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Original Research Article

Maternal and Neonatal Outcome among Women with Early-onset Pre-eclampsia and Late-onset Pre-eclampsia

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Abstract: *Severe pre-eclampsia remains a leading cause of maternal and perinatal morbidity and mortality worldwide. The clinical severity and outcomes differ substantially between early-onset and late-onset disease, necessitating comparative evaluation.* ***Objective:*** *To investigate and compare the clinical characteristics, maternal complications, and perinatal outcomes of early-onset and late-onset severe pre-eclampsia.* ***Methods:*** *This retrospective cohort study analyzed pregnant women diagnosed with severe pre-eclampsia and admitted to The First Affiliated Hospital of Xinjiang Medical University from January 2024 to November 2025. A total of 215 patients were included and categorized into early-onset severe pre-eclampsia occurring before 34 weeks of gestation and late-onset severe pre-eclampsia occurring at or after 34 weeks. Clinical features, laboratory parameters, maternal complications, delivery modes, and neonatal outcomes were extracted from medical records. Data were analyzed using cross-tabulation and chi-square tests, with a significance level set at $P < 0.05$.* ***Results:*** *Early-onset severe pre-eclampsia demonstrated significantly greater disease severity compared to late-onset disease. Pre-eclamps with severe features was more frequent in the early-onset group at 92.2% versus 61.6% ($P < 0.001$). Higher rates of proteinuria were observed at 85.3% versus 68.6% ($P = 0.004$). Electrolyte disorders occurred in 58.9% of early-onset cases compared to 26.7% in late-onset cases ($P < 0.001$). Anemia was present in 45.7% versus 31.4% ($P = 0.035$), and coagulation dysfunction in 15.5% versus 5.8% ($P = 0.03$). Induced abortion was significantly higher in early-onset severe pre-eclampsia at 7.7% ($P = 0.009$). Cesarean section was the predominant mode of delivery in early-onset cases. Neonatal outcomes were markedly worse in early-onset severe pre-eclampsia, with low birth weight observed in 95.3% versus 51.2% ($P < 0.001$), preterm birth in 86.8% versus 52.3% ($P < 0.001$), neonatal asphyxia in 18.6% versus 2.3% ($P < 0.001$), and NICU admission in 68.2% versus 53.5% ($P = 0.029$). Fetal growth restriction was more frequent in the early-onset group, but did not reach statistical significance.* ***Conclusion:*** *Early-onset severe pre-eclampsia is associated with substantially higher risks of severe maternal complications and adverse perinatal outcomes compared to late-onset disease. These findings emphasize the need for early identification, close surveillance, and intensive antenatal and perinatal management and care in high risk pregnant women to reduce maternal and neonatal morbidity and mortality.*

Keywords: Early-Onset Preeclampsia, Late-Onset Preeclampsia, Perinatal Outcomes, Pregnancy Complications, Severe Preeclampsia

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Introduction

Pre-eclampsia remains a significant global health concern, currently affecting approximately 5% of pregnancies worldwide and representing one of the leading causes of maternal and neonatal morbidity and mortality (1). Characterized by new-onset hypertension with or without proteinuria, pre-eclampsia is divided into early-onset, which occurs prior to 34 weeks of gestation, and late-onset, diagnosed thereafter (2). This classification reflects underlying pathophysiological differences, with evidence suggesting that early-onset pre-eclampsia is primarily driven by placental abnormalities and is associated with more severe maternal complications and adverse neonatal outcomes (3,4).

Recent studies have demonstrated marked differences in maternal and neonatal outcomes between early-onset and late-onset pre-eclampsia. Teka et al. reported a significantly higher incidence of maternal complications, including eclampsia and HELLP syndrome, among early-onset cases compared with late-onset disease (3). Maternal mortality rates in severe cases may exceed 18%, accompanied by high neonatal morbidity, including low birth weight and preterm delivery (5,6). Early-onset pre-eclampsia is consistently associated with worse neonatal outcomes, with approximately 28% of neonates from early-onset cases requiring admission to neonatal intensive care units compared with about 15% among late-onset cases (4,7).

