ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 06 | June - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

SERUM URIC ACID AS A PREDICTOR OF ADVERSE MATERNAL AND PERINATAL OUTCOMES IN WOMEN WITH HYPERTENSIVE DISORDERS OF PREGNANCY: A COMPREHENSIVE STUDY AT LAL DED HOSPITAL, SRINAGAR

Obstetrics & Gynaecology

Dr Asima Hassan* PG student Department of OB&G, GMC Srinagar, Jammu & Kashmir, India, *Corresponding Author

Dr Rahiq Ul Makhtoom Resident Department of OB&G, GMC Srinagar, Jammu & Kashmir, India

Dr Syed Masuma Rizvi Professor Department of OB&G, GMC Srinagar, Jammu & Kashmir, India

ABSTRACT

Background: Hypertensive Disorders of Pregnancy (HDP) pose substantial risks to maternal and perinatal health. Recognizing predictive biomarkers for adverse outcomes is crucial for early intervention and improved care. This study investigates the potential of Serum Uric Acid (SUA) as a marker in women with HDP attending Lal Ded Hospital, Srinagar. **Methods:** A comprehensive analysis involving 150 subjects was conducted to assess the association between SUA levels and maternal and perinatal outcomes. Patients were categorized based on SUA levels (<7 and >7), and statistical tests were employed to elucidate these relationships. **Results:** Significant correlations emerged between uric acid levels and non-severe PIH (43 cases <7, 9 cases >7) versus severe PIH (45 cases <7, 53 cases >7) with a p-value < 0.001. Similar trends were observed for uric acid levels and Eclampsia ($p < 0.01$), with 86 cases <7 and 53 cases >7 not experiencing Eclampsia, while 2 cases <7 and 9 cases >7 developed Eclampsia. Uric acid levels also strongly associated with HELLP syndrome ($p < 0.001$); 86 cases <7 and 52 cases >7 had no HELLP syndrome, whereas 2 cases <7 and 10 cases >7 did. Furthermore, the data revealed that elevated uric acid levels were linked to a higher incidence of perinatal mortality, low birth weight, IUGR, and NICU admission (p-value<0.001). **Conclusion:** Our study highlighted the significant impact of elevated serum uric acid levels on both maternal and perinatal health, including adverse outcomes such as severe PIH, eclampsia, and HELLP syndrome, as well as an increased risk of IUGR, NICU admission, perinatal mortality, and low birth weight neonates. Monitoring serum uric acid levels in maternal care can be clinically relevant for early interventions, although further research is needed to validate their applicability and elucidate underlying mechanisms.

KEYWORDS

Serum Uric Acid, Maternal Health, Perinatal Health, Adverse Outcomes

INTRODUCTION

Hypertensive disorders of pregnancy (HDP) constitute a formidable global public health challenge, imparting a substantial burden on maternal and neonatal well-being, accompanied by a lamentable toll of mortality. This category of disorders encompasses a heterogeneous array of clinical entities, notably embracing gestational hypertension, preeclampsia, and eclampsia, each distinguished by the elevation of systemic blood pressure during the gestational period. The pathophysiological underpinnings of HDP, marked by their intricate and multifarious nature, have become increasingly conspicuous as revelations emerge that extend beyond mere cardiovascular perturbations, encompassing systemic ramifications, most notably of metabolic provenance.

As per the pronouncements of the World Health Organization (WHO), the estimated incidence of Hypertensive disorders of pregnancy exhibits a starkly disparate pattern between developing and developed nations, with a prevalence sevenfold greater in the former as compared to the latter.[1] Within the Indian context, the incidence of Hypertensive disorders of pregnancy assumes a significant dimension, comprising 7–10% of all antenatal admissions.[2] On a global scale, it is discerned that approximately 5 to 10% of pregnancies are encumbered by the specter of hypertension. Preeclampsia, a formidable variant of hypertensive pathology, is projected to afflict 3-6% of pregnancies, whereas gestational hypertension, another manifestation of this malady, imposes its presence upon 5-10% of pregnancies on a worldwide scale.[3,4]It is worth noting that the ramifications of these hypertensive disorders are not confined to mere statistical representation; they exert substantial tolls in terms of maternal and fetal outcomes.

Uric acid, in the context of human physiology, serves as the ultimate culmination of purine metabolism, arising as a consequence of enzymatic catalysis mediated by xanthine oxidase. This enzyme, situated at the nexus of these metabolic pathways, orchestrates the conversion of hypoxanthine to xanthine and subsequently from xanthine to the final uric acid product.[5] A substantial body of empirical evidence substantiates the multifaceted roles played by uric acid in modulating various facets of cellular metabolism. This pivotal biomolecule assumes the mantle of a discerning sentinel, serving as a tangible marker denoting the presence of oxidative stress, tissue injury, and renal perturbation. Consequently, it is conjectured that uric acid may emerge as a valuable prognostic tool for anticipating the web of complications intricately woven into the clinical tapestry HDA.[6,7] Historical records, rooted in the annals of medical knowledge, harken back to the late 1800s when the initial observations of heightened uric acid concentrations in the milieu of preeclamptic women were first chronicled.[8] Subsequently, the scientific discourse has borne witness to a plethora of discordant reports within the extant literature, engendering a nuanced narrative concerning the intricate interplay between maternal hyperuricaemia and the severity of hypertensive disorders, along with its ensuing impact on pregnancy outcomes.[6,9-12]

In light of the contentious and inconclusive findings present in the extant scientific literature, the present study has been undertaken with the dual-fold purpose of elucidating the role of serum uric acid as a discerning biomarker for adverse maternal outcomes among women grappling with hypertensive disorders of pregnancy, as well as its potential utility in delineating adverse fetal outcomes within the same cohort.

