ISSN- O: 2458 - 868X, ISSN–P: 2458 – 8687
National Library of Medicine - ID: 101731606

International Journal of Medical Science and Innovative Research (IJMSIR)
IJMSIR : A Medical Publication Hub
Available Online at: www.ijmsir.com
Volume – 11, Issue – 3, June – 2026, Page No. : 153 – 163

A Prospective study to determine the predictive ability of hypertensive disease of pregnancy - gestosis score for the development of pre-eclampsia

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Citation this Article: Manju Jhuriya, Sunita Hemani, Neetu Meena, Alka Khanna, Ramesh Chandra, Radhika Ruhela, "A Prospective study to determine the predictive ability of hypertensive disease of pregnancy - gestosis score for the development of pre-eclampsia", IJMSIR – June – 2026, Vol – 11, Issue – 3, P. No. 153 – 163.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aim: To determine the predictive ability of the HDP-Gestosis Score for the development of pre-eclampsia.

Methodology: This observational, analytical, and prospective study at S.M.S. Medical College, Jaipur, involved 200 pregnant women between 11 and 18 weeks of gestation who met inclusion criteria and provided informed consent. Data collection included medical history, physical examinations, and laboratory tests. Participants were classified into risk categories based on the HDP-Gestosis Score. They were followed throughout their pregnancy for pre-eclampsia development, defined by specific blood pressure and symptom criteria.

Results: Among the 200 pregnant women studied, 56 (28%) developed HDP, while 144 (72%) did not, hence the prevalence of HDP in the present study came out to be 28 %. Of the 200 women who were studied, an HDP Gestosis Score of 0 was found in 66 (33%) women, a Score of 1 was found in 82 (41%), a Score of 2 in 27 (13.5%), and a Score ≥3 in 25 (12.5%) of women. Women with a Gestosis score ≥3 had a 56.67% probability of developing pre- eclampsia. Score ≥2 had a sensitivity of 76.67% for predicting pre-eclampsia, while

scores ≥3 had Sensitivity (56.67%) and specificity (95.29%).

Conclusion: The HDP-Gestosis score, derived from history and examination, effectively predicts hypertensive disorders of pregnancy with high accuracy. Its widespread use could enhance early detection, allowing for timely interventions and reducing maternal and fetal morbidity associated with HDP.

Keywords: HDP-Gestosis Score, Pre-Eclampsia, Hypertensive Disorders Of Pregnancy (HDP).

Introduction

Pregnancy is a special time in a woman's life and obstetricians try their best to give a healthy outcome. However, it is met with many complications which include anemia, gestational diabetes, haemorrhage and hypertension. Hypertensive disease of pregnancy (HDP), a serious complication, encompasses the following types- gestational hypertension, chronic hypertension, pre-eclampsia, eclampsia, and pre- eclampsia superimposed on chronic hypertension[1].

Hypertensive disease of pregnancy have been the most prevalent cause in developed countries, however its incidence has been increasing in developing countries like India in the recent years. The pooled prevalence of hypertensive disorders of pregnancy in India is 9 %, while it ranges between 5 to 10 % globally [2].

Pre-eclampsia , a type of HDP, is defined as new onset hypertension beyond 20 weeks of gestation accompanied by uteroplacental damage or maternal end-organ damage. It is a disorder of widespread vascular endothelial malfunction and vasospasm that occurs after 20 weeks of gestation and can present as late as 4-6 weeks postpartum, which affects 4.6% of pregnancies worldwide[3]. The prevalence of preeclampsia in developed countries varies between 1.8% and 16.7% with more cases of serious morbidity and mortality [4].

As the main pathogenesis of preeclampsia (PE) is related to placenta and inadequate vascular remodeling, it is difficult to completely prevent its development. Prediction of preeclampsia helps to identify at risk women and thus start appropriate measures timely. These preventive measures include healthy diet, regular exercise, sufficient sleep, calcium supplementation and low dose aspirin. Sonography done in first and second trimesters studying the Uterine artery Doppler Pulsatility Index is an important and widely used predictor. Some biochemical tests like PAPP-A , placental IGF , soluble-Fms like tyrosine kinase-1(s - Flt) and s-Flt and PIGF ratio are now employed in preeclampsia prediction[5-6]. However, their cost makes it difficult for their widespread use especially in our country.

