ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 09 | September - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

MATERNAL AND PLACENTAL FACTORS ASSOCIATED WITH PATIENTS OF SEVERE PRE-ECLAMPSIA IN BUNDELKHAND REGION

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ABSTRACT

Background: Severe pre-eclampsia remains a significant cause of maternal and perinatal morbidity and mortality, particularly in low-resource settings like Bundelkhand. Early identification through clinical and biochemical markers is essential for managing this condition. This study explores maternal and placental factors associated with severe pre-eclampsia in the Bundelkhand region, focusing on cost-effective indicators in resource-limited environments. **Methods:** This prospective observational study was conducted at MLB Medical College, Jhansi, over one year. 140 pregnant women with severe pre-eclampsia (diastolic BP ≥110 mmHg, proteinuria ≥3+, and complications such as headache, visual disturbances, IUGR, or eclampsia) were enrolled. Data on maternal health, biochemical markers, ultrasound findings, and neonatal outcomes were collected. Statistical analysis was performed using SPSS v27. **Results:** 75.4% of participants had a history of severe pre-eclampsia/eclampsia. 51.43% of participants had some form of anemia, with 9.29% experiencing severe anemia. 79.29% had high serum uric acid levels, indicating its potential as a biomarker for severe pre-eclampsia. 23.23% had oligohydramnios, and 20.71% had fetal growth restriction. 9.29% mortality and 90.71% stable at discharge. 44% required NICU admission. **Conclusion:** This study emphasizes the importance of identifying maternal, biochemical, and placental risk factors for severe pre-eclampsia. Early identification and monitoring of these indicators can significantly improve outcomes for both mothers and neonates, especially in resource-limited settings.

KEYWORDS

Severe Pre-Eclampsia, Placental Dysfunction, Uric Acid, Anemia, Bundelkhand Region

INTRODUCTION

Severe pre-eclampsia remains a major contributor to maternal and perinatal morbidity and mortality, particularly in low-resource settings like the Bundelkhand region of India. The multifactorial nature of this condition—spanning maternal health, placental function, and fetal well-being—demands early identification through both clinical indicators and biochemical markers.

In regions with limited healthcare access, risk factors often go undetected until complications arise. A study in Bundelkhand identified key maternal risk factors such as pre-pregnancy BMI >25, history of hypertension, diabetes, renal disease, and family history of hypertension, all of which were significantly associated with pre-eclampsia [1]. Additionally, elevated serum uric acid levels have been shown to be a strong predictor of severe pre-eclampsia, and may be used as a cost-effective biomarker in resource-limited settings [2, 3].

Placental dysfunction plays a central role, as evidenced by abnormal histopathological features like syncytial knots, fibrinoid necrosis, and calcifications, which are common in severe cases and linked to poor neonatal outcomes [4]. Ultrasound markers such as fetal growth restriction and oligohydramnios are also useful non-invasive indicators of fetal compromise [5].

Low calcium levels are another maternal factor linked with hypertensive disorders of pregnancy, underscoring the need for proper antenatal supplementation [6]. The interplay between maternal metabolic health and placental dysfunction, including imbalances in angiogenic factors, has also been well-documented [7, 8]. Studies further indicate that recurrence of pre-eclampsia in subsequent pregnancies is high, reinforcing the need for proactive risk assessment [9].

Finally, outcomes such as high NICU admission rates and peripartum complications like HELLP syndrome and liver dysfunction illustrate the burden this condition places on maternal and neonatal health systems [10].

This study aims to explore maternal, biochemical, and placental factors associated with severe pre-eclampsia in the Bundelkhand region, with a focus on cost-effective indicators relevant to low-resource healthcare environments.

Methodology

1. Study Design

This was a prospective observational study conducted to assess maternal and placental factors associated with severe pre-eclampsia. Patients diagnosed after 28 weeks of gestation were enrolled and followed from admission to postpartum discharge. No interventions were applied, and outcomes were observed naturally to analyze disease progression, complications, and clinical correlations.

2. Study Setting

The study was carried out at the Department of Obstetrics and Gynaecology, MLB Medical College, Jhansi—a tertiary care center equipped to manage high-risk pregnancies. The setting provided appropriate infrastructure, skilled staff, and resources for monitoring maternal and neonatal outcomes in severe pre-eclampsia cases.

3. Study Duration

The study was conducted over one year, allowing sufficient time for patient enrollment, monitoring, and follow-up. This period ensured adequate sample size and captured seasonal and referral variability in the incidence and outcomes of severe pre-eclampsia.