MATERIAL AND METHODS:

The present was meticulously executed within the precincts of the Postgraduate Department of Gynaecology and Obstetrics at Lal Ded Hospital, Government Medical College Srinagar. This study spanned a rigorous 18-month period, commencing after securing the requisite clearance from the Institutional Ethical Committee and written informed consent from the study participants. The study was diligently designed as a prospective endeavor, meticulously observing and scrutinizing 150 patients grappling with hypertensive disorders of pregnancy. Central to the research was the meticulous assessment of serum uric acid levels, which were ascertained via the employment of the Abott c4000 analyzer within the precincts of Lal Ded Hospital's laboratory. These uric acid levels were subsequently juxtaposed with the encompassing fetomaternal outcomes for rigorous analysis.

In delineating the contours of the study's criteria for participant inclusion and exclusion, strict parameters were adhered to. Inclusion was reserved for patients contending with hypertensive disorders of pregnancy, provided they were carrying singleton pregnancies and their gestational age fell within the ambit of 28 to 40 weeks. Conversely, exclusionary criteria encompassed cases characterized by

multiple pregnancies, the presence of concurrent comorbidities such as chronic hypertension, diabetes mellitus, renal disorders, or hepatic disorders. Additional exclusionary categories involved patients with a documented history of gout and those currently under the influence of diuretic medications.

The definition of hypertension during pregnancy was stringently characterized by systolic blood pressure values exceeding 140 mmHg and/or diastolic blood pressure values exceeding 90 mmHg, a diagnostic threshold that necessitated confirmation on two distinct occasions, separated by intervals exceeding four hours. Furthermore, the diagnostic parameters for preeclampsia encompassed the presence of hypertension, as previously defined, after the 20th week of gestation, coupled with proteinuria exceeding 300 mg within a 24-hour span or an equivalent measure of at least 1+ proteinuria on dipstick testing. This diagnostic criterion was further refined to encompass a urine protein-to-creatinine ratio surpassing 0.3. Ancillary diagnostic criteria were thrombocytopenia, renal insufficiency, impaired hepatic function, pulmonary edema, and the manifestation of persistent cerebral or visual symptoms. Eclampsia, a severe manifestation of preeclampsia, was discerned in patients exhibiting generalized seizures, with an etiology unattributable to other causative factors.

The gravity of Pregnancy-Induced Hypertension (PIH) was graded by systolic blood pressure readings equal to or exceeding 160/110 mmHg, coupled with the presence of symptoms such as headache, visual disturbances, upper abdominal pain, oliguria, pulmonary edema, convulsions, elevated serum creatinine levels, marked elevation in transaminase levels, thrombocytopenia (defined as a platelet count below 100,000), or the presence of fetal growth restriction.

The categorization of uric acid levels within the ambit of this study was demarcated by a threshold of 7 or higher, signifying elevated uric acid concentrations, while levels less than 7 were designated as normal uric acid concentrations. This categorization was further substantiated through Receiver Operating Characteristic (ROC) analysis and in alignment with the prevailing standards of the hospital's laboratory values.

A meticulous and comprehensive data acquisition process was initiated, commencing with a detailed elicitation of patients' medical histories, followed by a thorough clinical examination. Pertinently, the systolic and diastolic blood pressure readings of all cases were diligently ascertained both at the point of admission and following a two-hour period of rest, and these values were meticulously documented. Furthermore, a regimen of four-hourly blood pressure monitoring was scrupulously implemented for each case throughout their hospitalization. Upon admission, venous blood samples were judiciously drawn from the ante-cubital veins of the patients and expeditiously dispatched for laboratory analyses, which encompassed the quantification of serum uric acid levels.

Statistical Analysis

The subsequent phase involved the processing of the acquired data. This entailed the entry of data into a Microsoft Excel Spreadsheet, which served as the foundational platform for subsequent statistical analysis. For continuous measurements, pertinent statistical parameters, such as the mean and standard deviation, were employed for summarization, while categorical measurements were succinctly delineated in terms of percentages. This methodical approach to data analysis was accomplished utilizing the statistical software, Epi Info, thereby ensuring the rigor and precision of the ensuing statistical inferences.

