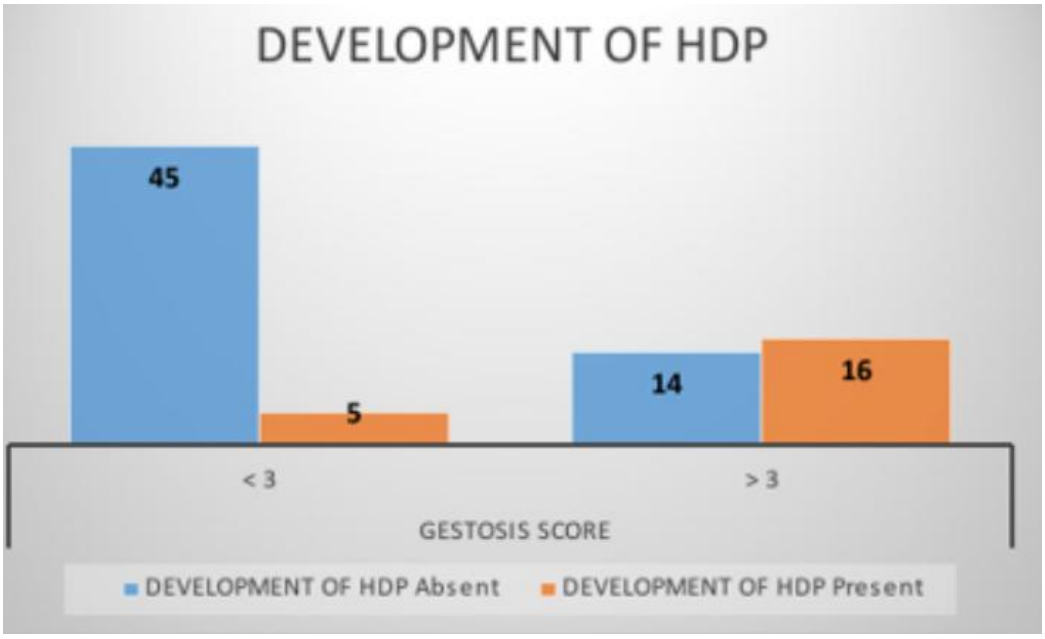

Figure 1: Development of HDP and gestosis score

Uterine artery doppler diastolic notching was persistent beyond 24 weeks in 22 (27%) participants, and it disappeared in 58 (73%) participants. Among 22 participants with persistent diastolic notching, 9 (11.25%) participants were having Gestosis score <3 and 13 (16.25%) participants were having Gestosis score >3 (Figure 2 A and Figure 2B).

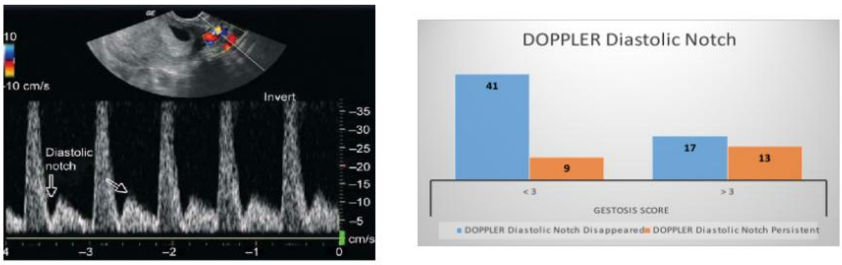

Figure 2A: Uterine artery doppler showing diastolic notch, Figure2B. Persistence of uterine artery diastolic notching beyond 24 weeks

The mean UtA-PI was >2.28 in participants who developed HDP and mean UtA-PI of was 1.74 in participants who did not develop HDP (Figure 3A and Figure 3B).

