Original Article

Association of High Maternal Serum Uric Acid with Adverse Fetal Outcomes in Patients with Preeclampsia

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Abstract

Objective: To determine the association of high maternal serum uric acid with adverse fetal outcome (IUGR, preterm birth, low birth weight) in patients with preeclampsia.

Methodology: A cohort study was done at conducted in Department of Obstetrics and Gynaecology, Sharif Medical City Hospital, Lahore, from October 2021 to April 2022. Blood was drawn to measure maternal serum uric acid. Females were then split into high-uric acid and normal-uric acid groups. All ladies were monitored in OPD till delivery. Serial ultrasounds assessed fetal biometry for IUGR and low birth weight infants in females.

Results: Overall patients mean age was 31.22+5.38 years. Moderate preeclampsia was 51.1%, and severe in 48.9%. IUGR occurred in 70.4% of exposed vs. 29.6% of controls "RR = 2.37, p = 0.022", preterm birth in 70% vs. 30% "RR = 2.33, p = 0.017", and low birth weight in 70% vs. 30% "RR = 2.33, p = 0.017". Additionally based parity IUGR was significantly higher in primiparous exposed women, while low birth weight was significantly higher in multiparous exposed women p <0.05. Furthermore severity of pre-eclampsia revealed a significant association of preterm birth with raised uric acid in mild disease and low birth weight in severe disease p <0.05.

Conclusion: Study revealed a clear association between elevated maternal serum uric acid levels and an increased risk of adverse fetal outcomes, including IUGR, preterm birth, and low birth weight among patients of pre-eclampsia.

Keywords: Preeclampsia, Serum Uric Acid, IUGR, Preterm Birth, LBW

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Introduction

Preeclampsia is hypertension-associated multifactorial-disorder of pregnancy that typically develops following 20th gestational week in approximately 2–10% of all pregnancies around the world.[1,2] It is a life-threatening condition that contributes to almost 10% to 25% deaths during perinatal period globally.[3] Its diagnostic criteria involves new-onset of hypertension and proteinuria with/without associated conditions including thrombocytopenia, hepatic abnormalities, renal dysfunction, or neurological symptoms.[4v]Preeclampsia can be effectively managed and prevented with early detection and monitoring. However, limited understanding of etiology, multiple risk factors, and various preeclampsia phenotypes often makes early detection more challenging.[5]

The pathophysiological mechanisms of preeclampsia involve a number of maternal and placental factors including, endothelial dysfunction, placental ischemia, syncytiotrophoblast deregulation, oxidative stress, and altered inflammatory responses.[6] Preeclampsia during pregnancy has shown good predictivity from the first trimester even in the absence of clinical signs.[7]Recent research studies have focused on the role of maternal serum biomarkers in predicting the onset, severity, and

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outcomes of preeclampsia. Elevated levels of serum uric acid have been consistently noted in preeclampsia, suggesting its potential role in severity and progression of disease.[8]

It has also been noted that serum uric acid elevation occurs in preeclampsia only following the onset of disease-associated clinical signs, indicating its relevance to preeclampsia.[9] Elevated uric acid levels in pre-eclamptic women, first reported in the late 1800s, have since been the subject of conflicting research regarding their association with disease severity and pregnancy outcomes.[10] Moreover, maternal serum uric acid has also been associated with poor fetal outcomes in preeclampsia, where elevated levels of uric acid during pregnancy increases the risks of IUGR, preterm birth, and LBW. These fetal outcomes play critical role in neonatal morbidity and mortality.[9,11] However, findings across studies are largely inconsistent. Some studies report strong correlations, while others show limited predictive value of uric acid. The prognostic efficacy of serum uric acid in preeclampsia as a valuable maker is yet to be clearly defined, particularly in populations with limited socioeconomic and healthcare settings.[9,12,13]

In this context, maternal serum uric acid is a low-cost, non-invasive marker that may aid in risk stratification and timely intervention. Therefore, this study was designed to determine the association between elevated maternal serum uric acid levels and adverse fetal outcomes in patients diagnosed with pre-eclampsia. The limited availability of local data underscores the need to further evaluate the reliability of serum uric acid levels in predicting adverse fetal outcomes among pre-eclamptic patients in our clinical settings. Ultimately, the findings of this study aim to support the integration of maternal serum uric acid assessment into routine antenatal care protocols for the timely identification and management of high-risk pregnancies.

Methodology

This cohort study was conducted in the Department of Obstetrics & Gynaecology, Sharif Medical City Hospital, Lahore, from October 2021 to April 2022. A total of 188 pregnant females, 94 in each group, were included. The sample size was calculated with a power of 80%, a confidence level of 95%, and an expected percentage of intrauterine growth restriction (IUGR) of 17.3% in the exposed group versus 5.5% in the non-exposed group. Participants were selected through non-probability consecutive sampling.