4. Participants – Inclusion And Exclusion Criteria

Inclusion criteria were pregnant women >28 weeks gestation with diastolic BP ≥110 mmHg, proteinuria ≥3+, and complications like headache, visual disturbances, IUGR, or eclampsia. Exclusion criteria included gestation <28 weeks, comorbidities (diabetes, chronic hypertension, anemia), multiple gestation, epilepsy, polyhydramnios, and vascular or renal disease.

5. Study Sampling

Participants were selected through consecutive sampling based on defined criteria. All eligible women admitted with severe pre-eclampsia were included sequentially during the study period, ensuring unbiased and representative data collection.

6. Study Sample Size

Using Cochran's formula, the required sample size was calculated as 138 based on a 10% expected prevalence and 5% margin of error. Two additional cases were included for contingency, resulting in a final sample of 140 patients.

7. Study Groups

The study comprised a single group of pregnant women with severe pre-eclampsia. Though no control group was included, data were stratified to compare variations in maternal and neonatal outcomes across different clinical parameters.

8. Study Parameters

Key maternal parameters included blood pressure, liver enzymes, platelet counts, and systemic complications. Neonatal outcomes like birth weight, Apgar scores, IUGR, and NICU admissions were recorded. Placental and umbilical cord histology were also analyzed.

9. Study Procedure
All participants underwent detailed history, clinical examination, and investigations. Management followed standard protocols, including antihypertensives and corticosteroids. Delivery was based on condition. Placental samples were collected, and postpartum follow-up continued for six weeks.

10. Study Data Collection
Data were documented in pre-designed proformas and included patient history, vitals, lab results, imaging, treatment details, and outcomes. Maternal and neonatal complications were tracked during hospital stay and postpartum follow-up.

11. Data Analysis
Data were analyzed using SPSS v27. Descriptive statistics summarized demographic and clinical data. Inferential tests like chi-square and t-tests assessed associations, with a significance threshold set at $p<0.05$.

12. Ethical Considerations
Ethical clearance was obtained from the institutional ethics committee. Written informed consent was taken in both Hindi and English. Participant confidentiality was maintained, and all procedures adhered to ethical research guidelines.

RESULTS

1. History Of Severe Preeclampsia/Eclampsia In Previous Pregnancy
A majority of participants (75.4%) had a history of severe preeclampsia/eclampsia, highlighting the recurrence risk in future pregnancies. This suggests prior preeclampsia is a significant predictor for future complications (Table 1).

Table 1: History Of Severe Preeclampsia/Eclampsia In Previous Pregnancy

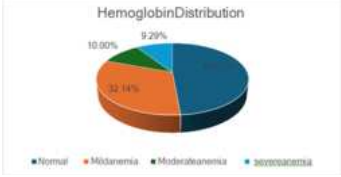
Severe preeclampsia /Eclampsia in previous pregnancy	Frequency	Percentage
No	15	24.59%
Yes	46	75.40%
Grand Total	61	100.00%

Graph 1: History of Severe Preeclampsia/Eclampsia in Previous Pregnancy

2. Hemoglobin Levels Of Participants
Over half of the participants (51.43%) had some form of anemia, which may elevate the risk of maternal and fetal complications in severe preeclampsia (Table 2).

Table 2: Hemoglobin Levels Of Participants

Hemoglobin (g/dL)	Frequency	Percentage
Normal(>10.9)	68	48.57%
Mild anemia(10.0-10.9)	45	32.14%
Moderate anemia(7.0- 9.9)	14	10.00%
Severe anemia(<7.0)	13	9.29%
Grand Total	140	100.00%

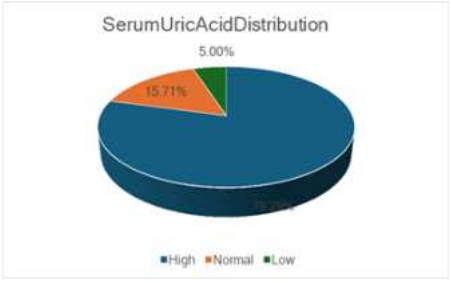


Graph 2: Hemoglobin Levels of Participants

3. Serum Uric Acid Levels Of Participants
A striking 79.29% of participants had high serum uric acid levels, supporting its use as a reliable biomarker for severe preeclampsia (Table 3).