RESULTS

The study population exhibited a mean age of 30.22 years, with a standard deviation of 3.84, encompassing an age range spanning from 23 to 38 years. Notably, a preponderance of patients fell within the age stratum of ≥25 and < 30 years. Regarding gestational age, the study cohort presented with a mean of 36.16 weeks, alongside a standard deviation of 3.19. This parameter displayed considerable variability, with the gestational age ranging from 28 to 40 weeks. The majority of patients clustered within the gestational bracket of ≥36 and <40 weeks. Among the 150 cases scrutinized, 38% (57 cases) were identified as primigravida, while the remaining 62% (93 cases) fell into the multigravida category. Furthermore, within this cohort, 22.6% (34 cases) experienced preterm delivery, characterized by a gestational duration of less than 37 weeks. Conversely, the overwhelming majority, constituting 77.3% (116 cases), culminated their pregnancies at term, signifying a gestational period of 37 weeks or more. Upon meticulous data analysis, it was discerned that within the subset of 150 cases afflicted by Pregnancy-Induced Hypertension (PIH), a significant majority, accounting for 65.3% (98 cases), manifested severe manifestations of PIH, whereas the remaining 34.6% (52 cases) presented with non-severe PIH.

The presented data in Table 1, illustrates a comprehensive analysis of the association between uric acid levels and various maternal outcomes in a clinical study involving 150 pregnant individuals. This study has examined several parameters, including uric acid levels categorized as '<7' and '>7,' and the following maternal outcomes: Pre-eclampsia (PIH), Eclampsia, HELLP syndrome, Placental abruption, Postpartum hemorrhage, Pulmonary edema, Coagulopathy, Stroke, Need for blood transfusion, and Prematurity. The analysis revealed a significant correlation between uric acid levels and non-severe PIH (43 cases with uric acid <7 and 9 cases with uric acid >7) compared to severe PIH (45 cases with uric acid <7 and 53 cases with uric acid >7). The p-value for this association is less than 0.001, indicating a highly significant relationship.

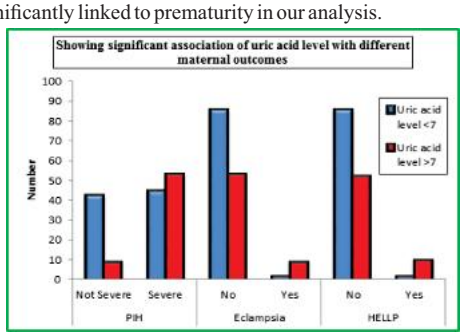
Table1: Showing association of uric acid level with different maternal outcomes

Outcome		Uric acid level		Total	P-value
		<7	>7		
PIH	**Not Severe**	43	9	52	<0.001*
	Severe	45	53	98	
	Total	88	62	150	
Eclampsia	**No**	86	53	139	<0.01*
	Yes	2	9	11	
	Total	88	62	150	
HELLP	**No**	86	52	138	<0.001*
	Yes	2	10	12	
	Total	88	62	150	
Placental abruption	**No**	83	58	141	0.845
	Yes	5	4	9	
	Total	88	62	150	
Postpartum hemorrhage	**No**	81	60	141	>0.05
	Yes	7	2	9	
	Total	88	62	150	
Pulmonary edema	**No**	87	60	147	>0.05
	Yes	1	2	3	
	Total	88	62	150	
Coagulopathy	**No**	86	62	148	>0.05
	Yes	0	2	2	
	Total	86	64	150	
Stroke	**No**	87	62	149	>0.05
	Yes	0	1	1	
	Total	87	63	150	
Need for blood transfusion	**No**	80	60	140	0.37
	Yes	8	2	10	
	Total	88	62	150	
Prematurity	**No**	71	45	116	0.243
	Yes	17	17	34	
	Total	88	62	150	

A similar pattern was observed in the association between uric acid levels and Eclampsia, with a p-value of less than 0.01. 86 cases with uric acid <7 and 53 cases with uric acid >7 experienced no Eclampsia, whereas 2 cases with uric acid <7 and 9 cases with uric acid >7 developed Eclampsia. In the context of HELLP syndrome, the data demonstrated a strong association between uric acid levels and its occurrence (p-value < 0.001). About 86 cases with uric acid <7 and 52 cases with uric acid >7 had no HELLP syndrome, while 2 cases with uric acid <7 and 10 cases with uric acid >7 had this condition. Uric acid levels do not exhibited a significant association with Placental Abruption (p-value = 0.845). A total of 83 cases with uric acid <7 and 58 cases with uric acid >7 had no placental abruption, whereas 5 cases with uric acid <7 and 4 cases with uric acid >7 experienced placental abruption.

The study does not find a significant correlation between uric acid levels and Postpartum Hemorrhage (p-value > 0.05). 81 cases with uric acid <7 and 60 cases with uric acid >7 did not experience postpartum

