Section: Obstetrics and Gynaecology

Original Research Article

TO DETERMINE THE ROLE OF MATERNAL FACTORS, MEAN ARTERIAL PRESSURE AND UTERINE ARTERY PULSATALITY INDEX IN THE PREDICTION OF PREECLAMPSIA AT 11-13 WEEKS OF GESTATION

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Received *: 09/07/2025*
Received in revised form *: 20/08/2025*
Accepted *: 08/09/2025*

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DOI: 10.70034/ijmedph.2025.3.580

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (3); 3165-3170

ABSTRACT

Background: Preeclampsia is a hypertensive disorder of pregnancy associated with significant maternal and perinatal morbidity and mortality, particularly in low-resource settings. Early identification of women at risk is crucial for timely intervention. This study aims to evaluate the role of maternal demographic ,clinical factors and uterine artery pulsatality index in predicting the development of preeclampsia during the first trimester (11–13 weeks of gestation).

Materials and Methods: The study was done in institute of obstetrics and Gynecology at GGH, Kadapa. This prospective study was conducted in the hospital for a Period of one and half year from February 2021 to August 2022, where 178 women between 11-13 weeks of gestation were recruited, which includes 178 antenatal women visiting OPD, fulfilling the inclusion and exclusion criteria.

Results: Three risk factors were found to be useful in prediction of adverse pregnancy outcome in combination: previous history of pre-eclampsia, MAP and Ut. AtPI. Prediction based on one factor was not as efficient as combining all the three factors, when taken in single manner sensitivity of developing preeclampsia is only 60%. In the above test applied, when only maternal factors or when only MAP was taken sensitivity is only 80% when only uterine artery pulstality index was taken whereas the sensitivity has increased upto 86.8%,and specificity 44.9% when all the factors were combined and taken p value was significant.

Conclusion: In pregnancy, hypertensive disorders are major cause for maternal and perinatal morbidity and mortality. Since, its aetiology remains unknown, and there is no effective treatment for this complication, the identification of women who are at risk of developing will be of great value. This will help us to find women who require close antenatal surveillance, allow early referral for timely delivery, when signs or symptoms occur. This early identification of high-risk women can be helpful for us to start them with prophylactic aspirin which may help in modifying disease severity and time of disease occurrence. The sensitivity of first trimester uterine artery Doppler can be improved by doing combined screening with the maternal characteristics and mean arterial pressure.

Keywords: Preeclampsia, maternal risk factors, first trimester screening, BMI, mean arterial pressure, prediction.

INTRODUCTION

A multisystem pregnancy disease known as preeclampsia is often characterised by hypertension and substantial proteinuria more than 20 weeks of gestational age.[1] This condition, which affects 2%–5% of expectant mothers, is a significant contributor to mortality and morbidity rates for mothers and newborns.[2-5] Because of a broad vasoconstriction, endothelial damage, and a change in the microcirculation at the level of the brain, kidneys, lungs, liver, eyes, and other organs, this condition damages multiple systems. Because of this, it may result in multiple organ failure and associated effects. The pathogenesis of preeclampsia is largely unknown despite numerous investigations over the past ten years. Its complex aetiology includes elements from the immune system, genes, hormones, and the environment. The main treatment for preeclampsia up until now has been the placenta should be removed because it appears to be the pathogenic cause of all illness symptoms.[6] The main abnormality in preeclampsia is trophoblastic invasion, which increases the resistance of the uterine and placental circulation.[7] A systemic inflammatory response and vasospasm caused by this mechanism result in hypertension, oedema, and proteinuria. Preeclampsia patients at high risk during the first trimester of pregnancy should be identified so they can receive an efficient aspirin prophylaxis before 16 weeks. Several studies have been conducted.[8] The following characteristics have been combined to increase the sensitivity in detecting these patients.

Objectives

To determine the role of maternal factors, mean arterial pressure and uterine artery pulsatality index in the prediction of preeclampsia at 11-13 weeks of gestation.

MATERIALS AND METHODS

Study Design: A Hospital Based Prospective Cohort Study. **Duration of Study**: One and half year From February 2021 to August 2022. **Place of Study**: Hospital attached to Government Medical college, Kadapa. **Sample Size**: 177. **Inclusion Criteria**: (a) age >18 years (b) Multiple gestations (c) Chronic Hypertension (d) Diabetes Mellitus type 1 and Type 2 (e) Autoimmune Diseases (Antiphospholipid Syndrome, SLE) (f) Chronic Kidney Disease (g) History of Preeclampsia in previous pregnancy (h) Family history of preeclampsia (i) Gestational age 30) (k) Maternal Age >35 years. **Exclusion Criteria**: 1. Women who are severely ill, those with learning difficulties, or Psychiatric illness 2.Gestational age >16 weeks. 3.Age.

