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Hypertensive Disease of pregnancy(HDP) Gestosis Score Assessment for the Prediction of Pre-eclampsia : A Diagnostic Study

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ABSTRACT

Introduction: Preeclampsia, marked by hypertension and proteinuria after 20 weeks of gestation, leads to severe maternal and fetal complications globally. The current diagnosis for preeclampsia includes blood pressure measurement with or without proteinuria. The HDP-Gestosis Score integrates clinical, laboratory, and imaging markers to enhance early detection and improve outcomes. There is a gap in diagnostic accuracy of HDP-Gestosis score in Nepalese context.

Objective: This study aimed to evaluate the diagnostic accuracy of the HDP-Gestosis Score for predicting preeclampsia, focusing on its sensitivity, specificity, positive predictive value, and negative predictive value.

Methodology: A prospective hospital-based study was conducted at Birat Medical College Teaching Hospital from 15 September 2023 to 10 July 2024. Data were collected from 284 consecutively enrolled antenatal patients and followed until delivery to predict the occurrence of preeclampsia and analysed using SPSS version 23.

Results: The incidence of Preeclampsia and Gestational Hypertension was 5(1.8%) and 20(7%) respectively. The HDP Gestosis Score distribution with a score of 1,2 and ≥3 showed 26.04%, 29.6% and 30.28% respectively. The sensitivity and negative predictive value of the HDP Gestosis Score were both 100%, while specificity was 70.96% and positive predictive value was 5.81%.

Conclusion: The HDP Gestosis Score demonstrates high sensitivity and negative predictive value in predicting preeclampsia, making it an effective tool for ruling out the condition in low-resource settings. However, its specificity was moderate, and the positive predictive value was low, suggesting use alongside other diagnostic methods.

INTRODUCTION

Preeclampsia is a multisystem progressive disorder that emerges after 20 weeks of gestation, marked by new onset of hypertension and proteinuria or the new onset of hypertension with significant end-organ dysfunction.[1,2] Globally, its prevalence ranges from 2 to 14%, with higher rates in developing countries,[3-6] in Nepal, it ranges from 1.8 to 2.6%.[7,8] Severe preeclampsia can cause serious maternal complications like cerebrovascular hemorrhage, pulmonary edema, and acute renal failure, while fetuses may suffer from growth restriction and increased perinatal morbidity and mortality.[9] Current diagnostic approaches for preeclampsia predominantly rely on blood pressure measurements with or without proteinuria assessment.[1] Blood pressure measurements can be inconsistent due to various factors, and proteinuria tests may not always accurately reflect the disease's presence or severity. This method is often detected late, yields false results, lacks sensitivity and specificity.[10] Universal screening for diagnosing preeclampsia is recommended but there is no single effective screening test to predict preeclampsia.[11] The Hypertensive Disorder of Pregnancy (HDP)-Gestosis Score integrates clinical, laboratory, and imaging markers, to enhance

early detection and management and is recommended for good clinical practice in India.[11] To the best of our knowledge, no studies in HDP Gestosis have been published in Nepal till date. Hence we aimed to evaluate the diagnostic accuracy of the HDP-Gestosis Score for predicting preeclampsia, focusing on its sensitivity, specificity, positive predictive value, and negative predictive value against the current diagnostic criteria.

METHODOLOGY

A hospital based prospective study was conducted in the department of obstetrics and gynecology of Birat Medical College Teaching Hospital from 15 September 2023 to 10 July 2024. Ethical approval was taken from the institutional review committee of the same college (IRC-PA-347/2023)prior to conducting the research . Patients were informed about the objective of the research and voluntary informed consent was obtained before collecting data. Booked antenatal patients presenting in Out Patient Department(OPD)of BMCTH at their first or second trimester before 20 weeks of gestation were included for the study and followed up till delivery and discharge from the hospital. Patients delivered outside BMCTH, prior history of smoking, alcohol intake, substance abuse and liver disease were excluded from the study. Patients withdrawing from participation and missing follow-up period continuously at any time till the delivery were also excluded from the study.

Sample size was calculated using the sample size calculator software.[12,13] Taking the reference of the values from the study entitled 'Improvement in the cases of hypertensive disorder of pregnancy with help of HDP-Gestosis Score, sensitivity = 86.666%, specificity = 96.649 %, Prevalence of preeclampsia = 17.43%, Precision =10%, Confidence level =95% and Expected drop out rate of 10%, the final sample size was 284.[14] Hence we included 284 antenatal women consecutively during our study period.