hemorrhage, while 7 cases with uric acid <7 and 2 cases with uric acid >7 did. A similar non-significant association was observed in the case of Pulmonary Edema (p-value > 0.05). Eighty seven (87) cases with uric acid <7 and 60 cases with uric acid >7 did not develop pulmonary edema, while 1 case with uric acid <7 and 2 cases with uric acid >7 did. Uric acid levels were not significantly associated with Coagulopathy (p-value > 0.05). 86 cases with uric acid <7 and 62 cases with uric acid >7 did not have coagulopathy, while 2 cases with uric acid <7 and 2 cases with uric acid >7 did. In the context of our analysis, we found that uric acid levels were not significantly linked to the occurrence of Stroke (p-value > 0.05). Among the 87 cases with uric acid levels below 7 and the 62 cases with levels exceeding 7, none experienced a stroke. Conversely, one case with uric acid below 7 and one case with uric acid above 7 did exhibited stroke occurrences. However, these findings did not reach a statistically significant level. Moving on to the Need for Blood Transfusion, our analysis reveals that there is no statistically significant association with uric acid levels (p-value = 0.37). Among the 80 cases with uric acid levels below 7 and the 60 cases with levels exceeding 7, none required a blood transfusion. In contrast, eight cases with uric acid levels below 7 and two cases with levels exceeding 7 did necessitate blood transfusions. Nonetheless, it's important to note that the observed association did not achieve statistical significance. Lastly, concerning Prematurity, we observed that uric acid levels did not demonstrate a statistically significant association with this outcome (p-value = 0.243). Among the 71 cases with uric acid levels below 7 and the 45 cases with levels above 7, full-term pregnancies were predominant, with 17 cases in each group delivering prematurely. These results indicate that uric acid levels are not significantly linked to prematurity in our analysis.



When the renal insufficiency was analyzed, the data showed that in the group with uric acid levels below 7, most patients (86 out of 88) did not experience renal insufficiency. However, two patients in this group had both azotemia and oliguria. In the group with uric acid levels above 7, none of the 62 patients exhibited renal insufficiency. Statistical analysis indicated no significant association between uric acid levels and renal insufficiency (p = 0.512). Overall, this suggests a lack of a substantial link between uric acid levels and renal insufficiency in this patient population.

In the context of our analysis focusing on the utility of uric acid levels as a predictive marker for Intensive Care Unit (ICU) admission in women with Pregnancy-Induced Hypertension (PIH), our findings unveiled notable distinctions. Specifically, among the subset of 62 patients presenting uric acid levels exceeding 7, 9 individuals, constituting 14.5% of this cohort, necessitated admission to the ICU. Of these, 4 patients required ventilator support, while the remaining 5 were admitted for observational purposes. Conversely, within the larger group encompassing 88 cases with uric acid levels falling below 7, a smaller proportion, 4 individuals (5.45%), experienced ICU admission. Importantly, all four of these patients were in a condition necessitating ventilator support. Upon statistical analysis, the p-value computed for this association was 0.199, signifying that there was no statistically significant correlation between uric acid levels and the need for ICU admission in this patient population.

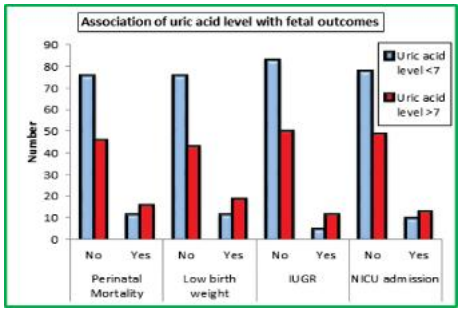
Table 2: Association of uric acid level with fetal outcome

Outcome		Uric acid level		Total	P-value
		<7	>7		
Perinatal Mortality	No	76	46	122	0.04*
	Yes	12	16	28	
	Total	88	62	150	
Low birth weight	No	76	43	119	0.01*
	Yes	12	19	31	
	Total	88	62	150	

We scrutinized the potential correlation between uric acid levels and various fetal outcomes within a given cohort of 150 pregnancies. Uric acid levels were categorized into two groups; those below 7 and those exceeding 7, and their association with fetal health outcomes was rigorously assessed. The statistical significance of these associations was determined using the Chi-squared test, yielding respective p-values for each outcome.

The investigation into Perinatal Mortality disclosed a noteworthy correlation with uric acid levels (p-value = 0.04*). Among individuals with uric acid levels below 7, 76 cases experienced no perinatal mortality, while 12 cases encountered such an unfortunate outcome. In contrast, for those with uric acid levels above 7, 46 cases exhibited no perinatal mortality, while 16 cases did. The statistical significance of this correlation, as indicated by the p-value, suggests that uric acid levels may be associated with perinatal mortality. Uric acid levels demonstrated a statistically significant association with Low Birth Weight (p-value = 0.01*). Among pregnancies characterized by uric acid levels below 7, 76 cases yielded infants without low birth weight, while 12 cases resulted in low birth weight infants. Conversely, in pregnancies with uric acid levels exceeding 7, 43 cases produced infants without low birth weight, while 19 cases resulted in low birth weight infants. The observed p-value underscores the significant relationship between uric acid levels and the occurrence of low birth weight.

Our analysis revealed a significant association between uric acid levels and Intrauterine Growth Restriction (IUGR) (p-value = 0.01*). Among pregnancies with uric acid levels below 7, 83 cases did not exhibit IUGR, while 5 cases did. For pregnancies characterized by uric acid levels above 7, 50 cases had no IUGR, while 12 cases did. The statistical significance of this association underscores the link between uric acid levels and the occurrence of IUGR. Uric acid levels were significantly associated with NICU admission (p-value = 0.01*).