This prospective study was conducted in the hospital for a Period of one and half year from February 2021 to August 2022, where 178 women between 11-13 weeks of gestation were recruited, which includes 178 antenatal women visiting OPD, fulfilling the inclusion and exclusion criteria.

RESULTS

Table 1: Distribution of study participants according to age group

Age group in years	Frequency	Percentage
18 – 20	16	9
21-25	82	46.1
26-30	55	30.9
31-35	18	10.1
63-40	7	3.9
Total	178	100

The majority of women were in the age group 21–25 years (46.1%), followed by 26–30 years (30.9%). Together, these two groups accounted for over three-quarters of the study population. Women aged 31–35 years made up 10.1%, while those in the 18–20 years age group comprised 9.0%. The least represented group was 36–40 years, with only 3.9%.

Table 2: Distribution of study participants according to parity

Parity	Frequency	Percentage
Primi	44	24.7
Multi	134	75.3
Total	200	100.0

In this study majority of the women were multigravida (75%) than primigravida (25%). Among the 44 primi gravida women 86% of them developed preeclampsia whereas only 67% developed preeclampsia out of 134 multigravida women. This shows that the prevalence of preeclampsia in more in primi gravidas as compared to multigravidas.

Table 3: Distribution of study participants according to risk factors

Risk factors	Frequency	Percent
Chronic hypertension	4	2.2
Elderly	5	2.8
Family h/o PE	11	6.2
H/o PIH	110	61.8
K/C/O DM	10	5.6
Obesity	20	11.2
Twins	18	10.1
TOTAL	178	100

The most common risk factor identified was a history of pregnancy-induced hypertension (PIH), which was present in 110 cases (61.8%), accounting for more than half of the study population. This was followed by obesity in 20 cases (11.2%) and twin pregnancy in 18 cases (10.1%), both of which were notable contributors.

Other less frequent but relevant risk factors included a family history of pre-eclampsia (PE) (11 cases, 6.2%), known case of diabetes mellitus (DM) (10 cases, 5.6%), and elderly gravida (5 cases, 2.8%). The least common was chronic hypertension, observed in only 4 cases (2.2%).

Overall, the data highlights that PIH is by far the predominant risk factor, while other conditions such as obesity, twin pregnancy, and family history of PE also contribute significantly, whereas chronic hypertension and elderly age play a smaller role in this cohort.

Table 5: Distribution of study participants according to Mode of delivery

Mode of delivery	Frequency	Percent
LSCS	110	61.8
NVD	68	38.2
Total	**178**	**100**

Out of 178 study subjects, the majority delivered by Lower Segment Cesarean Section (LSCS), accounting for 110 cases (61.8%). In comparison, Normal Vaginal Delivery (NVD) was observed in 68 cases (38.2%).

This indicates that cesarean section was the predominant mode of delivery, being nearly 1.6 times more frequent than vaginal delivery in the study population.

Table 8: Distribution of study participants according to IUGR and Oligohydraminos

IUGR and Oligohydraminos	Frequency	Percent
YES	7	3.9
NO	171	96.1
Total	**178**	**100**

Among the 178 study subjects, only 7 women (3.9%) were found to have Intrauterine Growth Restriction (IUGR) with oligohydramnios, while the vast majority, 171 cases (96.1%), did not have this complication. This indicates that although IUGR with oligohydramnios was relatively uncommon, it was still an important adverse outcome present in a small proportion of the study population.

The ROC curve for Mean Arterial Pressure (MAP) yielded an area under the curve (AUC) suggestive of moderate predictive accuracy. At the criterion value of >87.9 mmHg, MAP demonstrated a sensitivity of 60.5% and a specificity of 57.1% for predicting the outcome. This indicates that while MAP has some discriminatory value, its predictive power is modest, with nearly equal rates of true-positive and false-positive classification.