All pregnant women aged 18–40 years with a singleton pregnancy and diagnosed with pre-eclampsia were included. Pre-eclampsia was defined as blood pressure >140/90 mmHg, recorded on at least two separate occasions at least 4 hours apart, in the presence of ≥300 mg of protein in a 24-hour urine collection, arising de novo after the 20th week of gestation in a previously normotensive woman, and resolving completely by the 6th week postpartum. Women were excluded if they had congenitally anomalous fetuses, diabetes mellitus or gestational diabetes mellitus, anemia (Hb <10.5 g/dl), chronic hypertension, or conditions associated with hyperuricemia, such as BMI >35 kg/m², renal dysfunction, rheumatoid arthritis, or bleeding disorders.

Patients were categorized into two groups based on their maternal serum uric acid levels. The exposed group comprised pre-eclamptic pregnant females with high serum uric acid levels (≥6 mg/dl), while the control group included pre-eclamptic pregnant females with normal serum uric acid levels (<6 mg/dl).

Ethical approval was obtained from the Hospital Review Committee (Ref. No. SMDC/SMRC/156-20). Eligible participants were enrolled from the outpatient department after obtaining informed consent and were assured that all personal and medical information would remain strictly confidential. Blood samples were collected to measure maternal serum uric acid levels, after which participants were allocated to the exposed or control group. Demographic information, including name, age, gestational age, parity, and BMI, was recorded.

Management was carried out according to standard clinical protocols until delivery. All participants were followed up in the outpatient department until delivery to assess fetal outcomes, including IUGR, preterm birth, and low birth weight. All findings were documented in a pre-designed proforma.

Results

Overall mean age of the women was 31.22 ± 5.38 years, with a mean body mass index of 33.20 ± 3.22 kg/m². The mean gestational age at delivery was 37.59 ± 1.62 weeks, and the mean serum uric acid level was 6.09 ± 1.79 mg/dl. There were 62 (33%) nulliparous patients and 126 (67%) multiparous patients. Mild pre-eclampsia was observed in 96 (51.1%) patients, while 92 (48.9%) had severe pre-

eclampsia. Intrauterine growth restriction (IUGR) was found in 27 (14.4%) patients, preterm birth occurred in 30 (16%) patients, and low birth weight was noted in 32 (17%) patients. Overall adverse fetal outcomes were significantly more common in the exposed group compared to the control group: IUGR occurred in 70.4% vs. 29.6% "RR = 2.37, p = 0.022", preterm birth in 70% vs. 30% "RR = 2.33, p = 0.017", and low birth weight in 70% vs. 30% "RR = 2.33, p = 0.017". (Table I)

IUGR was significantly more common in the exposed group (87.5%) compared to the control group (12.5%) with a relative risk (RR) of 6.56 (p = 0.03), whereas in multiparous women, the difference (63.2% vs. 36.8%) was not statistically significant (RR = 1.77, p = 0.187). Regarding low birth weight, the difference among primiparous women (60% vs. 40%) was not significant (RR = 1.41, p = 0.562), but in multiparous women, LBW was significantly higher in the exposed group (75% vs. 25%) with an RR of 3.09 (p = 0.012), while no statistically significant differences were found for preterm birth in either parity group (p->0.05). (Table II)

Based on the stratification by severity of pre-eclampsia, preterm birth was significantly more common in the exposed group (83.3% vs. 16.7%, RR = 4.41, p = 0.025), while differences for IUGR (64.3% vs. 35.7%, RR = 1.59, p = 0.171) and low birth weight (60% vs. 40%, RR = 1.41, p = 0.562) were not statistically significant. In patients with severe pre-eclampsia, low birth weight was significantly higher in the exposed group (75% vs. 25%, RR = 3.09, p = 0.012), whereas differences for IUGR (76.9% vs. 23.1%, RR = 3.79) and preterm birth (61.1% vs. 38.9%, RR = 1.79) were not statistically significant (p>0.05). (Table III)

Table I: Comparison of fetal outcomes in both study groups. (n = 188)

Fetal outcomes		Study Group		Total	RR	P value
		Expose	Control			
IUGR	Yes	19(70.4%)	8(29.6%)	27(100%)	2.37	0.022
	No	75(46.6%)	86(53.4%)	161(100%)		
Pre term	Yes	21(70%)	9 (30%)	30 (100%)	2.33	0.017
	No	73(46.2%)	85(53.8%)	158(100%)		
LBW	Yes	21(70%)	9(30%)	30(100%)	2.33	0.017
	No	73(46.2%)	85(53.8%)	158(100%)		

