

Serum LDH And Uric Acid Level in Pre-Eclampsia and its Correlation with Maternal And Fetal Outcomes

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Abstract

Introduction: Preeclampsia is becoming a public health issue that contributes to fetomaternal morbidity and mortality. This study aims to measure serum LDH and Uric acid levels in preeclampsia and to assess their correlation with fetomaternal outcomes.

Methods: This hospital-based, cross-sectional study was conducted at National Medical College and Teaching Hospital. All patients with preeclampsia underwent estimations of serum LDH and Uric Acid levels. Correlation of their levels with fetomaternal outcomes was assessed. Non parametric variables were analyzed using pearsons correlation, while categorical variables were assessed using the Chi-square test. A p-value of <0.05 was considered statistically significant.

Results: Elevated serum lactate dehydrogenase (LDH ≥ 600 IU/L) and uric acid (≥ 6 mg/dl) levels were significantly more common in severe preeclampsia compared to mild cases (LDH: $p < 0.001$; uric acid: $p = 0.028$). Higher LDH levels were significantly associated with adverse maternal outcomes, including HELLP syndrome ($p = 0.011$), acute renal failure ($p = 0.001$), and eclampsia ($p < 0.001$). Similarly, elevated uric acid levels were significantly associated with acute renal failure ($p = 0.011$) and eclampsia ($p < 0.001$). Elevated LDH levels were significantly associated with low APGAR score ($p = 0.004$), NICU admission ($p = 0.025$), and intrauterine fetal death (IUFD) ($p = 0.015$).

Conclusion: Serum LDH and uric acid levels were significantly elevated in severe preeclampsia and showed strong associations with disease severity. Elevated LDH was linked to adverse maternal outcomes and markers of fetal compromise, while raised uric acid was associated with maternal complications and intrauterine fetal death. These biomarkers are easily available and cost-effective can aid in identifying high risk patients, closer monitoring, and timely intervention, thereby helping improve maternal and fetal outcomes in preeclampsia.

Keywords: Feto-maternal outcome; Lactate dehydrogenase; Preeclampsia; Uric acid

Introduction

Preeclampsia is a pregnancy-specific multisystem disorder that occurs after 20 weeks of gestation in women who were previously normotensive and is characterized by new-onset hypertension with proteinuria and/or evidence of end-organ dysfunction. It affects approximately 2–8% of pregnancies worldwide and remains a leading cause of maternal and perinatal illness and death, especially in low- and middle-income countries where delayed diagnosis and limited resources worsen outcomes.¹⁻⁴

The precise cause of preeclampsia remains unclear, but key mechanisms include abnormal placentation, placental hypoxia, oxidative stress, and systemic endothelial

dysfunction. Hypoxia in the placenta triggers increased anaerobic metabolism and cellular injury, leading to higher serum LDH levels. This marker is linked to disease severity and adverse outcomes such as placental abruption, renal and hepatic issues, intrauterine growth restriction, and prematurity.^{1,5-7}

Hyperuricemia is another biochemical abnormality commonly seen in preeclampsia. Elevated serum uric acid levels result from increased production and decreased renal clearance and indicate oxidative stress, kidney impairment, and endothelial dysfunction.^{2,6,8}

In resource-limited settings like Nepal, simple and inexpensive biomarkers are essential for early risk assessment. Therefore, this study aims to evaluate serum LDH and serum uric acid levels in women with preeclampsia and their association to disease severity and maternal and fetal outcomes.

Methods

This was a hospital-based cross-sectional study conducted at the National Medical College and Teaching Hospital from June 18, 2023, to June 18, 2024. Ethical approval was obtained from the Institutional Review Committee of the same institute. (Ref: PG-NMC/574/079-080).

Calculation of sample size done using, $n = Z^2 p(1-p)/d^2 = 113$, $P = 7.8\%$, $d = 95\%$.