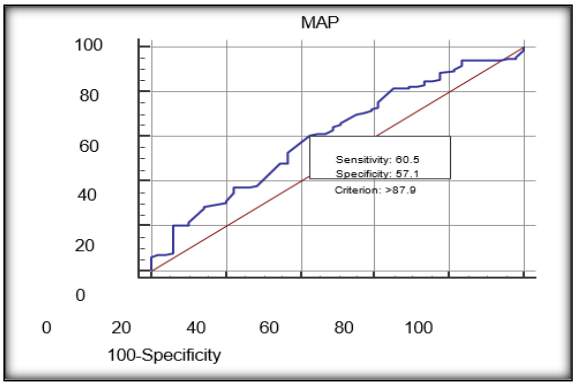
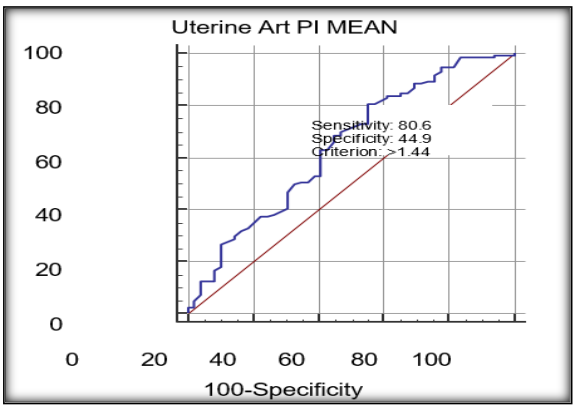


Figure 1: Prediction Based On Maternal Factors, Mean Arterial Pressure and Uterine Artery Pulsatality Index



For Uterine Artery PI, a cut-off of >1.44 showed a sensitivity of 80.6% and a specificity of 44.9%, suggesting higher sensitivity but lower specificity compared to MAP.

These findings indicate that while UtA-PI is more sensitive, MAP provides a better balance between sensitivity and specificity. Both maternal hemodynamic parameters can be considered useful tools for early risk prediction, though neither demonstrates perfect discriminatory ability.

The combined model (MF + MAP + UtA-PI) improved prediction, achieving a sensitivity of 86.8% with a specificity of 44.9%, highlighting that incorporating maternal risk factors with MAP and UtA-PI enhances early detection of preeclampsia, particularly in identifying true-positive cases, though specificity remains modest.

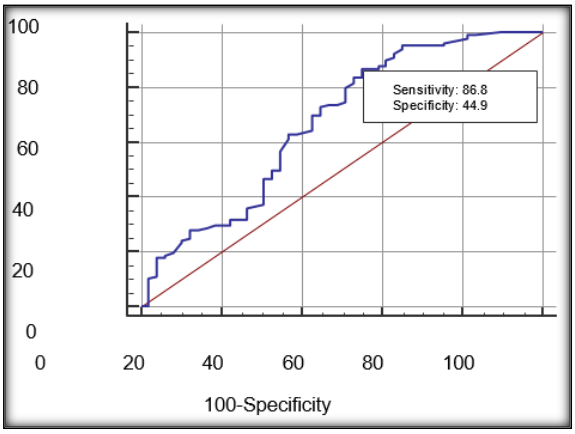


Figure 2: Prediction of preeclampsia based on mean arterial pressure and uterine artery pulsatality index only PREDICTION BASED ON MF, MAP, UTPI

Table 9: Area under the curve for map, maternal factors and uterine artery pulsatality index

Area under the ROC curve (AUC)	**0.670**
95% Confidence interval b	0.596 to 0.739
Significance level P (Area=0.5)	0.0005
CUT OFF	>0.0068
Sensitivity	86.82
Specificity	44.90
PPV	80.6
NPV	56.4

ANOVA

		N	Mean	Std. Deviation	P VALUE
PREDICTION BASED ON MF ONLY	IMMINENT	12	.035042	.0360715	0.334
	MILD PE	84	.027380	.0169883	
	SEVERE PE	27	.024419	.0138086	
	ECLAMPSIA	6	.030367	.0300710	
	NO	49	.023506	.0156646	
	Total	178	.026481	.0185811	
PREDICTION BASED ON MF, MAP, UT PI	IMMINENT	12	.0430925	.04391600	0.001
	MILD PE	84	.0212650	.01793031	
	SEVERE PE	27	.0336593	.02775847	
	ECLAMPSIA	6	.0750500	.07621847	
	NO	49	.0188306	.03242479	
	Total	178	.0257594	.03111501	

Three risk factors were found to be useful in prediction of adverse pregnancy outcome in combination: previous history of pre-eclampsia, MAP and Ut. AtPI. Prediction based on one factor was not as efficient as combining all the three factors, when taken in single manner sensitivity of developing preeclampsia is only 60%. In the above test applied, when only maternal factors or when only MAP was taken sensitivity is only 80% when only uterine artery pulstality index was taken whereas the sensitivity has increased upto 86.8%, and specificity 44.9% when all the factors were combined and taken p value was significant.