The progression of early-onset pre-eclampsia may precipitate multi-organ dysfunction in affected mothers, leading to complications such as hepatic rupture, cerebrovascular events, and renal failure, a burden that is further exacerbated by delayed or inadequate antenatal care in resource-limited settings (8,9). In a cohort study by Jehangir et al., early-onset pre-eclampsia accounted for approximately 40% of adverse maternal outcomes compared with 20% among late-onset cases (10). Neonatal complications are also more pronounced in early-onset disease, with higher rates of intrauterine growth restriction and fetal demise reported compared with late-onset pre-eclampsia (5,11).

From a management perspective, expectant management has shown potential benefits in selected cases of late-onset pre-eclampsia, where close surveillance and timely intervention may mitigate severe maternal and neonatal complications (12,13). In contrast, early-onset severe pre-eclampsia often necessitates expedited delivery once maternal and fetal stability allows, given the high risk of rapid disease progression and poor perinatal outcomes (14). Accordingly, understanding the differential impact of disease onset timing on maternal and neonatal health is essential to optimizing individualized management strategies.

A comprehensive understanding of the distinct maternal and neonatal outcomes associated with early-onset versus late-onset pre-eclampsia is critical for the development of targeted preventive and therapeutic interventions. As the global burden of pre-eclampsia continues to rise, particularly in low-resource settings, the present study aims to delineate the specific challenges and outcome patterns associated with these two phenotypes. The findings are expected to inform context-specific clinical

guidelines and contribute to improving maternal and neonatal healthcare outcomes.

Methodology

A total of 215 pregnant women with severe pre-eclampsia who delivered at the Department of Obstetrics, First Affiliated Hospital of Xinjiang Medical University between January 2024 and November 2025 were retrospectively included in this study. Women with pregnancies complicated by chronic hypertension, chronic nephritis, nephrotic syndrome, cardiac disease, or thyroid disease were excluded. Patients with poor treatment compliance who were unable to tolerate or cooperate with the complete diagnostic and treatment process, as well as those with incomplete medical records, were also excluded.

The inclusion criteria comprised all pregnant women, including primiparous, multiparous, and grand multiparous women, diagnosed with pre-eclampsia who delivered in the study hospital, aged between 23 and 48 years, with a gestational age ranging from 18 to 39 weeks, and with complete medical records available for review. Severe pre-eclampsia was diagnosed according to the criteria described in the 12th edition of Current Diagnosis and Treatment: Obstetrics and Gynecology (LANGE) by Alan H. DeCherny, defined as systolic blood pressure of at least 140 mmHg or diastolic blood pressure of at least 90 mmHg on two occasions four hours apart, accompanied by one or more of the following features: proteinuria of at least 300 mg in a 24 hour urine specimen or a spot urine protein to creatinine ratio of at least 0.3, thrombocytopenia with a platelet count below 100,000 per microliter, renal insufficiency indicated by a serum creatinine concentration above 1.1 mg per deciliter or a doubling of baseline serum creatinine in the absence of other renal disease, impaired liver function with transaminase levels at least twice the upper limit of normal, pulmonary edema, or new onset cerebral or visual symptoms. Based on gestational age at diagnosis, patients were categorized into early-onset severe pre-eclampsia occurring before 34 weeks of gestation and late-onset severe pre-eclampsia occurring at or beyond 34 weeks of gestation.

Maternal demographic and clinical variables, including age, weight, height, body mass index, use of more than three antihypertensive medications, family history of pre-eclampsia, number of pregnancies and deliveries, gestational age at onset, gestational age at delivery, and disease severity, were recorded. Pre-eclampsia without severe features was defined as systolic blood pressure>140 mmHg or diastolic blood pressure>109 mmHg. In comparison, pre-eclampsia with severe features was defined as systolic blood pressure of at least >160 mmHg or diastolic blood pressure of at least > 110 mmHg. (18) Maternal outcomes, including placental abruption, hepatic and renal dysfunction, coagulation abnormalities, hypoalbuminemia, HELLP syndrome, electrolyte disturbances, anemia, and degree of proteinuria, were documented. Perinatal outcomes, including prematurity, intrauterine fetal death, fetal distress, fetal growth restriction, birth asphyxia, and early neonatal death, were also recorded and analyzed.

Liver and renal function parameters, including serum albumin, 24-hour urine protein quantification, alanine aminotransferase, aspartate aminotransferase, lactate dehydrogenase, urea, creatinine, total bilirubin, serum electrolytes including sodium, potassium, and chloride, hemoglobin concentration, and platelet count, were monitored and recorded on a daily basis throughout the clinical course.