Where,

- n = required sample size
- Z = confidence level at 95% (standard value of 1.96)
- d = margin of error, confidence level at 5% (standard value of 0.05)
- p = estimated prevalence of preeclampsia
- $P = 7.8\%$ [Study conducted by Reddy Eleti M, Agrawal M, Dewani D, et al., (April 06, 2023)]⁶
- $Q = 1-p$, $CI = 95\%$

Preeclampsia was diagnosed based on the 2020 ACOG Task Force criteria.^{3,9}

Preeclampsia was categorised into two category: Mild preeclampsia and Severe preeclampsia.^{3,10,11} The onset of hypertension after 20 weeks of pregnancy with a systolic blood pressure of ≥ 140 mm Hg and less than 160 mm Hg or a diastolic blood pressure of ≥ 90 mm Hg and less than 110 mm Hg on two separate occasions at least 4 hours apart, with or without proteinuria and no indications of end organ damage, is known as mild preeclampsia.^{3,11}

Severe preeclampsia include systolic blood pressure of at least 160 mm Hg or diastolic blood pressure of at least 110 mm Hg on two separate occasions at least 4 hours apart (unless antihypertensive therapy is started before then), thrombocytopenia (platelets less than 100,000/ μ L), impaired liver function (not explained by other diagnoses and as demonstrated by abnormally elevated liver enzymes that are more than twice the upper limit of normal

or by severe, persistent right upper quadrant or epigastric pain that is not responsive to medication), impaired renal functions (serum creatinine concentration of more than 1.1 mg/dl or doubling of serum creatinine concentration in the absence of other renal disease), pulmonary oedema, new-onset headache (not responsive to medication and not explained by alternative diagnoses), and visual disturbances.^{3,11,12}

Other symptoms such as oliguria, cerebral abnormalities, shortness of breath with decreased oxygen saturation, hemolysis, vomiting, and decreased fetal movements beyond 20 weeks of pregnancy are also present in cases of severe preeclampsia.^{3,11,12}

All preeclamptic antenatal patients ≥ 28 weeks of gestation were included, while women with pre-existing hypertension, multiple pregnancies, renal disease, pre-existing diabetes or gestational diabetes, liver disease, thyroid disorders, and seizures due to causes other than eclampsia (e.g., pre-existing epilepsy, intracranial space-occupying lesions, brain trauma, or hyperpyrexia) were excluded from the study. Data was collected using a structured proforma, ensuring full confidentiality, and written informed consent was obtained. Relevant medical history was recorded, and thorough general, systemic, and obstetric examinations were performed. Blood pressure was measured in both arms in the lateral position every two hours after admission. Urine protein was estimated using a urine dipstick test. Blood samples were collected to measure Serum Uric acid and LDH levels. Measurements were done using pap colorimetric enzymatic method and automated analyser respectively in the laboratory. A single measurement may not reflect the dynamic nature of preeclampsia; therefore, in view of the progressive pathophysiological nature of preeclampsia, serial estimation of Serum LDH and Uric Acid was undertaken at admission and weekly thereafter until delivery, to assess the biochemical profile and its predictive value for maternal and perinatal outcomes.

Normal serum LDH levels in pregnancy range from 140–280 IU/L. Serum uric acid levels vary with gestational age, with normal values ranging from 2.0–4.0 mg/dL in the first trimester, 2.0–5.0 mg/dL in the second trimester, and 3.0–6.0 mg/dL in the third trimester.^{3,13,14} Values exceeding 600 IU/L for LDH and 6 mg/dL for uric acid were considered elevated in the present study.

Among study variables, independent variables are Serum LDH, Serum Uric Acid, Blood Pressure (Systolic BP, Diastolic BP) and dependent variables are mode of delivery (Vaginal delivery, caesarean section, Instrumental delivery), maternal outcomes like abruptio placentae, HELLP syndrome, DIC, PPH, aspiration pneumonia, acute renal failure, eclampsia, pulmonary edema, intracranial hemorrhage, maternal death, ICU admission, ventilator support, maternal death; and for fetal outcomes like preterm, IUGR, Birth asphyxia, APGAR at 5 minutes < 7 , Birth weight < 2.5 kg, NICU admission, IUFD.