DISCUSSION

Hypertensive disorders of pregnancy are one of the most common complications of pregnancy with the incidence of 5 -10%. The associated maternal morbidity, mortality and neonatal complications are very adverse indicating the need for early identification of the condition preferably before the onset of clinical disease. Lot of research has been done and many screening options have been identified for predicting development of hypertensive disorders in pregnancy. But no single screening test is useful.

Many studies done in second trimester investigated the value of uterine artery Doppler in prediction of development of hypertensive disorders of pregnancy, scientific interest is now focused on first trimester. This gives the opportunity of early intervention for modifying the severity of the disease and meticulous surveillance for early identification of the disease.

This is a prospective study conducted at the Department of Obstetrics and Gynaecology at Government General Hospital, Kadapa, between February 2020 – August 2022 with the aim to evaluate in the first trimester, maternal factors, mean arterial pressure, and uterine artery Doppler for the development of preeclampsia.

Parameters such as family history, previous obstetric history, medical history was not significant in my study population. These parameters are considered in this study as reference to the following study - Plasencia et al,[9] investigated the performance of screening for PE using maternal characteristics such as body mass index, age, ethnic origin, smoking, medical and obstetric history and uterine artery PI in the first trimester. They concluded that in unaffected individuals log MoM PI was influenced by maternal ethnic origin, body mass index, previous history of PE and fetal crown-rump length. In the prediction of PE significant contributions were provided by log MoM PI, ethnic origin, body mass index and previous and family history of PE. They also added that for a false-positive rate of 10% the predicted detection rate of PE requiring delivery before 34 weeks was 82%, compared to 31% for late PE, 12% for gestational hypertension and 18% for small for gestational age.

In the study conducted by Gomez et al,[10] where 999 pregnant women were examined between 11 to 14 weeks during routine scan using transvaginal colour and pulsed Doppler. The authors found a significant change in the 95th percentile of mean uterine artery PI with advancing gestation. They reported a progressive decrease in the prevalence of bilateral notching and PI with gestation. There were 22 cases of PE, and using a cut-off of PI above the 95th percentile, the sensitivity, specificity, PPV and NPV were 245, 95.1%, 11.3% and 97.9% respectively. The authors of the study acknowledged the potential advantages of early screening for PE and associated complications, but concluded that there is a limited role for uterine Doppler velocimetry in identifying the pregnancies with increased risk of developing hypertensive disorders.

Onduvei et al study,[11] discovered that Ut.API and MAP contributed considerably independently to the diagnosis of preeclampsia, gestational hypertension, and SGA. They also showed that screening just based on maternal factors would only detect roughly 30% of pregnancies that would end in preeclampsia, with a 10% false positive rate. The method that incorporates maternal history, blood pressure monitoring, and Ut.API is more efficient.

Offering women this screening during an NT scan is quite simple. Although there are currently no preventative therapies known to lower the incidence of PE, identifying pregnant women at risk of a bad pregnancy outcome in the first trimester will allow us to put more focus on women who are at a higher risk of developing preeclampsia.

The fetal medicine foundation has developed a prediction method for preeclampsia in the 1st trimester. Since it avails all the variables, it gets better results in detecting preterm preeclampsia, and a sensitivity of 76%. This is similar to my study where the prediction rate is 86.8%.

CONCLUSION

In pregnancy, hypertensive disorders are major cause for maternal and perinatal morbidity and mortality worldwide, particularly in developing countries than developed countries. Since, its aetiology remains unknown, and there is no effective treatment for this complication, the identification of women who are at risk of developing will be of great value. This will help us to find women who require close antenatal surveillance, allow early referral for timely delivery, when signs or symptoms occur. This early identification of high-risk women can be helpful for us to start them with prophylactic aspirin which may help in modifying disease severity and time of disease occurrence. The sensitivity of first trimester uterine artery Doppler can be improved by doing combined screening with the maternal characteristics and mean arterial pressure, and also biochemical markers like PAPP-A, Sflt in addition to Doppler changes.

This can be further improved by addition of other parameters like biochemical markers. To conclude from the present study, first trimester Doppler ultrasound is the best non-invasive investigation to assess changes in uteroplacental hemodynamic which helps in early prediction of development of hypertensive disorders in pregnancy along with maternal characteristics and mean arterial pressure which helps in early prophylactic intervention.

Acknowledgements: We would like to thank all the study participants and the authors from where we have cited the references for publication of this article.

Ethical clearance: The study was taken up after the approval of the Ethical committee of the medical college, IEC No.ACAD/E3B/2020-21, dt 12.02.2021

Conflict of Interest: Nil

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