Table 3: Serum Uric Acid Levels Of Participants

Serum Uric Acid (mg/dL)	Frequency	Percentage
High (>6.0)	111	79.29%
Normal (3.5–6.0)	22	15.71%
Low (<3.5)	7	5.00%
Total	**140**	**100.00%**

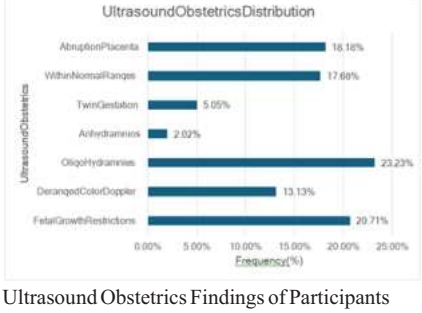


Graph 3: Serum Uric Acid Levels of Participants

4. Ultrasound Obstetrics Findings Of Participants
Oligohydramnios and fetal growth restriction were common (23.23% and 20.71%, respectively), emphasizing the high fetal risk in severe preeclampsia (Table 4).

Table 4: Ultrasound Obstetrics Findings Of Participants

Ultrasound Obstetrics	Frequency	Percentage
Fetal Growth Restrictions	41	20.71%
Deranged Color Doppler	26	13.13%
Oligohydramnios	46	23.23%
Anhydramnios	4	2.02%
Twin Gestation	10	5.05%
Abruption Placenta	36	18.18%
Within Normal Ranges	35	17.68%
Grand Total	198	100.00%

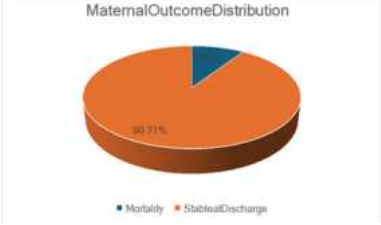


Graph 4: Ultrasound Obstetrics Findings of Participants

5. Maternal Outcome
Despite high complication rates, 90.71% of mothers were stable at discharge; however, the 9.29% mortality rate reflects the severity of the condition (Table 5).

Table 5: Maternal Outcome

Maternal Outcome	Frequency	Percentage
Mortality	13	9.29%
Stable at Discharge	127	90.71%
Grand Total	140	100.00%



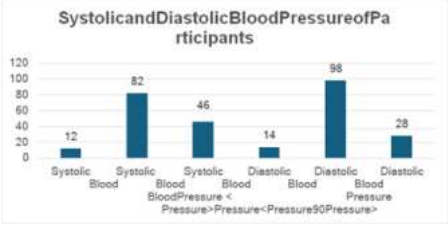
Graph 5: Maternal Outcome

6. Systolic And Diastolic Blood Pressure Of Participants

The majority of participants had elevated systolic and diastolic blood pressure, with 32.86% having a systolic BP greater than 160, and 20% exhibiting a diastolic BP above 110, indicating the severity of hypertension in severe pre-eclampsia. This data suggests the need for strict monitoring and management of blood pressure in such cases (Table 6).

Table 6: Systolic And Diastolic Blood Pressure Of Participants

Systolic Blood Pressure			Diastolic Blood Pressure		
Systolic Blood Pressure	Frequency	Percentage	Diastolic Blood Pressure	Frequency	Percentage
<140	12	8.57%	<90	14	10.00%
140-160	82	58.57%	90-110	98	70.00%
>160	46	32.86%	>110	28	20.00%
Grand Total	140	100.00%	Grand Total	140	100.00%



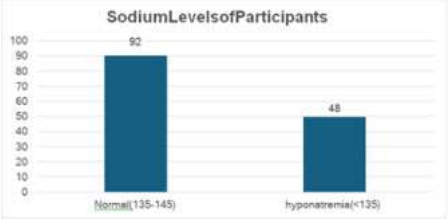
Graph 6: Systolic and Diastolic Blood Pressure of Participants

7. Sodium Levels

A significant proportion of participants (34.29%) had mildly low sodium levels (<135 mmol/L), suggesting possible early signs of hyponatremia, which can be linked to fluid retention in severe pre-eclampsia. Monitoring sodium levels is crucial to prevent electrolyte imbalances and associated complications (Table 7).

Table 7: Sodium Levels

Sodium (mmol/L)	Frequency	Percentage
Normal (135-145)	92	65.71%
hyponatremia (<135)	48	34.29%
Grand Total	140	100.00%



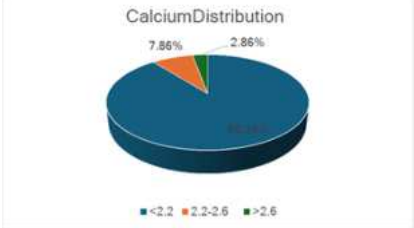
Graph 7: Sodium Levels

8. Calcium Levels

A high percentage of participants (89.29%) had calcium levels below 2.2 mmol/L, indicating a deficiency. Calcium deficiency is a common issue in pregnancies with hypertensive disorders, highlighting the need for appropriate supplementation to prevent complications like muscle spasms and bone health issues (Table 8).