We collected data on patient's baseline history which includes age, gravida, height, weight, Last Menstrual Period(LMP), Expected Date of Delivery(EDD), current diagnosis of pregnancy induced hypertension(PIH) which includes, Gestational Hypertension,Preeclampsia, eclampsia and mode of delivery(cesarean, instrumental, or spontaneous vaginal delivery) in the first part. Then in the second part the HDP Gestosis Scoring tool was used to screen the patients for diagnosis of preeclampsia. HDP Gestosis Score originally developed by Dr. Gorakh Mandrupkar and team is now recommended for good clinical practice by Federation of Obstetric and Gynaecological Societies of India (FOGSI)[11]. The score for presence of risk factor involves 1, 2 and 3 depending upon their severity in development of preeclampsia. The details of the tools are listed in table 1 with their scoring system. Women scoring ≥3 were considered 'At risk for Preeclampsia'. [11]

Face to face interview was done to obtain baseline history and history on HDP Gestosis risk factors including duration of pregnancy, marriage, interpregnancy interval, family history, medical history like polycystic ovarian disease, chronic vascular disease, thyroid disorders, diabetes mellitus, hypertension disorders, kidney disease, autoimmune disorders, assisted reproductive technique, thrombophilia, surgical intervention done in past, followed by routine antenatal examinations.

Body Mass Index(BMI) was calculated from weight and height of patients obtained. Venous blood sampling was done for assessing blood group, complete blood count, thyroid function test, blood sugar levels, anemia, liver function test, renal function test. The risk scoring was done for individual patients during 1st visit in OPD, then followed till delivery and assessed for development of preeclampsia. Blood pressure(BP) was measured to calculate mean arterial pressure. Mean arterial pressure was obtained using the formula {2(Diastolic Blood Pressure (DBP))+Systolic Blood Pressure(SBP)}/3.[15] Preeclampsia was defined as blood pressure (BP) ≥ 140 mm Hg systolic and/or ≥ 90 mmHg diastolic on two occasions and at least 4 hours apart after 20 weeks of gestations in a previous normotensive patient, or BP ≥ 160 mm Hg systolic and/or ≥ 110 mmHg diastolic confirmed by repeating BP within a short interval ,in association with proteinuria≥300 mg per 24 hour urine collection or a dipstick reading of ≥1. In the absence of proteinuria, preeclampsia was diagnosed as : new onset hypertension in pregnancy with the new onset of any of the following : Thrombocytopenia(Platelet count < 100000/ microliter, or renal insufficiency (Serum creatinine > 1.1 mg/dl or doubling of serum creatinine levels in the absence of other known renal disease) or impaired liver function(elevated blood concentration of transaminases to twice normal value), or pulmonary edema or cerebral/visual symptoms.[2] Gestational Hypertension was defined as blood pressure ≥ 140/90 mmHg, detected beyond 20 weeks of gestation and returns to normal within 12 weeks post delivery and not associated with any other features of preeclampsia.[16] The HDP Gestosis Score was compared according to the diagnosed cases of preeclampsia as above mentioned definition.

Collected data was entered in Microsoft excel sheet and transferred to SPSS version 23. Frequency mean percentage was calculated for analysing baseline history. Sensitivity, Specificity, Positive Predictive value(PPV), Negative Predictive Value(NPV) was calculated to obtain the diagnostic accuracy of HDP Gestosis Score against the confirmed patients with diagnosis of preeclampsia.

Table 1: HDP-Gestosis Scoring Tool[11]

Risk factors	Score
Age>35 years	1
Age <19 years	1
Maternal anemia	1
Obesity (BMI >30)	1
Primigravida	1
Short duration of sperm exposure (Cohabitation)	1
Women born as small for gestational age	1
Family history of cardiovascular disease	1
Polycystic ovary syndrome	1
Inter pregnancy interval more than 7 years	1
Conceived with assisted reproductive (IVF/ICSI) treatment	1

MAP >85 mm of Hg	1
Chronic vascular disease (Dyslipidemia)	1
Excessive weight gain during pregnancy	1
Maternal hypothyroidism	2
Family history of preeclampsia	2
Gestational diabetes mellitus	2
Obesity (BMI >35 kg/m^2)	2
Multifetal pregnancy	2
Hypertensive disease during previous pregnancy	2
Pregestational diabetes mellitus	3
Chronic hypertension	3
Mental disorders	3
Inherited/acquired thrombophilia	3
Maternal chronic kidney disease	3
Autoimmune disease (SLE/APLAS/RA)	3
Pregnancy with assisted reproductive (OD or surrogacy)	3
Treatment of hypertensive disease of pregnancy	3