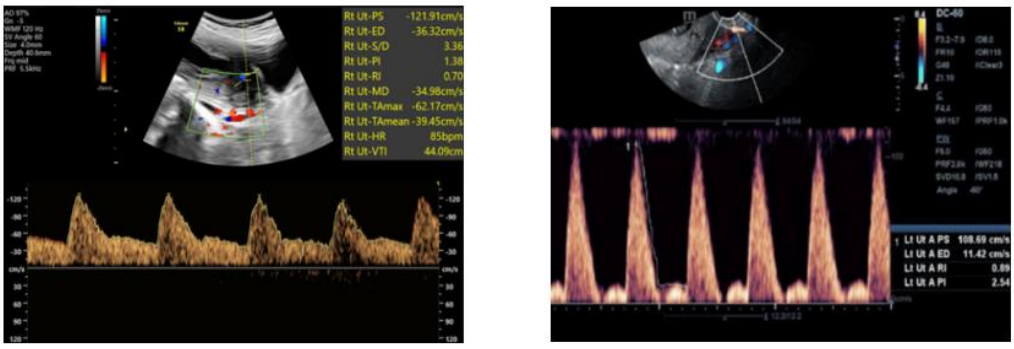

Figure 3A: Uterine artery doppler flow pattern with normal resistance, Figure 3B: Uterine artery doppler showing early diastolic notch with a PI of 2.54

The sensitivity, specificity, positive predictive value(PPV), negative predictive value(NPV) and diagnostic accuracy for predicting hypertensive disorders of pregnancy using gestosis score >/=3 were 76.19%, 76.27%, 53.33%, 90% and 76.26% respectively. Similarly, sensitivity, specificity, PPV, NPV and diagnostic accuracy of combined tests (gestosis score >/=3 and UtA-PI in prediction of HDP were 23.1%, 100%, 100%, 78.67 and 80% respectively (Table 2).

Table 2: Sensitivity, specificity, PPV, NPV, and diagnostic accuracy for predicting HDP using gestosis score

Variables	Gestosis score >/=3	Gestosis score and UtA-PI
Sensitivity, %	76.19	23.10
Specificity, %	76.27	100.00
PPV, %	53.33	100.00
NPV, %	90.00	78.67
Diagnostic accuracy, %	76.26	80.00

PPV, Positive predictive value; NPV, Negative predictive value

Maternal complications were predominantly hypertensive in nature, with imminent eclampsia and preterm labour being the most frequent adverse outcomes, each affecting 7.5% of participants. Eclampsia and oligohydramnios with Doppler abnormalities were each observed in 6.2%, while postpartum haemorrhage occurred in 5.0% of cases. Severe maternal complications, including maternal near miss and referral to a higher centre, were reported in 3.7% of participants each. Less frequent but clinically significant complications, such as abruptio placenta, HELLP syndrome, acute kidney injury, pulmonary oedema, peripartum cardiomyopathy, disseminated intravascular coagulation, and maternal death, were observed in a small proportion of women (1.2–2.5%), highlighting the potential for serious maternal morbidity and mortality in high-risk pregnancies (Table 3).

Table 3: Maternal outcomes

Maternal Outcome	N (%)
Imminent eclampsia	6 (7.5)
Preterm labour	6 (7.5)
Eclampsia	5 (6.2)
Oligohydramnios and doppler changes	5 (6.2)
Post partum haemorrhage	4 (5.0)
Near miss	3 (3.7)
Referred to higher centre	3 (3.7)
Abruptio placenta	2 (2.5)
Hemolysis, Elevated Liver enzymes, and Low Platelet count (HELLP) syndrome	1 (1.2)
Acute kidney injury (AKI)	1 (1.2)
Pulmonary oedema	1 (1.2)
Peripartum cardiomyopathy	1 (1.2)
Disseminated intravascular coagulation (DIC)	1 (1.2)
Maternal death	1 (1.2)

Adverse fetal outcomes were observed in a notable proportion of pregnancies, with NICU admission being the most common outcome, affecting 17.5% of neonates. Low birth weight was reported in 11.2% of newborns, while meconium aspiration syndrome and birth asphyxia each occurred in 8.8%, followed by preterm birth (7.5%) and respiratory distress syndrome (6.3%). Serious neonatal outcomes were less frequent, with long-term neurological sequelae documented in 5.0% of infants and neonatal mortality occurring in 2.5% of cases (Table 4).