In order to cover the unmet need of a cheap and easy predictive model, HDP Gestosis score was developed in India. It is a novel, easy to use scoring system that involves known and newly emerging risk factors for gestational hypertension. It was developed by Dr. Gorakh Mandrupkar and modified by the FOGSI-ICOG committee[7]. It takes into account all known and potential risk factors, assigning a score of 1, 2, or 3 to each factor depending on its significance in contributing to PE. By examining a woman's complete medical history and assessing risk factors, a total score is calculated. The developers of the score suggest that women with higher scores are at more risk to develop pre-eclampsia than the general population.

This study was carried out with the purpose that if this score was found to be able to predict pre-eclampsia to a good extent, at-risk women can be identified early in the pregnancy and preventive measures and prompt management can be initiated to decrease maternal and fetal complications.

Material and Methods

This was an observational, analytical, and prospective study conducted in the Department of Obstetrics and Gynecology at S.M.S. Medical College, Jaipur from January 2023 for one year. The study was conducted on pregnant women between 11-18 weeks of pregnancy who came for routine antenatal checkups. All women fulfilling the inclusion and exclusion criteria were enrolled in the study.

The methodology was approved by the institution's Doctoral Research Committee (199/MEC/2023).

Sample Size

A sample of 200 pregnant women was required to verify 94.37% sensitivity of HDP- Gestosis score to identify 43.13% of cases having HDP- Gestosis score >2 and among them 16.9% of cases having pre-eclampsia. After proper counseling regarding the purpose of the study, written informed consent was taken from all enrolled pregnant women who fulfilled the inclusion and exclusion criteria.

Inclusion Criteria

Pregnant women between 11 and 18 weeks of pregnancy who were willing to participate in the study.

Exclusion Criteria

Women with: -

1. Active infection
2. Malignancy
3. Chronic liver disease
4. History of alcohol, tobacco, or drug abuse.
5. Women that were included in any other study.

Methodology

After proper counseling regarding the purpose of the study, written informed consent was taken from all enrolled pregnant women and those fulfilling the inclusion and exclusion criteria.

A detailed history including age, obstetric history, menstrual history, history of PCOS, hypothyroidism, chronic kidney disease, chronic hypertensive disease, mental disorder, pregestational diabetes, and autoimmune disease was taken. Past history especially for hypertensive disease in previous pregnancy and treatment history of HDP was taken. A family history of cardiovascular disease and pre-eclampsia was noted and details relevant to the present pregnancy such as duration of sperm exposure, inter-pregnancy interval, and use of assisted reproductive techniques were also noted. Following that a thorough general physical examination and abdominal examination were done.

Blood investigations such as complete blood count, thyroid profile, liver function test, renal function test, anti-thyroid peroxides antibody, anti-nuclear antibody, rheumatoid factor, anti-ds DNA & blood sugar were done. Then HDP-Gestosis score was calculated according to the following table.

Table 1: HDP-Gestosis score[41]

Risk factor	Score
Age > 35 years	1
Age < 19 years	1
Maternal anaemia	1
Obesity (BMI > 30) (Range)	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
Interpregnancy interval of 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/m2)	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 Techniques	3
"On"or taking Treatment for hypertensive disease of pregnancy	3

Based on the above examinations HDP- Gestosis Score was calculated and pregnant women were classified as: -

- Mild risk (Score of 1)
- Moderate risk (Score of 2)
- High risk (Score of 3)

All these pregnant women were followed throughout pregnancy and delivery specifically for the development of preeclampsia.

Preeclampsia is defined [20]as systolic blood pressure of 140 mmHg or more or diastolic blood pressure of 90 mmHg or more on two occasions at least 4-hour apart after '20 weeks' gestations in a woman with a previous normal BP

OR

Systolic blood pressure of 160 mmHg or diastolic BP of 110 mmHg or more within a short interval and proteinuria [300 mg or more per 24-hour urine collection or protein/ creatinine ratio of 0.3 mg/dl or more or dipstick reading of +2]

OR

In the absence of proteinuria, new-onset Hypertension with the new onset of any of the following

1. Thrombocytopenia: - Platelet count less than $100,000*10^9$ 1/L
2. Renal Insufficiency: - Serum creatinine concentration greater than 1.1 mg/dl or a doubling of the serum creatinine concentration in the absence of other renal disease.