Data were analyzed using SPSS software version 27.0. The chi-square test and independent-samples t-test were used as appropriate to evaluate associations between categorical and continuous variables. Cross-tabulation was performed for categorical variables to examine relationships among key clinical parameters. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 215 women with severe pre-eclampsia were included, of whom 129 (60.0%) had early-onset pre-eclampsia (EOP, <34 weeks) and 86 (40.0%) had late-onset pre-eclampsia (LOP, ≥34 weeks). Most participants in both groups were aged 26 to 35 years (EOP: 67.4%; LOP: 79.1%). Obesity was common in both cohorts (EOP: 55.0%; LOP: 46.5%). Parity distribution, family history of hypertension, body mass index category, and use of more than three antihypertensive drugs were comparable between groups and did not differ significantly. In contrast, disease severity differed markedly: pre-eclampsia with severe features was substantially more frequent in the EOP group compared with the LOP group (92.2% vs 61.6%, $p < 0.001$), confirming a more aggressive disease phenotype in early-onset cases (Table 1).

Maternal complications were broadly similar between groups for primary life-threatening outcomes. The frequencies of HELLP syndrome, pulmonary edema, placental abruption, renal dysfunction, hepatic dysfunction, and hypoalbuminemia did not differ significantly between EOP and LOP. However, several maternal abnormalities were substantially more common in EOP, including electrolyte disturbances (58.9% vs 26.7%, $p < 0.001$), anemia (45.7% vs 31.4%, $p = 0.035$), coagulation dysfunction (15.5% vs 5.8%, $p = 0.030$), and heavy proteinuria (85.3% vs 68.6%, $p = 0.004$). Induced abortion occurred exclusively in the EOP group (7.7% vs 0%, $p = 0.009$). Cesarean section was the predominant mode of delivery in both cohorts, with no statistically significant difference between groups (Table 2).

Laboratory abnormalities showed broadly similar patterns between early- and late-onset disease. Elevated serum urea levels were more frequent in the EOP group (26.4% vs 19.8%), although this difference was not statistically significant. Nephrotic-range proteinuria was observed in nearly all patients in both groups (Figure 1). Hypoalbuminemia was highly prevalent across the cohort, affecting more than 80% of participants. Mild elevations in liver enzymes (AST, ALT, LDH) and abnormalities in creatinine, bilirubin, platelet count, and hemoglobin were observed in both groups without statistically significant intergroup differences. Electrolyte disturbances, particularly hyponatremia, were common but did not differ significantly between groups in the laboratory stratification (Table 3).

Neonatal outcomes differed substantially according to the timing of disease onset. Infants born to mothers with EOP had significantly higher rates of preterm birth (86.8% vs 52.3%, $p < 0.001$) and low birth weight (95.3% vs 51.2%, $p < 0.001$) compared with those born to mothers with LOP. Birth asphyxia occurred more frequently in the EOP group (18.6% vs 2.3%, $p < 0.001$), and neonatal intensive care unit admission was also significantly higher among infants of EOP mothers (68.2% vs 53.5%, $p = 0.029$). Although fetal growth restriction and intrauterine fetal distress were more frequent in EOP, these differences did not reach statistical significance. No early neonatal deaths were recorded in either group, while intrauterine fetal death occurred only in the EOP group (Table 4).

Table 1: Baseline Clinical Profiles of Women with Early-Onset Versus Late-Onset Pre-eclampsia

Baseline Characteristic	Early-Onset Pre-eclampsia (EOP) n=129 n (%)	Late-Onset Pre-eclampsia (LOP) n=86 n (%)	Total n=215 n(%)	P-value
Maternal Age Group				(0.069)
<25 years	12 (9.3)	2 (2.3)	14 (6.5)	
26–35 years	87 (67.4)	68 (79.1)	155 (72.1)	
36–48 years	30 (23.3)	16 (18.6)	46 (21.4)	
BMI Category				(0.430)