SPSS version 27.0 was used for statistical analysis. Data were analyzed using descriptive statistics (frequencies, percentages) and tests like chi-square test for categorical variables and spearman correlation for non-parametric data was used. p value < 0.05 was considered to be statistically significant. The values

have been expressed as Mean $\pm$ Standard Deviation wherever applicable.

Results

A total of 113 women with preeclampsia were included, of whom 61 (53.98%) had mild and 52 (46.02%) had severe disease. Elevated serum lactate dehydrogenase (LDH ≥ 600 IU/L) was observed more frequently in severe preeclampsia (51.9%) compared to mild cases (16.4%), showing a statistically significant association ($\chi^2 = 16.091$, $p < 0.001$). Similarly, raised serum uric acid levels (≥ 6 mg/dl) were more common in severe preeclampsia (42.3%) than in mild preeclampsia cases (23.0%) ($\chi^2 = 4.845$, $p = 0.028$) as shown in Table 1.

A statistically significant association was observed between elevated serum LDH levels (≥ 600 IU/L) and adverse maternal outcomes. Higher rates of complications such as HELLP syndrome ($p = 0.011$), acute renal failure ($p = 0.001$), and eclampsia ($p < 0.001$) were noted in women with elevated LDH levels, particularly in those with severe preeclampsia. However, no statistically significant association was found between serum LDH levels and other maternal outcomes, including mode of delivery ($\chi^2 = 5.187$, $p = 0.159$) as shown in Table 3 and Table

2 respectively. Statistically significant associations were shown for acute renal failure ($p=0.011$) and eclampsia ($p=0.000$), with higher complication rates observed in women with elevated uric acid levels, most notably in the severe preeclampsia group. No significant differences were detected for the remaining maternal outcomes as shown in Table 4.

Serum LDH levels showed a statistically significant association with certain adverse fetal outcomes. Higher LDH levels were significantly associated with low APGAR score (<7 at 5 minutes) ($p = 0.004$), increased NICU admission ($p = 0.025$), and intrauterine fetal death (IUFD) ($p = 0.015$). However, no statistically significant association was found between serum LDH levels and preterm birth, intrauterine growth restriction (IUGR), birth asphyxia, or low birth weight (LBW) as shown in Table 5. Among the fetal outcomes assessed, only intrauterine fetal death (IUFD) showed a statistically significant association with elevated uric acid levels ($p=0.021$), with higher rates observed in both the mild and severe preeclampsia subgroups with uric acid ≥ 6 mg/dL. No statistically significant differences were identified for preterm birth, IUGR, birth asphyxia, APGAR score <7 at 5 minutes, low birth weight, or NICU admission as shown in Table 6.

Table 1: Distribution of mild preeclampsia and severe preeclampsia women based on serum LDH and serum uric acid levels

Parameter	Level	Mild Preeclampsia (n=61)	Severe Preeclampsia (n=52)	Total (n=113)	Chi-square (X ²)	P value
Mean $\pm$ SD	—	30.5 $\pm$ 28.41	26 $\pm$ 1.39	—	—	—
Serum Uric Acid (mg/dl)	< 6	47 (77%)	30 (57.7%)	77	4.845	0.028
	≥ 6	14 (23%)	22 (42.3%)	36		
Mean $\pm$ SD	—	30.5 $\pm$ 22.868	26 $\pm$ 5.544	—	—	—

Table 2: Distribution of mild preeclampsia and severe preeclampsia based on serum LDH and serum uric acid with mode of delivery