3. Impaired liver function - Elevated blood concentration of liver transaminases to twice of normal concentration
4. Pulmonary edema
5. New onset headache unresponsive to medication and not accounted by alternative diagnosis
6. Visual symptoms.

Maternal and fetal outcomes were noted in terms of: –

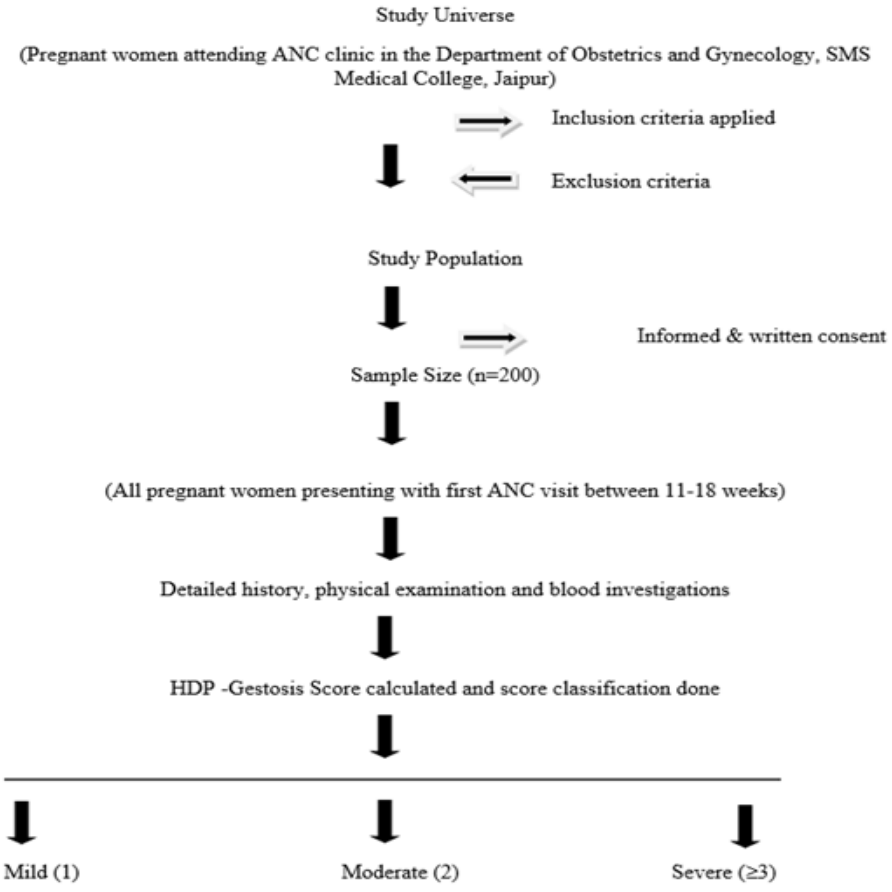
1. Gestational age at the time of delivery
2. Mode of initiation of labor
3. Type of delivery
4. Any complication during pregnancy and delivery
5. Birth of live/ stillbirth or intrauterine fetal death
6. Birth weight
7. APGAR at 1 min and 5 min
8. Neonatal complication
9. Admission of neonates to ICU