Table 8: Calcium Levels

Calcium	Frequency	Percentage
<2.2	125	89.29%
2.2-2.6	11	7.86%
>2.6	4	2.86%
Grand Total	140	100.00%



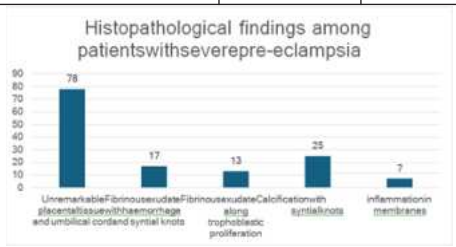
Graph 8: Calcium Levels

9. Histopathological Findings

Placental abnormalities like fibrinous exudates, calcification, and syncytial knots were commonly observed in participants, highlighting the compromised placental function in severe pre-eclampsia. These findings are indicative of hypoxic stress and poor fetal outcomes (Table 9).

Table 9: Histopathological Findings

Unremarkable placental tissue and umbilical cord	78	55.71%
Fibrinous exudate with haemorrhage and syntial knots	17	12.14%
Fibrinous exudate along trophoblastic proliferation	13	9.29%
Calcification with syntialknots	25	16.43%
Inflammation in membranes	7	5.00%
Total	140	100%



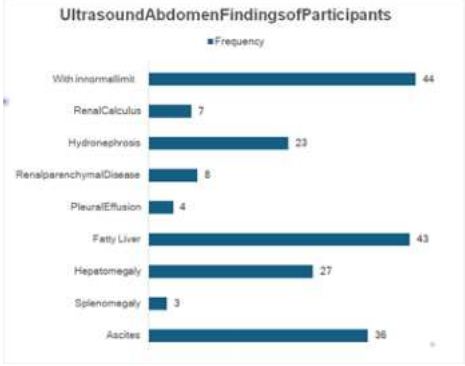
Graph 9: Histopathological Findings

10. Ultrasound Abdomen Findings

Fatty liver (22.05%) and ascites (18.46%) were among the most common abdominal findings, both indicative of severe pre-eclampsia complications. These findings stress the importance of abdominal monitoring in managing such cases (Table 10).

Table 10: Ultrasound Abdomen Findings

Ultrasound Abdomen	Frequency	Percentage
Ascites	36	18.46%
Splenomegaly	3	1.54%
Hepatomegaly	27	13.85%
Fatty Liver	43	22.05%
Pleural Effusion	4	2.05%
Renal parenchymal Disease	8	4.10%
Hydronephrosis	23	11.79%
Renal Calculus	7	3.59%
With in normal limit	44	22.56%
Grand Total	195	100.00%



Graph 10: Ultrasound Abdomen Findings

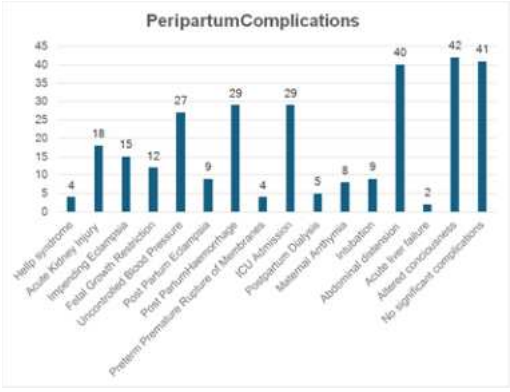
11. Peripartum Complications

Abdominal distension (14%) and altered consciousness (14%) were the most frequent complications observed, reflecting the severity of maternal conditions in severe pre-eclampsia. The high prevalence of these complications highlights the need for close monitoring and immediate interventions (Table 12).