Among pregnancies featuring uric acid levels below 7, 78 cases did not result in NICU admission, while 10 cases necessitated NICU admission. Conversely, in pregnancies characterized by uric acid levels above 7, 49 cases avoided NICU admission, while 13 cases required admission. The obtained p-value reinforced the significant correlation between uric acid levels and NICU admission, suggesting that higher uric acid levels may be linked to a greater likelihood of NICU admission among neonates.

DISCUSSION

Hypertensive Disorders of Pregnancy encompass a spectrum of conditions, ranging from the relatively mild gestational hypertension to the more severe forms such as Pre-eclampsia, Eclampsia, and the Hemolysis, Elevated Liver Enzymes, and Low Platelet (HELLP) syndrome. The management of these disorders remains a clinical challenge, necessitating a need for robust biomarkers to facilitate early detection and risk stratification. The present study was conducted on the utility of Serum Uric Acid (SUA) as a discerning marker of adverse maternal and perinatal outcomes in the context of Hypertensive Disorders of Pregnancy (HDP).

In this study, a cohort of 150 pregnant females afflicted with hypertensive disorders of pregnancy was included. The mean age of the study population was 30.22 ± 3.84 years, with an age range spanning from 23 to 38 years. Notably, the preponderance of patients (44.6%) fell within the 25 to 30-year age bracket. A comparative analysis with the study conducted by Razia S et al. in 2013 suggests that the age distribution of the subjects largely aligns with their findings, where the majority also fell within the 21 to 30-year age group.[13] In a separate study led by Asgharnia M et al. in 2017, the mean age of participants was reported as 31.18 ± 5.41 years, whereas Ryu A

et al. in 2019 documented a mean age of 31.3 ± 5.0 years among their study participants.[14,15] Among the 150 cases examined, 38% of the females were primigravida, while the remaining 62% were multigravida. This distribution contrasts somewhat with the study conducted by Nahar K et al. in 2017, where a majority of the participants were multigravida (with 20 primigravida and 72 multigravida).[16] Conversely, Andrew L et al. in 2018 reported that primigravida accounted for 53% of the cases in their study.[17]

The study revealed that a significant majority, encompassing 98 patients (68.3%), presented with severe Pregnancy-Induced Hypertension (PIH), whereas 52 individuals (34.6%) were diagnosed with non-severe PIH. The determination of the severity of PIH was contingent on established clinical criteria, including elevated blood pressure (BP) equal to or exceeding 160/110 mm Hg and the presence of indicative symptoms such as headache, visual disturbances, upper abdominal pain, oliguria, pulmonary edema, convulsions, elevated serum creatinine, marked transaminase elevation, thrombocytopenia (platelet count < 1,00,000), or fetal growth restriction. This characterization underscored the predominance of severe PIH cases within the study cohort. Moreover, a statistically significant correlation between maternal serum uric acid levels and the severity of PIH was discerned, a finding that aligns with prior research. Kumar et al. (2019) conducted a prospective cohort study involving 110 women with Hypertensive Disorders of Pregnancy, where a substantial correlation between maternal serum uric acid levels and disease severity was observed.[18] Similar observations were made by Nair et al. (2017) and Andrew et al. (2016), who reported a positive correlation between serum uric acid levels and PIH severity.[17,19] These studies collectively indicated the potential utility of serum uric acid as a biochemical indicator of preeclampsia/eclampsia and its associated complications. Lin et al. (2018) explored the predictive value of serum uric acid in women with hypertensive disorders of pregnancy and found a positive correlation between serum uric acid levels and both disease severity and adverse pregnancy outcomes.[20] Meena et al. (2019) conducted a case-control study involving 100 cases of preeclampsia and 100 healthy women, noting a positive correlation between maternal serum uric acid levels and disease severity.[21] This correlation was also observed by Nahar et al. (2017).[16]

In the current study, when assessing the relationship between PIH severity and uric acid levels, it was noted that among the 52 cases with non-severe PIH, 43 cases (82.6%) exhibited uric acid levels below 7, while 9 cases (17.30%) registered levels exceeding 7. Conversely, among the 98 cases diagnosed with severe PIH, 45 cases (45.91%) displayed uric acid levels below 7, with the remaining 53 cases (54.08%) exceeding 7. This observation substantiated the significant elevation of uric acid levels in the severe PIH cohort (p-value < 0.001), consistent with the findings from previous studies. Bellos et al. (2020) conducted a comprehensive meta-analysis in 2020, encompassing 196 observational studies involving 39,540 women.[22] Their aim was to amalgamate the existing body of literature pertaining to the role of serum uric acid in preeclampsia, with a particular focus on its potential as a marker for disease severity and complications. Notably, their analysis revealed a marked elevation in uric acid levels among individuals afflicted by the severe form of the condition, as well as those diagnosed with eclampsia and the Hemolysis, Elevated Liver Enzymes, and Low Platelet (HELLP) syndrome.[22] In our own investigation, we also assessed the relationship between serum uric acid levels and the development of eclampsia. Among our study participants, 14.51% of those with elevated serum uric acid levels were diagnosed with eclampsia. Importantly, this association proved to be statistically significant, with a p-value of 0.01. In patients with eclampsia, the mean serum uric acid level was found to be 8.1. These findings align with the observations reported by Kumar et al. (2019), Kondareddy et al. (2016), Hawkins et al. (2012), and Johnson et al. (2011), all of whom underscored a robust correlation between heightened serum uric acid levels and adverse maternal outcomes.[18,23-25] Furthermore, in their meta-analysis, Bellos et al. (2020) identified a significant association between HELLP syndrome and elevated uric acid levels when compared to uncomplicated preeclampsia.[22] A similar association was reported by Williams et al. (2002), who noted substantial elevations in serum uric acid levels among patients with hypertensive disorders of pregnancy, particularly in those with HELLP syndrome.[7] Conversely, Agharnia et al. (2017) reported an insignificant relationship between serum uric acid levels and HELLP syndrome.[14]In our study, among the 62 patients whose uric acid levels exceeded 7, 10 individuals (equivalent to 16.1%) were diagnosed with HELLP syndrome, while among the 88 cases with uric acid levels below 7, only 2 individuals (approximately 2.27%) were afflicted by HELLP syndrome. The association between uric acid levels and HELLP syndrome was established as statistically significant, denoted by a p-value of <0.001. Conversely, a study conducted by Kumar N et al. in 2019 reported elevated serum uric acid levels in hypertensive disorder of pregnancy patients admitted to the ICU.[18]