Mode of Delivery	Mild PE LDH <600 n (%)	Mild PE LDH ≥ 600 n (%)	Severe PE LDH <600 n (%)	Severe PE LDH ≥ 600 n (%)	Mild PE Uric Acid <6 n (%)	Mild PE Uric Acid ≥ 6 n (%)	Severe PE Uric Acid <6 n (%)	Severe PE Uric Acid ≥ 6 n (%)	Total	X ²	P value
FTVD	10 (19.6)	3 (30)	3 (12)	3 (11.1)	10 (21.3)	3 (21.4)	2 (6.7)	4 (18.2)	19	5.2	0.159
PTVD	9 (17.6)	5 (50)	7 (28)	5 (18.5)	9 (19.1)	5 (35.7)	7 (23.3)	5 (22.7)	26		
ID	2 (3.9)	1 (10)	0 (0)	0 (0)	2 (4.3)	1 (7.1)	0 (0)	0 (0)	3		
LSCS	30 (58.8)	1 (10)	15 (60)	19 (70.4)	26 (55.3)	5 (35.7)	21 (70)	13 (59.1)	65		
Mean $\pm$ SD	12.75 $\pm$ 10.22	2.5 $\pm$ 1.63	6.25 $\pm$ 5.52	6.75 $\pm$ 7.15	11.75 $\pm$ 8.61	3.5 $\pm$ 1.625	7.5 $\pm$ 8.037	5.5 $\pm$ 4.623			

PE: Preeclampsia; FTVD: Full Term Vaginal Delivery; PTVD: Preterm Vaginal Delivery; ID: Instrumental Delivery; LSCS: Lower Segment Caesarean Section.

Table 3: Distribution of Mild preeclampsia and Severe preeclampsia women based on serum lactate dehydrogenase (LDH) and correlation with its maternal outcome

Maternal Outcomes	Mild Preeclampsia (n %)		Severe Preeclampsia (n %)		P value
	LDH <600 (n=51)	LDH ≥600 (n=10)	LDH <600 (n=25)	LDH ≥600 (n=27)	
Abruptio placentae	4 (7.8%)	3 (30.0%)	5 (20.0%)	2 (7.4%)	0.123
HELLP syndrome	2 (3.9%)	3 (30.0%)	2 (8.0%)	7 (25.9%)	0.011
DIC	1 (2.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0.747
PPH	5 (9.8%)	1 (10.0%)	1 (4.0%)	1 (3.7%)	0.675
Aspiration Pneumonia	0 (0.0%)	0 (0.0%)	1 (4.0%)	1 (3.7%)	0.495
Acute Renal Failure	1 (2.0%)	3 (30.0%)	0 (0.0%)	6 (22.2%)	0.001
Eclampsia	4 (7.8%)	3 (30.0%)	11 (44.0%)	16 (59.3%)	0.000
Pulmonary Edema	2 (3.9%)	0 (0.0%)	2 (8.0%)	2 (7.4%)	0.717
Intracranial Hemorrhage	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	—
Maternal Death	1 (2.0%)	0 (0.0%)	0 (0.0%)	2 (7.4%)	0.333
ICU Admission	5 (9.8%)	3 (30.0%)	2 (8.0%)	3 (11.1%)	0.283
Ventilator Support	3 (5.9%)	1 (10.0%)	1 (4.0%)	2 (7.4%)	0.912

Table 4: Distribution of Mild preeclampsia and Severe preeclampsia women based on serum uric acid levels and correlation with its maternal outcome