Table 11: Peripartum Complications

Peripartum Complications	Frequency	Percentage

Hellp syndrome	4	1
Acute Kidney Injury	18	6
Impending Eclampsia	15	5
Fetal Growth Restriction	12	4
Uncontrolled Blood Pressure	27	9
Post-Partum Eclampsia	9	3
Post-Partum Hemorrhage	29	10
Preterm Premature Rupture of Membranes	4	1
ICU Admission	29	10
Postpartum Dialysis	5	2
Maternal Arrthymia	8	3
Intubation	9	3
Abdominal distension	40	14
Acute liver failure	2	1
Altered conciousness	42	14
No significant complications	41	14
Grand Total	261	100



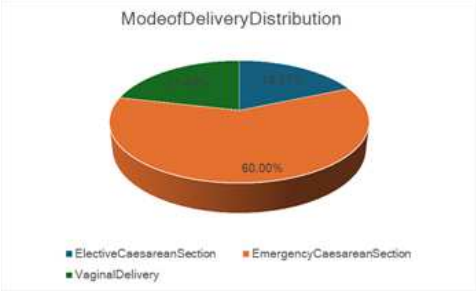
Graph 11: Peripartum Complications

12. Mode Of Delivery

A significant majority of participants (60%) underwent an emergency cesarean section, indicating the need for urgent surgical intervention due to the severity of pre-eclampsia. This data underscores the critical nature of managing severe cases promptly (Table 13).

Table 12: Mode Of Delivery

Mode of Delivery	Frequency	Percentage
Elective Caesarean Section	26	18.57%
Emergency Caesarean Section	84	60.00%
Vaginal Delivery	30	21.43%
Grand Total	140	100.00%



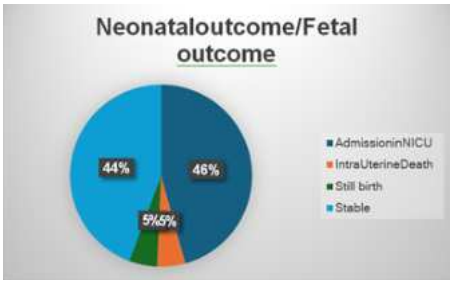
Graph 12: Mode Of Delivery

13. Maternal And Fetal Outcome

A significant proportion (44%) of neonates required NICU admission, highlighting the neonatal distress associated with severe pre-eclampsia. Despite this, 46% of the newborns were stable, indicating favorable outcomes for some infants (Table 14).

Table 13: Maternal And Fetal Outcome

Neonatal outcome/Fetal outcome	Frequency	Percentage
Admission in NICU	64	44
IntraUterine Death	7	5
Stillbirth	7	5
Stable	62	46
Total	140	100



Graph 13: Maternal and Fetal Outcome

DISCUSSION

This study highlights multiple maternal and placental risk factors associated with severe pre-eclampsia, aligning closely with findings from prior Indian and global research.

A significant 75.4% of participants had a history of severe pre-eclampsia/eclampsia, supporting previous reports that prior pre-eclampsia is a strong predictor for recurrence (Bhatia et al., 2022) [11]. Similarly, Kar et al. (2024) noted high recurrence rates in rural and tribal populations, which underscores the importance of regular antenatal surveillance in high-risk groups [12].

Our study found that over half of participants were anemic, with 19.3% experiencing moderate to severe anemia. This mirrors the findings of Patel et al. (2021), who also identified anemia as a common comorbidity exacerbating maternal complications [14]. Additionally, 79.29% of participants had elevated serum uric acid levels, consistent with earlier work suggesting uric acid as a reliable biochemical marker for disease severity (Espinoza & Espinoza, 2011) [2].

Ultrasound findings in our study—such as oligohydramnios (23.2%) and fetal growth restriction (20.7%)—also agree with reports by DivyaJayan et al. (2018), who emphasized how placental insufficiency in pre-eclampsia results in impaired fetal growth [13]. Additionally, abnormal Doppler studies and abruption placentae in 18.18% of participants point to severe uteroplacental vascular compromise, aligning with earlier histological studies showing fibrinoid necrosis and syncytial knots (Ojha et al., 2018) [4].

In terms of maternal outcomes, 9.29% mortality is alarmingly high but comparable to regional data from Bundelkhand and Jharkhand, where late referrals and limited antenatal care are major issues (Kar et al., 2024) [12]. Our high emergency cesarean rate (60%) and NICU admissions (44%) further confirm the severe burden on maternal-fetal health services.

This study reinforces findings from prior literature on the multifactorial nature of severe pre-eclampsia, highlighting the need for early identification, biomarker monitoring, and integrated obstetric care to improve maternal and neonatal outcomes.

CONCLUSION

This study underscores the multifactorial nature of severe pre-eclampsia and its significant impact on maternal and neonatal health in the Bundelkhand region. High rates of recurrence, anemia, and elevated uric acid levels highlight the need for regular monitoring. Ultrasound and histopathological findings reinforce the importance of identifying placental dysfunction early. The high emergency cesarean rate and NICU admissions further emphasize the need for improved antenatal care and timely interventions to reduce maternal and neonatal morbidity.

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