Discussion

Pre-eclampsia is globally considered a key causative factor of adverse feto-maternal outcomes, pregnancy-associated complication and even perinatal death, leading to over 70,000 maternal deaths and 500,000 neonatal deaths. [14] Despite the valuable contribution of serum uric acid as a potential marker to predict adverse outcomes, its routine assessment is limited. This study has been conducted to assess the association of high maternal serum uric acid with adverse fetal outcome (IUGR, preterm birth, LBW) in patients with pre-eclampsia; with an overall mean age of the women 31.22 ± 5.38 years, mean BMI of 33.20 ± 3.22 kg/m², mean gestational age 37.59 ± 1.62 weeks, and the mean serum uric acid level 6.09 ± 1.79 mg/dl. Most of the women were multiparous (67%). Comparable findings were reported by Le et al[15] where the mean maternal age (30.6 ± 6.7 years) and mean BMI (27.23 ± 3.82) were slightly lower than in our study. In their cohort, nulliparous women (51.2%) were more common than multiparous women (48.8%), and the rates of IUGR (25.9%) and preterm birth (22.4%) were higher than those observed in our study. Similarly, Lawal et al.[16] reported a mean maternal age of 26.81 ± 6.03

Table II: Stratification of fetal outcomes in both groups with respect to parity. (n = 188)

Outcomes		Parity	Study Group		Total	RR	P value
			Expose	Control			
IUGR	Yes	Primiparous	7(87.5%)	1(12.5%)	8(100%)	6.56	0.03
	No		25(46.3%)	29(53.7%)	54(100%)		
	Yes	Multipara	12(63.2%)	7(36.8%)	19(100%)	1.77	0.187
	No		50(46.7%)	57(53.3%)	107(100%)		
Preterm	Yes	Primiparous	8(72.7%)	3(27.3%)	11(100%)	2.50	0.122
	No		24(47.1%)	27(52.9%)	51(100%)		
	Yes	Multipara	13(68.4%)	6(31.6%)	19(100%)	2.37	0.069
	No		49(45.8%)	58(54.2%)	107(100%)		
LBW	Yes	Primiparous	6(60%)	4(40%)	10(100%)	1.41	0.562
	No		26(50%)	26(50%)	52(100%)		
	Yes	Multipara	15(75%)	5(25%)	20(100%)	3.09	0.012
	No		47(44.3%)	59(55.7%)	106(100%)		

Table III: Stratification of fetal outcomes with respect to severity of pre-eclampsia. (n = 188)

Outcomes		Severity of pre-eclampsia	STUDY GROUP		Total	RR	P-value
			Expose	Control			
IUGR	Yes	Mild	9(64.3%)	5(35.7%)	14(100%)	1.59	1.71
	No		42(51.2%)	40(48.8%)	82(100%)		
	Yes	Severe	10(76.9%)	3(23.1%)	13(100%)	3.79	4.64
	No		33(41.8%)	46(58.2%)	79(100%)		
Preterm birth	Yes	Mild	10(83.3%)	2(16.7%)	12(100%)	4.41	0.025
	No		41(48.8%)	43(51.2%)	84(100%)		
	Yes	Severe	11(61.1%)	7(38.9%)	18(100%)	1.79	0.173
	No		32(43.2)	42(53.3%)	74(100%)		
LBW	Yes	Mild	6(60%)	4(40%)	10(100%)	1.41	0.562
	No		25(50%)	26(50%)	52(100%)		
	Yes	Severe	15(75%)	5(25%)	20(100%)	3.09	0.012
	No		47(44.3%)	59(55.7%)	106(100%)		

years and a mean baseline gestational age of 34.32 ± 3.21 weeks at admission, with the majority being multiparous (63%) compared to nulliparous (37%). In alignment with these findings, Shakarami et al.[17] reported mean gestational age, maternal age, and BMI of 34.71 ± 4.31 weeks, 31.82 ± 5.79 years, and 25.37 ± 3.97, respectively. Additionally, in this study, mild pre-eclampsia was observed in 96 (51.1%) patients, while 92 (48.9%) had severe pre-eclampsia and this distribution was comparable to the study by Le et al[15], who reported a higher proportion of mild pre-eclampsia (54.6%) than severe cases (45.4%). In contrast, Lawal et al[16] found that the majority of patients presented with severe pre-eclampsia (70%) compared to mild pre-eclampsia (30%). The variability in the severity distribution of pre-eclampsia may because difference in study sample size and sample selection criteria.