Maternal Outcomes	Mild Preeclampsia (n %)		Severe Preeclampsia (n %)		P value
	Uric Acid <6 (n=45)	Uric Acid ≥6 (n=16)	Uric Acid <6 (n=27)	Uric Acid ≥6 (n=25)	
Abruptio placentae	3 (6.7%)	4 (25.0%)	2 (7.4%)	5 (20.0%)	0.130
HELLP syndrome	4 (8.9%)	1 (6.2%)	3 (11.1%)	6 (24.0%)	0.240
DIC	1 (2.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0.677
PPH	5 (11.1%)	1 (6.2%)	1 (3.7%)	1 (4.0%)	0.581
Aspiration Pneumonia	0 (0.0%)	0 (0.0%)	2 (7.4%)	0 (0.0%)	0.090
Acute Renal Failure	2 (4.4%)	2 (12.5%)	0 (0.0%)	6 (24.0%)	0.011
Eclampsia	6 (13.3%)	1 (6.2%)	14 (51.9%)	13 (52.0%)	0.000
Pulmonary Edema	1 (2.2%)	1 (6.2%)	1 (3.7%)	3 (12.0%)	0.355
Intracranial Hemorrhage	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	—
Maternal Death	1 (2.2%)	0 (0.0%)	1 (3.7%)	1 (4.0%)	0.859
ICU Admission	5 (11.1%)	3 (18.8%)	2 (7.4%)	3 (12.0%)	0.733
Ventilator Support	2 (4.4%)	2 (12.5%)	1 (3.7%)	2 (8.0%)	0.624

Table 5: Distribution of Mild preeclampsia and Severe preeclampsia women based on serum lactate dehydrogenase (LDH) and correlation with its fetal outcome

Fetal Outcomes	Mild Preeclampsia (n %)		Severe Preeclampsia (n %)		P value
	LDH <600 (n=51)	LDH ≥600 (n=10)	LDH <600 (n=25)	LDH ≥600 (n=27)	
Preterm	9 (17.6%)	2 (20.0%)	8 (32.0%)	6 (22.2%)	0.565
IUGR	6 (11.8%)	1 (10.0%)	4 (16.0%)	0 (0.0%)	0.234
Birth Asphyxia	5 (9.8%)	1 (10.0%)	5 (20.0%)	5 (18.5%)	0.560
APGAR at 5 min <7	10 (19.6%)	7 (70.0%)	10 (40.0%)	5 (18.5%)	0.004
Birth weight <2.5 kg	23 (45.1%)	7 (70.0%)	18 (72.0%)	14 (51.9%)	0.114
NICU Admission	22 (43.1%)	2 (20.0%)	18 (72.0%)	13 (48.1%)	0.025
IUFD	3 (5.9%)	4 (40.0%)	2 (8.0%)	3 (11.1%)	0.015

Table 6: Distribution of Mild preeclampsia and Severe preeclampsia women based on serum Uric acid level and correlation with its fetal outcome

Fetal Outcomes	Mild Preeclampsia (n %)		Severe Preeclampsia (n %)		P value
	Uric Acid <6 (n=45)	Uric Acid ≥6 (n=16)	Uric Acid <6 (n=27)	Uric Acid ≥6 (n=25)	
Preterm	6 (13.3%)	5 (31.2%)	7 (25.9%)	7 (28.0%)	0.318
IUGR	5 (11.1%)	2 (12.5%)	3 (11.1%)	1 (4.0%)	0.746
Birth Asphyxia	5 (11.1%)	1 (6.2%)	5 (18.5%)	5 (20.0%)	0.514
APGAR at 5 min <7	12 (26.7%)	5 (31.2%)	5 (18.5%)	10 (40.0%)	0.379
Birth weight <2.5 kg	21 (46.7%)	9 (56.2%)	15 (55.6%)	17 (68.0%)	0.395
NICU Admission	17 (37.8%)	7 (43.8%)	18 (66.7%)	13 (52.0%)	0.116
IUFD	3 (6.7%)	4 (25.0%)	0 (0.0%)	5 (20.0%)	0.021