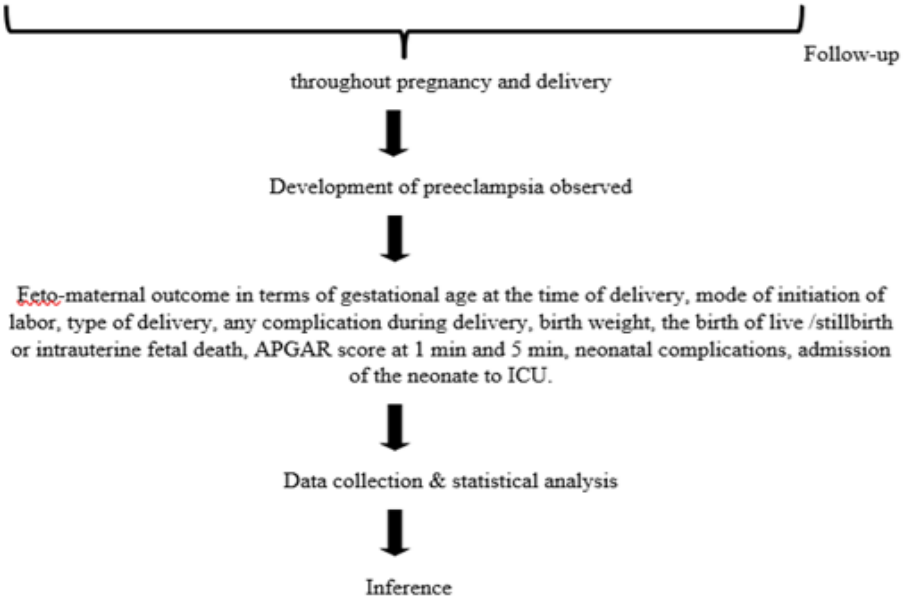
The above parameters were compared in the 3 groups of 'mild' 'moderate' and 'high' HDP Gestosis scores.

Statistical Analysis

Continuous variables were summarized as mean and were analyzed by using unpaired t-tests. Nominal/categorical variables were summarized as proportions and were analyzed by using the chi-square/ Fischer exact test. P-value <0.05 was taken as significant.

Flow-Chart





Results

In our study, among 200 pregnant women, 56 (28%) developed HDP and they were included in Group 1 while 144 women (72%) did not develop HDP (Group 2).

Table 1: Demographic characteristics of pregnant women

Demographic characteristics	Group 1(With HDP)	Group **2** (With HDP)
Age (years) (Mean ± SD)	26.38 ± 3.66	24.12 ± 2.48
Primigravida (%)	46.42	27.78
Multigravida (%)	53.58	72.22
BMI (kg/m^2) (Mean ± SD)	26.56 ± 3.77	24.49 ± 3.70

Table 2: Distribution of hypertensive pregnant women according to the sub- classes of HDP

HDP	Number (n = 56)	Percent (%)
Gestational hypertension (BP> 140/90)	25	44.6
Pre-eclampsia (End organ damage)	29	51.8
Eclampsia (Fits)	1	1.8
Chronic HTN superimposed pre-eclampsia	1	1.8
Total	56	100

Table 3: Distribution of pregnant women according to Gestosis score

Gestosis Score	Normotensive (No.)	Gestational hypertension (No.)	Pre-eclampsia (No.)	Eclampsia (No.)	HELLP (No.)	Chronic HTN superimposed PE (No.)
0	60	4	2	0	0	0
1	72	5	5	0	0	0

2	11	10	6	0	0	0
3	1	6	16	1	0	1
Total	144	25	29	1	0	1

Table 4: Distribution of pregnant women with pre-eclampsia according to risk factors

Risk factor	Number
Age > 35 years	1
Maternal anaemia	14
Obesity (BMI > 30)	1
Primigravida	12
MAP (> 85 mmHg)	4
Short duration of sperm exposure (cohabitation)	2
Family history of cardiovascular disease	1
Interpregnancy interval more than 5 years	3
Maternal hypothyroidism	15
Hypertensive disease during previous pregnancy	2
Chronic hypertension	1
Autoimmune disease (SLE/APLAS/RA)	1

Table 5: Predictive value of Gestosis score for pre-eclampsia: -

Gestosis score	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
1	93.33	37.65	20.90	96.97	46.00
2	76.67	82.94	44.23	95.27	82.00
□3	56.67	95.29	68.00	92.57	89.50