Interestingly, our study yielded contrasting results, revealing that out of the 62 patients with uric acid levels exceeding 7, 9 individuals (constituting 14.5%) required ICU admission. Among these, 4 patients necessitated ventilator support, while 5 were admitted for observational purposes. Within the group of 88 cases featuring uric acid levels below 7, 4 individuals (approximately 5.45%) required ICU admission, and all of them received ventilator support. The relationship between uric acid levels and ICU admission was determined to be statistically insignificant, with a p-value of 0.199. Furthermore, our findings align with a cross-sectional study conducted by Agharnia M et al. in 2017, which included 160 singleton preeclamptic women at gestational ages exceeding 28 weeks.[14] This study revealed that serum uric acid levels were not significantly elevated in patients admitted to the ICU, thus corroborating our own observations. In terms of the association between serum uric acid levels and placental abruption, our study did not establish a statistically significant relationship. Among the 62 patients with elevated uric acid levels, 4 individuals (6.45%) experienced placental abruption. In contrast, among the 88 patients with lower serum uric acid levels, 5 individuals (approximately 5.68%) encountered placental abruption. The statistical analysis yielded a p-value of 0.845, indicating that the association between elevated uric acid levels and placental abruption was not statistically significant. These findings contrast with those of Lin J et al. in 2018, who reported significantly elevated serum uric acid levels in patients diagnosed with placental abruption.[20]Within this study encompassing 150 patients, two cases manifested renal insufficiency, denoted by azotemia and oliguria. Strikingly, both of these cases exhibited uric acid levels below 7, and one of them had developed acute kidney injury secondary to placental abruption. Our analysis revealed a limited correlation between serum uric acid levels and the occurrence of renal insufficiency. This outcome aligns with the study conducted by Corominas AI et al. (2022), which similarly reported normal levels of urea and creatinine across all cases, affirming the absence of renal compromise and underscoring the ineffectiveness of uric acid as a predictor for renal compromise.[27] Furthermore, Andrew L et al. (2016) noted one occurrence of acute renal failure in both the high uric acid group and the low uric acid group, further substantiating the lack of a robust correlation between elevated uric acid levels and the onset of acute renal failure.[17] In concordance with these findings, a study conducted by Obagah L et al. (2020) identified acute kidney failure in five patients exhibiting high serum uric acid levels, yet, it too disclosed a statistically insignificant relationship between acute renal failure and hyperuricemia.[27]

In our study, we observed a divergence in outcomes when considering serum uric acid levels in relation to postpartum hemorrhage (PPH) and coagulopathy. Firstly, regarding PPH, we noted that 7.95% of patients in the low serum uric acid group experienced this complication, while only 3.2% of patients in the high serum uric acid group did. This observation indicates a rather feeble correlation between serum uric acid levels and PPH, which stands in contrast to the findings reported by Lin J et al. (2018) in their case-control study.[20] In their study, they classified 180 pregnant women with hypertensive disorders into two groups based on serum uric acid levels: high UA group (n = 137) and normal UA group (n = 43). In addition, 180 healthy pregnant women were selected as the control group. Lin et al. found a statistically significant difference in the occurrence of postpartum hemorrhage between the high serum uric acid group and the control group.[20] The disparity in our findings may be attributed to the absence of a control group in our study and the comparison made between high serum uric acid and low serum uric acid level groups, as opposed to Lin et al.'s comparison between healthy controls and the high serum uric acid group.[20] Similarly, in another study by Andrew L et al. (2016), postpartum hemorrhage was observed in 4 patients with high serum uric acid levels and 1 patient with low serum uric acid levels.[14] This contrasts with our findings, where the majority of patients with postpartum hemorrhage belonged to the low serum uric acid group.