Table 4: Fetal outcomes

Fetal Outcome	N (%)
NICU transfer rate	14 (17.5)
Low Birth weight	9 (11.2)
Meconium aspiration syndrome (MAS)	7 (8.75)
Birth Asphyxia	7 (8.75)
Preterm Labour	6 (7.5)
Respiratory distress syndrome (RDS)	5 (6.25)
Long term sequelae (Cerebral palsy, developmental delay)	4 (5.00)
Neonatal deaths	2 (2.50)

Discussion

Hypertensive disorders of pregnancy (HDPs) affect approximately 10–12% of pregnancies worldwide. According to the World Health Organization (WHO) systematic review on maternal mortality, hypertensive disorders continue to be one of the leading direct causes of maternal death. Together with obstetric haemorrhage and sepsis, hypertension constitutes the major triad responsible for substantial maternal morbidity and mortality during pregnancy and the puerperium. In our institution, the prevalence of HDP was 17.5%, with a near-miss rate of 3.75% and a maternal mortality rate of 1.25% attributable to HDP.The present study observed a preeclampsia (PE) prevalence of 26.25%, which closely resembles the findings of Khanijo et al., who reported a prevalence of 26.7%.[10] In contrast, Gupta et al., documented a prevalence of 15.01%,[1] while Imam et al., and Mou et al., reported prevalence rates of 17.43%[4] and 14.4%,6 respectively.

Lower rates have been described in population-based studies from Sweden and China, where the prevalence of PE was 3.98% and 4.02%, respectively.7 Similarly, Mayrink et al., observed PE in 7.5% of pregnant women,[8] whereas Mishra et al. reported an HDP incidence of 15.4% among Indian women.[9] Overall, the reported prevalence of PE varies between 3% and 16%, with higher rates generally observed in developing countries. The comparatively higher prevalence identified in the present study underscores the need for greater awareness and early risk identification. Furthermore, our findings support the usefulness of a simple Gestosis scoring system as a practical tool for predicting HDPs, thereby facilitating timely intervention and improving maternal and fetal outcomes.The mean maternal age, gestational age at enrolment, and body mass index (BMI) in the present study were 26.2 ± 4.8 years, 13.2 ± 3.14 weeks, and 26.5 ± 3.9 kg/m², respectively. These findings are comparable with those reported by Gupta et al., whose study demonstrated corresponding values of 28.4 ± 6.8 years, 11.5 ± 2.04 weeks, and 24.5 ± 3.7 kg/m².[1] Likewise, Imam et al., observed a mean maternal age of 25.71 ± 5.9 years, a mean gestational age of 11.9 ± 2.19 weeks, and a BMI of 24.9 ± 3.6 kg/m²,[4] while Basavanapalli et al., reported mean values of 26.6 ± 3.98 years, 11.2 ± 1.04 weeks, and 21.7 ± 1.99 kg/m², respectively.11 These similarities indicate that the demographic characteristics of our study population are consistent with previously published literature.The average systolic and diastolic blood pressures recorded at enrolment were 119.3 ± 10.8 mmHg and 76.9 ± 7.8 mmHg, respectively. Additionally, primigravidae constituted 65% of the study population, whereas multigravidae accounted for the remaining 35%. Comparable observations were reported by Gupta et al., who documented mean SBP and DBP values of 117.4 ± 10.2 mmHg and 78.7 ± 5.8 mmHg, respectively, with 65.12% primigravidae and 34.88% multigravidae.[1] Imam et al., also observed similar blood pressure values (116.8 ± 12.4 mmHg and 75.8 ± 6.7 mmHg), with 66.72% primigravid and 33.28% multigravida women.[4] In comparison, Basavanapalli et al., reported relatively lower baseline blood pressure values of 102.6 ± 9.05 mmHg systolic and 69.4 ± 7.50 mmHg diastolic.[11] Table 5 presents a comparison of the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of the HDP-Gestosis score for predicting HDPs with findings reported in previous studies.

Table 5: Comparison of sensitivity, specificity, PPV, NPV and diagnostic accuracy of gestosis scoring of pregnancy

S. No.	Study	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Diagnostic accuracy
1	Our study	76.19	76.27	53.33	90	76.26%
2	Gupta et al., (2022)[1]	83.1	97.51	85.51	97.03	95.35%
3	Imam et al., (2023) [4]	86.66	96.49	86.91	97.98	96.12%
4	Basavanapalli et al., (2023) [11]	81.5	71.7	25.9	97	72.80%

Uterine artery Doppler assessment was performed between 11 and 13+6 weeks of gestation to evaluate the uterine artery pulsatility index (UtA-PI). In the present study, the optimal UtA-PI cut-off value was 2.28.

A comparable threshold of 2.007 was reported by Das et al.,[13] whereas Poon et al. observed a mean UtA-PI of 2.26 among women who subsequently developed preeclampsia compared with 1.40 in those who remained normotensive.[14] These observations indicate that an elevated UtA-PI during the first trimester is associated with an increased likelihood of developing hypertensive disorders of pregnancy.