Maximum women in both the groups were in the age group range of 20-24 years (32.14% in Group 1 and 59.7% in Group 2) The mean age of the pregnant women with HDP was 26.38 years (SD = 3.66) while that of without HDP was 24.12 years (SD 2.48). There was no statistically significant difference in the two groups when age was studied. Among the pregnant women with HDP, 46.42% were primigravida and 53.58% were multigravida women. This difference was statistically significant substantiating the fact that HDP is more common in primigravida women. The mean BMI in group 1 was 26.56 kg/m² (SD = 3.77) while it was 24.49 kg/m² (SD = 3.70) in Group 2 . The difference between the two was statistically significant with a p- value of 0.025. These women were also distributed according to socio economic status as per the Modified Kuppuswamy Scale. In Group 1, maximum (37.5%) women belonged to Lower class. Maximum women in Group 2 also belonged to Lower Class (24.3%). The difference in socio economic status was not found to be statistically significant (p-value 0.20). Demographic characteristics of pregnant women of both groups are shown in Table 1.

Women who developed hypertensive disorders were further classified. Pre-eclampsia was the most prevalent

condition making up 51.8 % of the HDP cases while Gestational hypertension accounted for 44.6 % of HDP. Table 2 shows this distribution in detail. The study group was categorized according to the Gestosis score. We observed that sixty women had a score of zero, among those only four developed HDP. In contrast, it was found that out of 25 women with a Gestosis score of ≥3, 24 had HDP. This is an important observation which suggests that a high Gestosis Score has a good predictive value for development of HDP. This division according to Gestosis score is depicted in Table 3.

The 56 women who developed HDP were also divided on the basis of the gestational age at which HDP developed. 28 women developed HDP before 34 weeks of gestation and 28 women developed HDP after 34 weeks. It was observed that 20 women with a Gestosis score of ≥3 developed HDP before 34 weeks of gestation. These findings suggest that higher scores are more frequently associated with early development of HDP which is detrimental to both mother and fetus' health and often associated with severe complications and premature birth.

When the risk factors were further evaluated, we found that maternal hypothyroidism was the most common risk factor, observed in 15 women with pre-eclampsia, followed by maternal anemia in 14 women and primigravida status in 12 women developing pre-eclampsia. The detailed occurrence of various risk factors is tabulated in Table 4.

All the collected data were used to calculate the predictive ability of the HDP Gestosis score. The sensitivity, specificity, positive predictive ability, and negative predictive ability of the HDP-Gestosis Score were calculated individually for each score and it is shown in Table 5.

It was observed that for, the HDP Gestosis score ≥3, the specificity is 95.29% and NPV is 92.57%. Thus, we can say that the HDP-Gestosis score has a good predictive ability to anticipate the development of hypertensive diseases during pregnancy. High Gestosis scores are more specific for the prediction of HDP.

Discussion

Hypertensive disease in pregnancy is a major medical issue that can lead to severe complications for both the mother and fetus. Early identification and monitoring of high-risk pregnancies are crucial for providing appropriate care and management to decrease maternal mortality and perinatal mortality.

The present study was conducted with the aim to determine the predictive ability of the HDP-Gestosis score for the development of pre-eclampsia.

In the present study, the prevalence of pre-eclampsia was found to be 15%. Gupta M et al[8] in their study found the prevalence of pre-eclampsia to be 15.1%. Similarly, in a study by Mou et al[4], the prevalence rate of pre-eclampsia was 14.4%. This shows that the results of this study are in concordance with the global incidence.

We found that the mean age in Group 1 was 26.38 ± 3.66 years, compared to 24.12 ± 2.48 years in Group 2. The observations of the present study suggested that women aged ≥30 years had a significantly higher incidence of HDP. This finding was statistically significant (p-value = 0.005). Gupta M et al[8] found the mean age of women with pre-eclampsia to be 28.4 ± 6.8 years, and Sachdeva P et al[9] reported that the mean age of women with HDP was 28.3 ± 4.6 years in their study. Both these studies along with the present study show that increasing age shows an increased incidence to develop pre-eclampsia. Mishra SS et al[10] conducted a study on the HDP Gestosis score as a predictor of pregnancy-induced hypertension (PIH) in elderly age groups. They observed that women older than

35 years and those younger than 19 years had a propensity to develop pre-eclampsia.

In the present study, we found that women who were primigravida had more chances of developing preeclampsia. It can be probably attributed to maternal immunological incompetence during the first pregnancy against the chorionic villi of the fetus, which increases the risk of pre-eclampsia. Sravani et al[11] found that pre-eclampsia was more commonly seen in women who were pregnant for the first time. The result of the study by Sravani et al[11]are in concordance with the results of the present study.