In this study, overall adverse fetal outcomes were significantly more common in the exposed group compared to the control group: IUGR occurred in 70.4% vs. 29.6% (RR = 2.37, p = 0.022), preterm birth in 70% vs. 30% (RR = 2.33, p = 0.017), and low birth weight in 70% vs. 30% {RR = 2.33, p = 0.017). In aligns to this study, Nadeem et al[18] reported that IUGR and low birth weight were significantly more common in cases (93.3% and 70%, respectively) compared to controls (60% and 10%, respectively), with a statistically significant difference (p < 0.01). Consistently, Obagah et al[19] found that serum uric acid levels were significantly higher in pre-eclampsia patients (405.6 ± 99.5 µmol/L) than in healthy controls (232.7 ± 26.3 µmol/L; (p-0.01). The most frequent feto-maternal complications among patients with elevated serum uric acid were severe hypertension (88.4%), followed by eclampsia (18.8%) and IUGR (13%). Elevated uric acid has been associated with an increased risk of multiple feto-maternal complications, including pre-eclampsia, severe hypertension, birth asphyxia, and IUGR.[20] Some variations in the findings across the studies may due to the variations in study populations, sample sizes of studies, clinical profiles, and management practices, while consistent trends likely reflect shared pathophysiological mechanisms of pre-eclampsia.

Additionally in this study on the stratification by severity of pre-eclampsia, preterm birth was significantly more frequent in pre-eclamptic patients (83.3% vs. 16.7%, RR = 4.41, p = 0.025), while differences for IUGR and low birth weight were not significant. Among those with severe pre-eclampsia, low birth weight was significantly higher in the exposed group (75% vs. 25%, RR = 3.09, p = 0.012), but differences for IUGR and preterm birth were not statistically significant.

In the agreement with our study, Xiong et al.[21] reported that pre-eclampsia and its severity increased the risk of low birth weight and IUGR, with significantly higher adjusted odds of low birth weight in pre-eclampsia (OR = 2.65) and severe pre-eclampsia (OR = 2.53). Consistently, Mansour Ghanaei et al.[22] found that low birth weight was significantly more common in pre-eclampsia–induced IUGR patients compared to those with idiopathic IUGR (p < 0.001). Overall association observed between elevated maternal serum uric acid levels and an increased risk of adverse fetal outcomes, consistent with previous research linking hyperuricemia in pre-eclampsia to heightened risks of feto-maternal complications. However, based on the study limitations, like relatively small sample size, single-center design

study, and potential variability in clinical profiles and management practices, may limited the validity of the findings. Hence future multi-center studies with larger, more diverse populations should be done to validate these associations and clarify underlying mechanisms.

Conclusion

Based study conclusion there was a significant association between elevated maternal serum uric acid levels and an increased risk of adverse fetal outcomes, including IUGR, preterm birth, and low birth weight among pre-eclamptic women, especially for IUGR in primiparous women and low birth weight among multiparous women and those with severe disease. Overall, the findings highlight the potential role of serum uric acid as a simple, cost-effective prognostic marker for identifying high-risk pregnancies in women with pre-eclampsia, enabling close monitoring and timely interventions to reduce adverse perinatal outcomes. However, further large-scale studies are recommended to confirm these results and to explore its integration into routine antenatal care.