Discussion

In this study, 113 antenatal preeclampsia cases ≥28 weeks of gestation were included in the study duration of 1 year. Among the study population most participants were aged 21–30 years in both mild (68.9%) and severe (63.5%) preeclampsia groups, with no significant association between age and disease severity ($X^2=1.524$, $p=0.467$). In a similar study done by Gupta et al in 2019 reported that the maximum number of women belonged to the age group of 20-25 years followed by 25-30 years, the mean age for the study group was 24.38 ± 3.68 year.¹ A similar age range was reported by other studies.^{15–18} Primigravida women constituted the largest proportion of cases in both groups (49.2% mild vs 42.3% severe), and parity was not significantly associated with severity ($X^2=7.037$, $p=0.42$). Qublan et al and Dave et al in 2005 and 2016 respectively observed that majority of the cases were young primigravida who were affected by preeclampsia in the study population similar to our study.^{2,19} Several studies conducted in various geographical locations have also confirmed the higher incidence of preeclampsia among primigravida women. Research from Egypt, Nigeria, and Uganda, for example, has identified primigravida as a significant risk factor for preeclampsia.^{20–22} Severe preeclampsia was more frequently observed at <34 weeks of gestation (44.2%), while most mild cases presented at ≥37 weeks (68.9%); however, the difference was not statistically significant ($X^2=5.935$, $p=0.051$). In a similar study done by wojtowicz et al in 2019 reported that mean gestation age was 30 ± 2.5 in severe preeclampsia group compared to mild preeclampsia.²³ Whereas study done by Reddy Eleti et al in 2023 had 64.3% of cases in preeclamptic-eclamptic group with gestational age between 37 and 40 weeks.⁶ Similarly, study done by Kumar et al. reported that the majority of the women (48.98%) with preeclampsia presented between 37 and 40 weeks.⁹ It was observed that the mean systolic and diastolic blood pressure (BP) reading for mild preeclampsia group was 144.26 ± 11.61 and 93.44 ± 7.93 , for severe preeclampsia group it was 164.42 ± 14.47 and 110.38 ± 9.06 . Similar to this study, a study conducted by Sachan et al. in 2013 states that the mean systolic BP and diastolic BP among severe preeclampsia cases were 159.88 ± 8.3 and 103.25 ± 7.6 , respectively; for mild preeclampsia group, the mean systolic BP and diastolic BP were 145.32 ± 9.7 and 93.72 ± 5.2 , respectively.²⁴ Another study conducted by Bellomo et al. in 2011, women diagnosed with preeclampsia, the mean systolic reading was 149.0 ± 11.7 mmHg while the diastolic reading was 96.1 ± 6.2 mmHg, which

was similar with the present study.²⁵ Elevated serum LDH (≥ 600 IU/L) and serum uric acid (≥ 6 mg/dl) levels were more frequently observed in women with severe preeclampsia compared to those with mild preeclampsia. The association was statistically significant for both LDH ($X^2 = 16.091$, $p < 0.001$) and uric acid ($X^2 = 4.845$, $p = 0.028$), indicating that higher levels of these biomarkers are significantly associated with increased severity of preeclampsia. The study done by Mary et al. showed a significant rise in LDH levels with increasing disease severity ($p < 0.001$). Mean LDH levels were 478 ± 86 in mild preeclampsia compared with 756 ± 76 in cases with severe preeclampsia. The data obtained from the above study were in contrast to this study.¹² In another study by Jaiswar et al., mean LDH level was 400.45 ± 145 IU/L in mild preeclamptic and 646.95 ± 401.64 IU/L in severe preeclamptic groups ($p < 0.001$) were in contrast to this study.¹⁵ In another study by Prajapati and Maitra in 2013 there was a notable rise in mean LDH levels with rising severity of disease from mild preeclampsia 626.59 ± 225.72 , severe preeclampsia 699.54 ± 254.17 , to eclampsia 1270.63 ± 753.58 ($p < 0.001$).¹⁶ A comparative study done by Pramanik et al. in Nepal in 2013 over a period of one year comparing uric acid level in 35 patients with preeclampsia and 20 normal pregnant women which showed that there was significant rise in uric acid level in the patients with preeclampsia while normal in control group.²⁶ The distribution of modes of delivery was similar across different categories of serum LDH and uric acid levels among women with mild and severe preeclampsia. Most women underwent LSCS irrespective of LDH or uric acid levels. The association between mode of delivery and biochemical markers was not statistically significant ($X^2 = 5.187$, $p = 0.159$; $p > 0.05$). On the contrary study conducted by Reddy et al. in 2023 showed LSCS rate higher in the severe preeclampsia group compared with mild preeclampsia which was statistically significant ($p < 0.0001$).⁶ In the present study, elevated levels of Lactate Dehydrogenase (LDH) and Uric Acid were more commonly observed in women with severe Preeclampsia and were associated with a higher frequency of maternal complications. Among the outcomes, eclampsia, acute renal failure and HELLP syndrome showed a statistically significant association with elevated LDH levels ($p < 0.001$) while eclampsia and acute renal failure showed a statistically significant association with elevated uric acid levels ($p < 0.001$), indicating that these biomarkers may reflect disease severity and progression. Similar study done by Qublan et al and Jaiswar et al, who reported that increased LDH levels are associated with severe disease and adverse