Table 6 compares the diagnostic performance of UtA-PI, including sensitivity, specificity, PPV, NPV, and overall diagnostic accuracy, for predicting HDPs.

Table 6: Comparison of sensitivity, specificity, PPV, NPV and diagnostic accuracy of UtA-PI

S. No.	Study	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Diagnostic Accuracy
1	Our study	66.67	93.22	57.28	95.35	90.03
2	Cnossen et al., (2008) [12]	78.00	95.00	-	-	-
3	Karpagam et al., (2024)[15]	92.90	97.10	81.47	99.01	96.59
4	Panda et al., (2023)[16]	56.25	92.60	42.80	95.50	89.40

An ideal screening strategy should provide an optimal balance between sensitivity and specificity. In the present study, an HDP-Gestosis score of ≥3 demonstrated superior predictive performance for identifying women at risk of preeclampsia. Nevertheless, women with an intermediate score of 2 may also benefit from closer surveillance and preventive interventions. The pathogenesis of preeclampsia is multifactorial and involves several mechanisms, including increased arterial stiffness, impaired uterine vascular compliance, endothelial dysfunction, abnormal placentation, inadequate maternal nutritional status, exaggerated inflammatory responses, enhanced lipid peroxidation, diminished antioxidant capacity, immunological intolerance to fetal antigens, and underlying genetic or epigenetic susceptibility. Table 7 summarizes the diagnostic accuracy of the combined use of the HDP-Gestosis score and UtA-PI for predicting HDPs.

Table 7: Comparison of sensitivity, specificity, PPV, NPV and diagnostic accuracy of combined tests in prediction of HDP

S. No.	Study	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Diagnostic Accuracy
1	Our study	23.81	100.00	100.00	78.67	80.0%
2	Razzak et al., (2023)[17]	63.70	95.50	80.950	89.90	88.29%
3	Cnossen et al., (2008)[12]	23.00	99.00	-	-	-
4	Panda et al., (2023)[16]	63.60	96.20	70.00	95.00	95%

The findings of the present study emphasize the considerable burden of hypertensive disorders of pregnancy and demonstrate that combining a simple clinical scoring system with uterine artery Doppler assessment provides an effective approach for early risk stratification. Early identification of women at high risk offers an opportunity to initiate preventive strategies, intensify antenatal surveillance, and optimize clinical management, thereby reducing maternal and neonatal complications. In the present study, HDP was associated with several serious maternal complications, including imminent eclampsia, preterm labour, oligohydramnios, postpartum haemorrhage, abruptio placentae, HELLP syndrome, acute kidney injury, pulmonary oedema, peripartum cardiomyopathy, disseminated intravascular coagulation, and maternal death. Adverse neonatal outcomes included NICU admission, low birth weight, meconium aspiration syndrome, birth asphyxia, preterm birth, respiratory distress syndrome, long-term neurological sequelae, and neonatal mortality.

The present study has certain limitations that should be considered while interpreting the findings. First, the sample size was relatively small, which may have limited the statistical power of the study. Second, the study population was recruited from a government hospital, with most participants belonging to lower-middle and lower socioeconomic groups, thereby restricting the demographic diversity of the sample. Finally, as this was a single-center, hospital-based study, the findings may not be representative of the general population and should therefore be interpreted with caution. Larger multicenter studies involving more diverse populations are warranted to validate and generalize the present findings.

Conclusion

The findings of the present study demonstrate that several early pregnancy risk factors are associated with the subsequent development of preeclampsia. Early recognition of these risk factors enables timely prediction, closer surveillance, and appropriate intervention, thereby improving maternal and neonatal outcomes. The results support the use of simple, non-invasive screening tools, such as the HDP-Gestosis score and uterine artery pulsatility index (UtA-PI), for the early identification of women at increased risk of hypertensive disorders of pregnancy. The combined application of the Gestosis score and UtA-PI achieved a diagnostic accuracy of 76.26% in predicting the development of preeclampsia, indicating its potential utility as an effective early screening strategy. Incorporating these screening methods into routine antenatal care may facilitate timely preventive interventions and contribute to reducing adverse obstetric and perinatal outcomes associated with hypertensive disorders of pregnancy.

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