References

1. Marzioni D, Piani F, Di Simone N, Giannubilo SR, Ciavattini A, Tossetta G. Importance of STAT3 signaling in preeclampsia. Int J Mol Med. 2025;55(4):58. https://doi.org/10.3892/ijmm.2025.5499
2. Countouris ME, Bello NA. Advances in our understanding of cardiovascular diseases after preeclampsia. Circ Res. 2025;136(6):583-93. https://doi.org/10.1161/CIRCRESAHA.124.325581
3. Yevgenevna SO. Prediction of preeclampsia development in pregnant women with overweight and obesity. Web of Medicine: Journal of Medicine, Practice and Nursing. 2025;3(5):561-8.
4. Afrose D, Alfonso-Sánchez S, McClements L. Targeting oxidative stress in preeclampsia. Hypertens Pregnancy. 2025;44(1):2445556. https://doi.org/10.1080/10641955.2024.2445556
5. Layton AT. Artificial intelligence and machine learning in preeclampsia. Arterioscler Thromb Vasc Biol. 2025;45(2):165-71. https://doi.org/10.1161/ATVBAHA.124.321673
6. Santulli G, Kansakar U, Varzideh F. Epidemiology and pathophysiology of preeclampsia: new mechanistic insights. Hypertension. 2025;82(5):800-3. https://doi.org/10.1161/HYPERTENSIONAHA.124.24117
7. Arias-Sánchez C, Pérez-Olmos A, Reverte V, Hernández I, Cuevas S, Llinás MT. Uric acid and preeclampsia: pathophysiological interactions and the emerging role of inflammasome activation. Antioxidants. 2025;14(8):928. https://doi.org/10.3390/antiox14080928
8. JCM, GNS, Patil GL. Estimation of serum uric acid levels as adverse prognostic indicator of perinatal outcome in pregnant women with pre-eclampsia: a prospective observational study. Int J Reprod Contracept Obstet Gynecol. 2025;14(5):1596-600. https://doi.org/10.18203/2320-1770.ijrcog20251247
9. Ugwuanyi RU, Chiege IM, Agwu FE, Eleje GU, Ifediorah NM. Association between serum uric acid levels and perinatal outcome in women with preeclampsia. Obstet Gynecol Int. 2021;2021:6611828. https://doi.org/10.1155/2021/6611828
10. Xiong Y, Zheng P, Chen C, He C, Yang X, Cheng W. Association of maternal serum uric acid levels with LBW/SGA: a large retrospective cohort study. BMC Pregnancy Childbirth. 2024;24(1):160. https://doi.org/10.1186/s12884-024-06261-0
11. Omar Wehlie H, Fajardo Tornes Y, Businge J, Byamukama O, Kayondo M, Kato Kalyebara P, et al. Association between hyperuricemia and adverse perinatal outcomes among women with preeclampsia at a tertiary hospital in Southwestern Uganda: a prospective cohort study. J Matern Fetal Neonatal Med. 2025;38(1):2496394. https://doi.org/10.1080/14767058.2025.2496394
12. Adu-Bonsaffoh K, Kudaya DQ, Fidelis B, Fondjo LA, Ahenkorah J. Alteration in maternal serum uric acid levels in pre-eclampsia and associated perinatal outcomes: a cross-sectional study in Ghana. Pan Afr Med J. 2024;47:49. https://doi.org/10.11604/pamj.2024.47.49.37106
13. Le TM, Nguyen LH, Phan NL, Le DD, Nguyen HV, Truong VQ, et al. Maternal serum uric acid concentration and pregnancy outcomes in women with pre-eclampsia/eclampsia. Int J Gynaecol Obstet. 2019 Jan;144(1):21-6. https://doi.org/10.1002/ijgo.12697
14. Lawal AM, Atabo-Peter OD, Ibrahim H. The role of serum uric acid in predicting adverse pregnancy outcome in preeclampsia at Aminu Kano Teaching Hospital. Trop J Obstet Gynaecol. 2020;37(2):342-8.
15. Shakarami A, Ghafarzadeh M, Yari F, Fathi L. Association between maternal serum uric acid and preeclampsia. Arch Physiol Biochem. 2022 Nov 2;128(6):1434-7. https://doi.org/10.1080/13813455.2020.1773863
16. Nadeem A, Rehman A, Sultana N, Mehmood R, Merum A, Riaz N, et al. Fetal outcomes in pre-eclampsia with raised maternal serum uric acid. Pak J Med Health Sci. 202;16(5):119. https://doi.org/10.53350/pjmhs22165119
17. Obagah L, Kasia BE, Jeremiah I, Allagoa DO, Aigere EE, Kotingo EL, et al. Serum uric acid: a biochemical prognostic indicator of pregnancy outcomes among pre-eclampsia patients at the Federal Medical Centre, Yenagoa. Int J Reprod Contracept Obstet Gynecol. 2020;9:4235. https://doi.org/10.18203/2320-1770.ijrcog20204778
18. Corominas AI, Medina Y, Balconi S, Casale R, Farina M, Martínez N, et al. Assessing the role of uric acid as a predictor of preeclampsia. Front Physiol. 2022 Jan 13;12:785219. https://doi.org/10.3389/fphys.2021.785219
19. Xiong X, Mayes D, Demianczuk N, Olson DM, Davidge ST, Newburn-Cook C, et al. Impact of pregnancy-induced hypertension on fetal growth. Am J Obstet Gynecol. 1999;180(1):207-13. https://doi.org/10.1016/S0002-9378(99)70176-6
20. Mansour Ghanaei M, Amir Afzali S, Morady A, Mansour Ghanaie R, Asghari Ghalebin SM, Rafiei E, et al. Intrauterine growth restriction with and without pre-eclampsia: pregnancy outcome and placental findings. J Obstet Gynecol Cancer Res. 2022;7(3):177-85. https://doi.org/10.30699/jogcr.7.3.177