maternal outcomes in preeclampsia.^{15,19} Similarly, studies by Le et al. have demonstrated that elevated uric acid levels are linked to worsening disease severity.²⁷ Although other maternal complications did not show statistically significant associations, they were more frequent in severe preeclampsia with higher LDH and uric acid levels. This suggests that these biochemical markers may serve as useful indicators for identifying patients at increased risk of complications. In the present study, elevated maternal serum Lactate Dehydrogenase (LDH) and Uric Acid levels were more frequently associated with adverse fetal outcomes in pregnancies complicated by Preeclampsia, particularly in severe cases. In this study, statistically significant differences were observed in APGAR score <7 at 5 minutes ($p=0.004$), NICU admission ($p=0.025$), and intrauterine fetal death ($p=0.015$), with higher rates of adverse fetal outcomes noted in women with elevated LDH levels, particularly in the mild preeclampsia subgroup. Although outcomes such as preterm birth, IUGR, birth asphyxia, or low birth weight were more common in women with higher LDH and uric acid levels in both the mild and severe preeclampsia subgroups, no statistically significant associations were observed. Among the fetal outcomes assessed, only intrauterine fetal death (IUFD) demonstrated a statistically significant association with elevated uric acid levels ($p=0.021$). These results suggest that serum LDH elevation may be a useful biochemical indicator of fetal compromise in women with preeclampsia, irrespective of disease severity; while serum uric acid elevation indicates close fetal surveillance as it is independently associated with intrauterine fetal death in preeclamptic women. These findings are consistent with previous studies by Qublan et al. and Jaiswar et al., which reported that elevated LDH levels are associated with poor perinatal outcomes due to placental dysfunction.^{15,19} Similarly, studies by Le et al. have shown that increased maternal uric acid levels are linked to fetal growth restriction and adverse neonatal outcomes.²⁷ Overall, these findings support the potential role of LDH and uric acid as markers of disease severity and predictors of neonatal risk in preeclampsia.

Conclusion

Serum lactate dehydrogenase (LDH) and uric acid levels were found to be significantly elevated in women with severe preeclampsia, demonstrating a clear association with disease severity. Elevated LDH levels showed a strong correlation with adverse maternal outcomes, including HELLP syndrome, acute renal failure, and eclampsia, and were also associated with indicators of fetal compromise such as low APGAR scores, increased NICU admissions, and intrauterine fetal death. Similarly, elevated serum uric acid levels were significantly associated with maternal complications, particularly acute renal failure and eclampsia, and showed a significant relationship with intrauterine fetal death. Neither LDH nor uric acid levels demonstrated consistent associations with other fetal outcomes however outcomes such as preterm birth, IUGR, birth asphyxia, or low birth weight were more common in women with higher LDH and uric acid levels in both the mild and severe preeclampsia. Therefore, assessment of serum LDH and uric

acid levels can serve as simple, accessible, and cost-effective tools for evaluating the severity of preeclampsia and guiding timely management to improve fetomaternal outcomes.

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