Normal	12 (9.3)	8 (9.3)	20 (9.3)	
Overweight	46 (35.7)	38 (44.2)	84 (39.1)	
Obese	71 (55.0)	40 (46.5)	111 (51.6)	
Drug History (>3 antihypertensives)				(0.154)
No	126 (97.7)	86 (100)	212 (98.6)	
Yes	3 (2.3)	0 (0.0)	3 (1.4)	
Parity				(0.794)
Primiparous (1st pregnancy)	51 (39.5)	31 (36.0)	82 (38.1)	
Multiparous (2–4 pregnancies)	75 (58.1)	52 (60.5)	127 (59.1)	
Grande-multiparous (≥5 pregnancies)	3(2.3)	3 (3.5)	6 (2.8)	
Pre-eclampsia without severe features(140-159/90-109mmHg)				(0.000)
No	119 (92.2)	53 (61.6)	172 (80.0)	
Yes	10 (7.8)	33 (38.4)	43 (20.0)	
Pre-eclampsia with severe features (≥160/ ≥110 mmHg)				(0.000)
No	10 (7.8)	33 (38.4)	43 (20.0)	
Yes	119 (92.2)	53 (61.6)	172 (80.0)	
Family History of Hypertension				(0.447)
No	93 (72.1)	66 (76.7)	159 (74.0)	
Yes	36 (27.9)	20 (23.3)	56 (26.0)	

Table2: Maternal Clinical Outcomes in Women with Early-Onset versus Late–Onset Preeclampsia

Clinical Outcome	Early-Onset Pre-eclampsia (EOP) n (%)	Late-Onset Pre-eclampsia (LOP) n (%)	Total n (%)	P-value
HELLP Syndrome				(0.376)
No	121 (93.8)	83 (96.5)	204 (94.9)	
Yes	8 (6.2)	3 (3.5)	11 (5.1)	
Pulmonary Edema				(0.483)
No	120 (93.0)	82 (95.3)	202 (94.0)	
Yes	9 (7.0)	4 (4.7)	13 (6.0)	
Placental Abruption				(0.082)
No	95 (73.6)	72 (83.7)	167 (77.7)	
Yes	34 (26.4)	14 (16.3)	48 (22.3)	
Maternal Renal Dysfunction				(0.626)
No	89 (69.0)	62 (72.1)	151 (70.2)	
Yes	40 (31.0)	24 (27.9)	64 (29.8)	
Maternal Liver Dysfunction				(0.319)
No	96 (74.4%)	69 (81.2%)	167 (76.7%)	
Yes	33 (25.5%)	16 (18.8%)	49(22.7%)	
Electrolyte disorders				(0.000)
No	53 (41.1)	63 (73.3)	116 (54.0)	
Yes	76 (58.9)	23 (26.7)	99 (46.0)	
Hypoalbuminemia				(0.402)
No	72 (55.8)	43 (50.0)	115 (53.5)	
Yes	57 (44.2)	43 (50.0)	100 (46.5)	
Anemia				(0.035)
No	70 (54.3)	59 (68.6)	129 (60.0)	
yes	59 (45.7)	27 (31.4)	86 (40.0)	
Coagulation dysfunction				(0.030)
No	109 (84.5)	81 (94.2)	190 (88.4)	
Yes	20 (15.5)	5 (5.8)	25 (11.6)	
Proteinuria				(0.004)
No	19 (14.7)	27 (31.4)	46 (21.4)	
Yes	110 (85.3)	59 (68.6)	169 (78.6)	
Induced Abortion				(0.009)
No	119 (92.2%)	86 (100%)	205 (95.3%)	
yes	10 (7.7%)	0 (0.0%)	10 (4.7%)	
Mode Of Delivery Vaginal delivery				(0.377)
No	123 (95.3)	84 (97.7)	207 (96.3)	
Yes	6 (4.7)	2 (2.3)	8 (3.7)	
Post-Induction Vaginal Delivery				(0.082)

No	129 (100)	84 (97.7)	213 (99.1)	
Yes	0 (0%)	2 (2.3)	2 (0.9)	
Cesarean section				(0.628)
No	8 (6.2)	4 (4.7)	12 (5.6)	
Yes	121 (93.8)	82 (95.3)	203 (94.4)	

Table 3: Maternal Laboratory Abnormalities in Women with Early-Onset versus Late–Onset Pre-eclampsia