Notes:IVF/ICSI=in vitro fertilization/Intracytoplasmic sperm injection, MAP= Mean arterial Pressure,BMI= Body mass Index,SLE/ APLAS/RA= Systemic lupus erythematosus/ Antiphospholipid syndrome (APLS)/ rheumatoid arthritis (RA), OD=oocyte donation

RESULTS

Table 2: Sociodemographic characteristics of participants (n=284).

Variables	n (%)
Age in years (Mean±SD) (Range)	25.67± 4.52 (16-40) years
Gravida	
Primigravida	101(35.6)
Multigravida	179(63.0)
Grandmultigravida	4(1.4)
Hypertensive disorders	
Gestational Hypertension(Yes)	20(7.0)
Preeclampsia(Yes)	5(1.8)

A total of 284 patients participated in the study, with mean age and standard deviation of 25.67 ± 4.52, ranging from 16 to 40 years. Among them, 18 patients (6.34%) were under 19 years old, and 12 patients (4.2%) were over 35 years old. Sixtythree percent were multigravida. The incidence rates of preeclampsia and gestational hypertension were 1.8% and 7%, respectively, Table 2.

Table 3: Distribution of women with Gestational Hypertension and Preeclampsia according to HDP Gestosis Score.

HDP-Gestosis Score	n(%)	Gestational Hypertension (n=20)	Preeclampsia (n=5)
0	0(0)	0	0
1	75(26.04%)	2	0
2	84(29.6%)	3	0
≥3	86(30.28%)	15	5

The HDP Gestosis score was 1 in 75 (26.04%) women, 2 in 84 (29.6%) and >3 (at risk) in 86 (30.28%) of women. Fifteen patients with Gestational Hypertension and all five patients with Preeclampsia among 86 patients who had HDP Gestosis Score of ≥3. None of the patients with HDP Gestosis Score 2 or Score 1 developed preeclampsia, however three patients with score 2 and two patients with score 1 developed Gestational hypertension, Table 3.

Table 4: Sensitivity, Specificity, PPV, NPV of HDP Gestosis Score ≥3 for predicting Preeclampsia

Variables	Sensitivity n(%)	Specificity n(%)	PPV n(%)	NPV n(%)
HDP Gestosis Score ≥3	1(100%)	0.709(70.9)	0.058(5.8)	1(100)

Note: PPV=Positive predictive value, NPV=Negative Predictive Value

Among 284 patients, there were 5 true positive (TP) cases of preeclampsia and 279 true negative (TN) cases. Out of the 86 patients with an HDP Gestosis Score of ≥3, 5 were true positives for preeclampsia, while 81 were false positives (FP). All 198 patients with an HDP Gestosis Score of <3 were true negatives for preeclampsia. The HDP Gestosis Score demonstrated a sensitivity(true positive rate) of 100% demonstrating highly effective in correctly identifying all true patients with preeclampsia,. The specificity was 70.9% reflecting a moderate ability to correctly identify those without preeclampsia.

The positive predictive value was low with only about 5.8% of the 86 patients classified as high risk (score ≥ 3), actually have preeclampsia. The NPV was very high(100%), meaning that among 198 patients with a low score (< 3) all were rules out without preeclampsia Table 4.

DISCUSSION

The findings from our study highlight the HDP-Gestosis Score's potential in predicting preeclampsia. The HDP Gestosis Score demonstrated a sensitivity (true positive rate) and negative predictive value (NPV) of 100%, indicating that it was highly effective in accurately identifying all true cases of preeclampsia. However, the specificity was 70.96%, reflecting a moderate ability to correctly identify patients without the condition.

The positive predictive value (PPV) was low, with only 5.8% of the 86 patients classified as high risk (score ≥3) actually having preeclampsia. The NPV was very high at 100%, meaning that nearly all patients with a low score (<3) could be reliably

considered free of preeclampsia.