Turning to coagulopathy, we observed two cases of coagulopathy in the form of disseminated intravascular coagulation (DIC), both of

which had uric acid levels exceeding 7. Notably, coagulopathy was absent in the low serum uric acid level group. However, when we compared these findings with the low serum uric acid group, we found the relationship to be statistically insignificant. In contrast, Lin J et al. (2018) noted a significant elevation of uric acid levels in patients with DIC compared to healthy controls. This discrepancy between our results and those of Lin et al. may be attributed to the limited sample size in our study and the absence of a control group.[20] Additionally, our study compared high serum uric acid and low serum uric acid level groups, whereas Lin et al. compared healthy controls with the high serum uric acid group.

In this study, the role of serum uric acid as a potential marker for pulmonary edema, stroke, and blood transfusion in patients with hypertensive disorders of pregnancy was explored. However; all of them were found to have an insignificant association with uric acid levels ($p > 0.05$). Moreover; we did not find a significant association between varying serum uric acid levels and preterm birth, which is consistent with the study of Paula LG et al. (2008) who also reported an insignificant difference in preterm birth among groups with varying serum uric acid levels.[28] Conversely, studies conducted by Nair A and Savitha C (2017), Ryu A et al. (2019), and Ugwuanyi RU et al. (2021) reported statistically significant differences in mean serum uric acid levels between preterm and term pregnancy groups, with higher uric acid levels noted in the preterm groups.[15,19,29]

In this study, we noted that within our cohort, 5.68% of patients (5 individuals) among the 88 with low serum uric acid levels experienced Intrauterine Growth Restriction (IUGR). In contrast, among the 62 patients with high serum uric acid levels, a significantly higher proportion, 19.35% (12 individuals), encountered IUGR ($p < 0.01$). These findings resonate with previous research by Magnann EF et al. (1993), which also discerned a substantial correlation between elevated serum uric acid levels and IUGR.[30] Additionally, a study conducted by Zhao X et al. (2021) aligns with this observation, collectively emphasizing the relevance of uric acid levels in assessing fetal growth.[31] This association, in our analysis, is attributed to the heightened incidence of IUGR among patients with severe Pregnancy-Induced Hypertension (PIH). Nonetheless, further investigations are imperative to comprehensively elucidate the relationship between PIH severity, early onset PIH, and elevated serum uric acid levels.

In an independent cross-sectional study undertaken by Agharnia M et al. (2017), no discernible influence of uric acid levels on neonatal hospitalization in the Neonatal Intensive Care Unit (NICU) was identified.[14] This finding was echoed in the work of Paula LG et al. (2008), which reported no substantial disparities in NICU admission with regard to serum uric acid levels between high and low serum uric acid groups, consistent with our study.[28] Notably, while assessing the correlation between elevated uric acid levels and NICU admission in our analysis, it was observed that 11.36% (10 individuals) of the 88 patients with low serum uric acid levels and 20.96% (13 individuals) of the 62 patients with high serum uric acid levels had neonates admitted to the NICU following delivery. However, statistical analysis indicated that this relationship was not statistically significant ($p = 0.108$).

A significant correlation was established in our study between high serum uric acid levels and perinatal mortality. Among patients with elevated serum uric acid levels, perinatal mortality was observed in 13.6% (16 individuals), with 11 cases manifesting intrauterine fetal death, 1 case presenting stillbirth, and 4 cases indicating early neonatal death. In contrast, perinatal mortality occurred in 7.4% (12 individuals) of patients with low uric acid levels, with 7 experiencing intrauterine fetal death and 5 encountering early neonatal death. This association demonstrated statistical significance with a p-value of 0.04. Similar findings were documented in a study by Nair A and Savitha C (2017), wherein perinatal mortality in the study group reached 22%, while it was absent in the control group.[15] Moreover, elevated serum uric acid levels were consistently reported in studies conducted by Magnann EF et al. (1993) and Lin J et al. (2018) among patients experiencing perinatal mortality.[20,30] This underscores the imperative of vigilant fetal well-being assessment in cases with elevated serum uric acid levels and the need for prompt intervention in the presence of fetal distress.

Remarkably, our study revealed a significantly higher occurrence of low birth weight infants (30.6%) among patients with elevated serum uric acid levels, compared to those with lower levels (13.63%). This correlation held statistical significance ($p = 0.01$). Consistent findings from studies by Nair A and Savitha C (2017), Kumar N et al. (2019), Lin J et al. (2018), Meena R et al. (2018), and Ugwuanyi RU et al. (2021) underscore the compelling association between maternal serum uric acid levels and adverse perinatal outcomes.[18-20,29]

CONCLUSION

Our study illuminates the substantial influence of serum uric acid levels on various facets of maternal and perinatal well-being. Elevated uric acid levels were intricately linked to adverse maternal outcomes, including the severity of Pregnancy-Induced Hypertension (PIH), the incidence of eclampsia, and the development of the Hemolysis, Elevated Liver Enzymes, and Low Platelet (HELLP) syndrome. Furthermore, heightened uric acid levels were associated with an increased susceptibility to Intrauterine Growth Restriction (IUGR), neonatal admission to the Neonatal Intensive Care Unit (NICU), perinatal mortality, and the delivery of low birth weight neonates. These compelling findings underscore the clinical significance of vigilantly monitoring serum uric acid levels within the realm of maternal care. This monitoring could potentially serve as an invaluable tool for early risk assessment and intervention, ultimately enhancing perinatal outcomes. However, it is crucial to acknowledge that while our findings are promising, further extensive research is imperative to validate their applicability within clinical settings and to elucidate the intricate mechanisms underpinning these observed associations.