Laboratory Parameter	Early-Onset Pre-eclampsia (EOP) n (%)	Late-Onset Preeclampsia (LOP) n (%)	Total n (%)	P-value
Urea (mmol/L)				(0.463)
Low Urea	6 (4.7)	3 (3.5)	9 (4.2)	
Normal Urea	89 (69.0)	66 (76.7)	155 (72.1)	
High Urea	34 (26.4)	17 (19.8)	51 (23.7)	
Creatinine (µ mol/L)				0.053)
Low	20 (15.5)	20 (23.3)	40 (18.6)	
Normal	108 (83.7)	62 (72.1)	170 (79.1)	
High	1 (0.8)	4 (4.6)	5 (2.3)	
24h Urinary Protein (gm/24h)				(0.149)
Moderate (gm/24h)	1 (0.8)	3 (3.5)	4 (1.9)	
Nephrotic Range (gm/24h)	128 (99.2)	83 (96.5)	211 (98.1)	
Albumin (g/L)				(0.375)
Low (<35 g/L)	103 (79.8)	71 (82.6)	174 (81.0)	
Normal (35–50 g/L)	26 (20.2)	14 (16.3)	40 (18.6)	
High (>50 g/L)	0	1 (1.2)	1 (0.5)	
AST (U/L)				(0.781)
Normal (10–40 U/L)	104 (80.6)	68 (79.1)	172 (80.0)	
Elevated (41–80 U/L)	25 (19.4)	18 (20.9)	43 (20.0)	
ALT (U/L)				(0.172)
Normal (7–40 U/L)	102 (79.1)	61 (70.9)	163 (75.8)	
Elevated (41–80 U/L)	27 (20.9)	25 (29.1)	52 (24.2)	
LDH (U/L)				(0.575)
Normal (140–250 U/L)	70 (54.3)	50 (58.1)	120 (55.8)	
Mildly Elevated (251–400 U/L)	59 (45.7)	36 (41.9)	95 (44.2)	
Total Bilirubin (µmol/L)				(0.510)
Normal (µmol/L)	127 (98.4)	86 (100.0)	213 (99.1)	
Mildly Elevated (µmol/L)	1 (0.8)	0	1 (0.5)	
High (µmol/L)	1 (0.8)	0	1 (0.5)	
Sodium (mmol/L)				(0.106)
Hyponatremia (<135 mmol/L)	76 (58.9)	60 (69.8)	136 (63.3)	
Normal (135–145 mmol/L)	53 (41.1)	26 (30.2)	79 (36.7)	
Potassium (mmol/L)				(0.467)
Hypokalemia (<3.5 mmol/L)	6 (4.7)	6 (7.0)	12 (5.6)	
Normal (3.5–5.0 mmol/L)	123 (95.3)	80 (93.0)	203 (94.4)	
Chloride (mmol/L)				(0.664)
Normal (98–107 mmol/L)	115 (89.1)	75 (87.2)	190 (88.4)	
Hyperchloremia (>107 mmol/L)	14 (10.9)	11 (12.8)	25 (11.6)	
PLT Count				(0.315)
Thrombocytopenia (<150 x10^9/L)	4 (3.1)	1 (1.2)	5 (2.3)	
Normal (150–450 x10^9/L)	120 (93.0)	84 (97.7)	204 (94.9)	
Thrombocytosis (>450 x10^9/L)	5 (3.9)	1 (1.2)	6 (2.8)	
Hemoglobin (g/L)				(0.369)
Low (Anemia)	59 (45.7)	34 (39.5)	93 (43.3)	
Normal	70 (54.3)	52 (60.5)	122 (56.7)	

Table 4: Clinical Outcomes of Infants Born to Mothers with Early-Onset versus Late-Onset Preeclampsia

Clinical Outcome	Early-Onset Pre-eclampsia (EOP) n (%)	Late-Onset Pre-eclampsia (LOP) n (%)	Total n (%)	P-value
Birth Weight				(<0.001)

Low Birth Weight (<2500g)	123 (95.3)	44 (51.2)	167 (77.7)	
Normal Birth Weight (2500–3999g)	6 (4.7)	40 (46.5)	46 (21.4)	
High Birth Weight (≥4000g)	0 (0.0)	2 (2.3)	2 (0.9)	
Preterm				(<0.001)
Yes	112 (86.8)	45 (52.3)	157 (73.0)	
No	17 (13.2)	41 (47.7)	58 (27.0)	
Intrauterine Fetal Death (IU Death)				(0.065)
Yes	5 (3.9)	0 (0.0)	5 (2.3)	
No	124 (96.1)	86 (100)	210 (97.7)	
Early Neonatal Mortality				----
No	129 (100)	86 (100)	215 (100)	
Intrauterine Fetal Distress (IUFD)				(0.422)
Yes	20 (15.5)	10 (11.6)	30 (14.0)	
No	109 (84.5)	76 (88.4)	185 (86.0)	
Asphyxia				(<0.001)
Yes	24 (18.6)	2 (2.3)	26 (12.1)	
No	105 (81.4)	84 (97.7)	189 (87.9)	
NICU Admission				(<0.029)
Yes	88 (68.2)	46 (53.5)	134 (62.3)	
No	41 (31.8)	40 (46.5)	81 (37.7)	
FGR				(0.082)
Yes	34 (26.4)	14 (16.3)	48 (22.3)	
No	95 (73.6)	72 (83.7)	167 (77.7)	