This discrepancy suggests that while the HDP-Gestosis Score is effective in identifying those not at risk, it may overestimate the risk in some patients, leading to unnecessary interventions. The distribution of HDP-Gestosis Scores among the participants showed that 26.04% had a score of 1, 29.6% had a score of 2, and 30.28% had a score of ≥3. Importantly, all cases of preeclampsia and a significant proportion of gestational hypertension 15(17.41%) cases were found in women with scores of ≥3. No preeclampsia cases were observed in women with scores of 1 or 2, although a small number of these women did develop gestational hypertension.

These findings align with the current literature, which suggests that comprehensive risk assessment tools can enhance early detection and management of preeclampsia.[17] Studies across India provide additional insights into the utility of the HDP-gestosis score integrating multiple markers—such as clinical, laboratory, and imaging parameters—can improve the predictive accuracy of preeclampsia screening tools. A study done among 109 patients in antenatal OPD of Bhagalpur, India stated the sensitivity, specificity, PPV, NPV, and diagnostic accuracy of HDP gestosis score as 86.66%, 96.49%, 86.91% and 97.98% respectively.[14] A study done in ASCOMS, Jammu, stated the sensitivity and NPV was of 83.1%, 97.03% respectively which was relatively low in comparison to our study; specificity and PPV of 97.51%, 85.51% respectively which was high compared to our study findings[18]. Similarly, a study involving 400 antenatal women, reported a sensitivity of 72.2%, specificity of 94.6%, PPV of 68.4%, NPV of 95.5%, and an overall predictive accuracy of 91.6% .[19]

Another study in 2023, involving 440 participants, combined the HDP-gestosis score with maternal characteristics and Doppler ultrasound findings to predict pre-eclampsia. Although specific sensitivity and specificity metrics were not provided, the study emphasized the potential for improved prediction accuracy through multimodal approaches. This suggests that integrating the HDP-gestosis score with other diagnostic tools could enhance its predictive performance.[20] This study highlights the HDP-gestosis score's effectiveness in a clinical setting, with higher specificity and PPV compared to our findings. This difference may be attributed to the larger sample size and inclusion of additional risk factors.

Among the 284 patients, five patients(1.8%) had preeclampsia and 20(7%) had gestational hypertension in our study. The findings of our study is similar to the study conducted in Paropakar Maternity and Women's Hospital which stated the same incidence of preeclampsia(1.8%). Multiple risk factors were associated with increased incidence of preeclampsia Age(<19 and >35), primiparous, gestational age<37 weeks, supplementation insufficiency, twin pregnancy, and maternal diseases like GDM, chronic hypertension were found to be the risk factors for preeclampsia.[8] This finding is identified based on the ACOG definition of preeclampsia. It is the second major cause of maternal death in Nepal and is associated with both maternal and perinatal complications worldwide. [8,18] There is no single effective screening test to predict preeclampsia though universal screening is recommended. HDP Gestosis score tool incorporates detailed risk factors associated with preeclampsia and can be done by any health care providers using the risk scoring tool. Meticulous observation in the early first trimester using HDP Gestosis scoring tool can warrant attention for effective prediction and prevention of at risk mothers. [11]

CONCLUSION

The HDP-Gestosis Score demonstrated high sensitivity and negative predictive value for predicting preeclampsia, effectively ruling out the condition in low-risk patients. However, its moderate specificity and low positive predictive value indicate a high rate of false positives, suggesting the need for further refinement. Despite these limitations, the score shows promise in enhancing early detection and management of preeclampsia, especially in low- and middle-income countries where the burden of the disease is highest.

RECOMMENDATIONS

Based on the findings and limitations of our study, we recommend refining the HDP-Gestosis Score to improve specificity and positive predictive value by incorporating additional biomarkers. Larger, multicentric studies are needed to validate the score's effectiveness across diverse populations. Integrating the score into existing clinical guidelines and training healthcare providers on its use will ensure broader applicability. Allocating resources for implementation, particularly in low- and middle-income countries, and educating patients on the importance of early screening are crucial. Further research on preeclampsia mechanisms and new biomarkers will enhance early detection and management.

LIMITATION

This study's limitations include a relatively small sample size and its single-institution setting, which may affect generalizability. The study population may not represent the broader demographic of Nepal. While the HDP-Gestosis Score was evaluated with available clinical, laboratory, and imaging markers, including additional biomarkers could improve accuracy. The high rate of false positives suggests further refinement is needed. Additionally, as a prospective study, it is subject to inherent biases and limitations, such as potential loss to follow-up and variability in clinical practice, which may influence the results.

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CONFLICT OF INTEREST: None

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