The mean BMI of women who developed HDP was 26.56 ± 3.77 kg/m².It was greater than the mean BMI of women not developing preeclampsia. Imam ST et al[12] found a mean BMI of 24.9 ± 3.6 kg/m², while Gupta M et al[8] reported a mean BMI of 24.5 ± 3.7 kg/m² in pregnant women who developed HDP. The Gestosis score identifies obesity as a risk factor to develop HDP.

The results of this study show that among the 56 women with HDP, 44.6% developed gestational hypertension, 51.8% developed preeclampsia, 1.8% developed chronic hypertension with superimposed preeclampsia, and one woman (1.8%) had eclampsia. When these results were compared to those with the study by Pahwa et al[13], it was seen that 26% of HDP had gestational hypertension,34% had preeclampsia, 8% developed eclampsia and 20% had chronic hypertension with superimposed preeclampsia. At-risk women should be monitored and treated so as to prevent development of eclamptic fits.

In the present study, out of 30 women who developed pre-eclampsia, 17 had a Gestosis Score of more than 3, indicating that a higher Gestosis score is associated with an increased probability of developing HDP and pre-eclampsia. A similar study by Manhar R et al[14] found that amongst 22 women with a Gestosis score of 3 or more, 12 women (54.55%) developed pre-eclampsia. Among 62 women (31%) with no risk factors, only 5 (8%) developed pre-eclampsia. These findings are consistent with the present study. This difference was also significant ($p < 0.005$). Higher the Gestosis score, more is the predictive value of the score as the risk factors increase.

Sensitivity, specificity, and positive and negative predictive value of the Gestosis score to develop pre-eclampsia were calculated in this study. Imam ST et al[12] also found the above parameters and reported that a Gestosis Score of ≥ 3 showed a sensitivity of 86.66%, specificity of 96.49%, PPV of 86.91%, NPV of 97.98%, and diagnostic accuracy of 96.12%. Gupta M et al[8] reported sensitivity, specificity, PPV, NPV, and diagnostic accuracy of the HDP Gestosis Score for predicting pre-eclampsia as 83.1%, 97.51%, 85.51%, 97.03%, and 95.35% respectively. Khanijo P et al[15] found that a Gestosis Score of ≥ 3 had a sensitivity of 84.38%, specificity of 93.18%, PPV of 81.82%, NPV of 97.03%, and diagnostic accuracy of 94.25%. These results are quite close to those of the present study. The composite results of these Indian studies along with the present study shows that HDP-Gestosis score has a good predictive value.

This study identified several risk factors associated with the Gestosis Score among the 30 women who developed pre-eclampsia. Maternal hypothyroidism was the most common risk factor for these women, followed by maternal anemia and primigravida status. A retrospective study by Pahwa S et al[13] found maternal anemia in 56% of women, primigravida status in 46% of women while 28% of women had a mean arterial pressure (MAP) > 85 mmHg. Another prospective study by Manhar et al[14] concluded that overt diabetes mellitus, a history of HDP in a previous pregnancy, and gestational diabetes mellitus

were major risk factors for developing pre- eclampsia. A closer study of these risk factors can change the approach of the obstetricians during prenatal counselling and care. The modifiable risk factors should be taken care of before conception.

Conclusion

In the present scenario, a lot of effort is being put by the government and the doctors to decrease the maternal and neonatal mortality. Early prediction and identification of complications is very vital in this regard. The HDP Gestosis score, which is based on history and examination, is a simple and inexpensive tool to predict hypertensive disorders of pregnancy. With a sensitivity ranging between 56.67% and 93.33% and a high negative predictive value (92.57% to 96.97%), HDP-Gestosis score has become a promising tool which can be easily used easily by nursing staff and junior doctors thus enhancing the identification of at-risk women which can be managed at specialized centres.

Limitations of the Study

1. The sample size was small for the results to be generalized to the broader population.
2. The study was conducted at a single tertiary referral centre which may limit the generalizability of the findings to other settings.
3. As a prospective study, there was a risk of cases being lost to follow up.

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