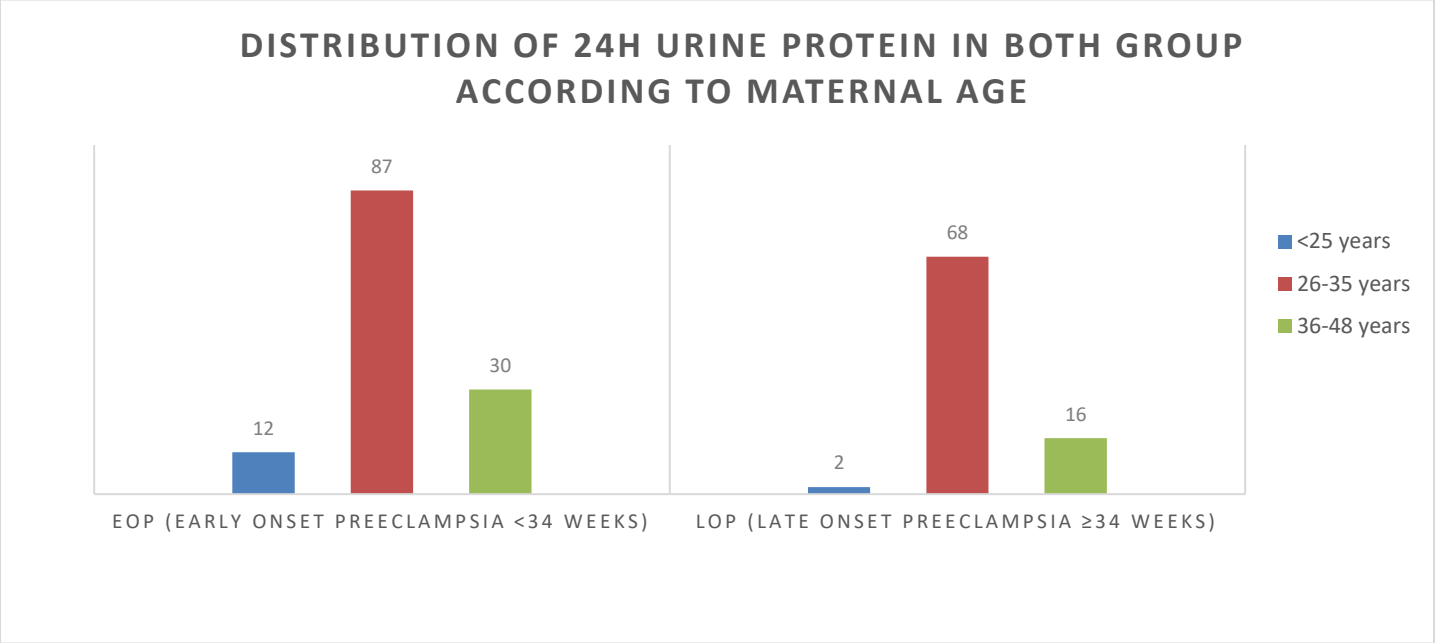

Figure 1: Distribution of 24h urine protein in both groups according to maternal age

Discussion

The results of our study highlight significant contrasts in maternal and neonatal outcomes between women with early-onset pre-eclampsia (EOP) and late-onset pre-eclampsia (LOP). Our cohort comprised 215 women diagnosed with severe pre-eclampsia, of whom 60.0% presented with early-onset disease and 40.0% with late-onset disease. Notably, EOP was associated with a markedly higher frequency of pre-eclampsia with severe features compared with LOP (92.2% vs 61.6%, $p < 0.001$). This observation is consistent with existing literature, where early-onset disease is frequently characterized by a more aggressive clinical phenotype, leading to increased maternal and perinatal morbidity (15,16).

Our findings further indicate that although major maternal complications such as HELLP syndrome and acute pulmonary edema did not differ significantly between groups, women with EOP experienced substantially higher rates of electrolyte disturbances (58.9% vs 26.7%, $p < 0.001$) and anemia (45.7% vs 31.4%, $p = 0.035$). Similar patterns have been reported by Wadhwani et al., who observed a higher burden of maternal complications, including coagulation abnormalities, in early-onset pre-eclampsia (16). In addition, heavy proteinuria was significantly more prevalent among women with EOP (85.3% vs 68.6%, $p = 0.004$), supporting the findings of Teka et al., who emphasized a higher frequency of renal involvement in early-onset pre-eclampsia (17).

Cesarean section was the predominant mode of delivery across both cohorts (94.4% overall), with no statistically significant difference

between groups. This aligns with prior reports indicating that operative delivery is frequently required in severe pre-eclampsia to minimize further maternal and fetal compromise (18,19).

Marked disparities in neonatal outcomes were observed according to the timing of disease onset. Neonates born to mothers with EOP had substantially higher rates of preterm birth (86.8% vs 52.3%, $p < 0.001$) and low birth weight (95.3% vs 51.2%, $p < 0.001$) compared with those born to mothers with LOP. These findings are in agreement with Irwanto et al., who reported significantly increased risks of prematurity and related neonatal complications in early-onset pre-eclampsia (15). Moreover, birth asphyxia occurred more frequently among neonates in the EOP group, consistent with observations by Gomathy et al., highlighting the elevated risk of adverse perinatal outcomes associated with early-onset disease (20).

A significantly higher proportion of neonates born to mothers with EOP required admission to the neonatal intensive care unit compared with those born to mothers with LOP (68.2% vs 53.5%, $p = 0.029$). This is concordant with existing evidence demonstrating that early-onset pre-eclampsia is associated with greater neonatal morbidity and increased need for intensive care support (16,21). Although fetal growth restriction and intrauterine fetal distress were more frequent in the EOP group, these differences did not reach statistical significance, suggesting that larger, multicenter studies may be needed to clarify these associations.

The pronounced differences in outcomes between early- and late-onset pre-eclampsia observed in this study underscore the importance of tailored clinical management strategies based on disease phenotype. Recognition of the greater severity and complexity associated with early-onset disease is critical for optimizing antenatal surveillance, delivery planning, and neonatal preparedness.

Given the consistently poorer maternal and neonatal outcomes associated with early-onset pre-eclampsia, more intensive monitoring, timely referral to tertiary care centers, and multidisciplinary management approaches may be warranted to mitigate risks. Further research into the underlying pathophysiological mechanisms that differentiate early- and late-onset pre-eclampsia, along with the development of improved screening and surveillance strategies, may help reduce the substantial burden of morbidity and mortality associated with this condition.

In summary, our findings provide additional evidence supporting the distinct clinical trajectories and outcomes of early-onset and late-onset pre-eclampsia, reinforcing the urgent need for phenotype-specific preventive and therapeutic interventions in contemporary obstetric practice.

Conclusion

Early-onset pre-eclampsia is a more severe clinical entity than late-onset disease and is associated with greater maternal disease severity and markedly worse neonatal outcomes. Although acute maternal complications were comparable between groups, early-onset disease was characterized by a higher burden of severe features, greater renal involvement, and a high rate of iatrogenic prematurity, resulting in substantial neonatal morbidity. In contrast, late-onset pre-eclampsia allowed longer gestation and comparatively better neonatal outcomes. These findings reinforce that early- and late-onset pre-eclampsia are distinct phenotypes with important implications for risk stratification and tailored clinical management.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-XPENJA-12e24-24)

Consent for publication

Approved

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Conflict of interest

The authors declared no conflicts of interest.

Author Contribution

ZUN, WZM, ZK

Contributed to study design, data collection, and initial manuscript drafting

Assisted in data acquisition, literature review, and manuscript editing

Performed statistical analysis and contributed to the interpretation of results

Helped in methodology development, data organization, and manuscript formatting

Contributed to patient recruitment, data entry, and results compilation

FM, AM

Assisted in referencing, proofreading, and final revisions of the manuscript

Guided study execution and critically reviewed the manuscript

Supervised the research, coordinated among authors, finalized the manuscript, and approved the final version

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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