REFERENCES

1. World Health Organization: World heal rep. 2005. Geneva: WHO, 2005.
2. Magee L.A., Helewa M., and Rey E.: Hypertension guideline committee; strategic training initiative in research in the reproductive health sciences (STIRRHS) scholars. Diagnosis, evaluation, and management of the hypertensive disorders of pregnancy. J Obstet Gynaecol Can 2008; 30: S1-S2
3. Ananth CV, Keyes KM and Wapner RJ. Pre-eclampsia rates in the United States, 1980-2010: age- period-cohort analysis. Br Med J 2013; 347: f6564
4. Hutcheon JA, Lisonkova S and Joseph KS. Epidemiology of preeclampsia and the other hypertensive disorders of pregnancy. Best Pract Res Clin Obstet Gynaecol 2011; 25: 391-403.
5. Schorn C., Janko C., Munoz L., et al. Sodium and potassium urate crystals differ in their inflammatorypotential. Autoimmunity. 2009;**42**(4):314–316.
6. Powers R. W., Bodnar L. M., Ness R. B. Uric acid concentration in early pregnancy among preeclamptic women with gestational hyperuricemia at delivery. American Journal of Obstetrics and Gynecology. 2006; **194**:1–8. doi: 10.1016/j.ajog.2005.06.066. [PubMed] [CrossRef] [Google Scholar]
7. Williams K. P., Galerneau F. The role of serum uric acid as a prognostic indicator of the severity of maternal and fetal complications in hypertensive pregnancies. Journal of Obstetrics and Gynaecology Canada. 2002;**24**(8):628–632. doi: 10.1016/s1701-2163(16)30193-1. [PubMed] [CrossRef] [Google Scholar]
8. Zangana J. W., Hamadamen A. I. Serum uric acid as a predictor of perinatal outcome in women with pre-eclampsia. International Journal of Medical Research &Health Sciences. 2018;**7**(3):168–174. [Google Scholar]
9. Nura A., Gadzama A. Effect of hyperuricemia on pre-eclamptic, eclamptic patients and their fetal outcome. Ejbps. 2016;**3**(9):85–88. [Google Scholar]
10. Wu Y., Xiong X., Fraser W. D., Luo Z.-C. Association of uric acid with progression to preeclampsia and development of adverse conditions in gestational hypertensive pregnancies. *American Journal of Hypertension*. 2012;**25**(6):711–717. doi: 10.1038/ajh.2012.18. [PubMed] [CrossRef] [Google Scholar]
11. Tejal P., Astha D. Uric acid and maternal and perinatal outcome in hypertensive disease in pregnancy. Gujarat Medical Journal. 2014;**69**(2):5–6. [Google Scholar]
12. Hawkins T.-A., Roberts J., Mangos G., Davis G., Roberts L., Brown M. Plasma uric acid remains a marker of poor outcome in hypertensive pregnancy: a retrospective cohort study. BJOG: An International Journal of Obstetrics & Gynaecology. 2012;**119**(4):484–492. doi: 10.1111/j.1471-0528.2011.03232.x. [PubMed] [CrossRef] [Google Scholar]
13. Razia S, Selina A, Nasima S, Karim SF, Farhana A. Association of serum uric acid with preeclampsia: a case control study. Delta Medical College Journal. 2013;1(2):46-50.
14. Agharnia M et al. Maternal serum uric acid level and maternal and neonatal complications in preeclamptic women: A cross-sectional study. Int J Reprod BioMed Vol. 15. No. 9. pp: 583-588, September 2017
15. Ryu A, Cho NJ, Kim YS, Lee EY. Predictive value of serum uric acid levels for adverse perinatal outcomes in preeclampsia. Medicine. 2019 May;98(18).
16. Nahar K, Khatun SF, Khan NA. Serum uric acid level in preeclamptic women determine the severity of preeclampsia. Bangladesh J Obstet Gynaecol, 2017; 32(2): 67-72
17. Andrew L and Patel N. Uric acid levels in pregnancy induced hypertension (PIH) in relation to maternal and perinatal outcomes. International Journal of Clinical Biochemistry and Research 2016; 3(2): 150-53.
18. Kumar N and Singh AK. Maternal Serum Uric Acid as a Predictor of Severity of Hypertensive Disorders of Pregnancy: A Prospective Cohort Study. Curr Hypertens Rev. 2019;15(2):154-60.
19. Nair A and Savitha C. Estimation of Serum Uric Acid as an Indicator of Severity of Preeclampsia and Perinatal Outcome. J Obstet Gynaecol India. 2017;67(2):109-18.
20. Lin J, Hong XY, Tu RZ. The value of serum uric acid in predicting adverse pregnancy outcomes of women with hypertensive disorders of pregnancy. Ginekol Pol. 2018;89(7):375-380. doi:10.5603/GP.a2018.0064.
21. Meena R, Pachori P, Chaudhary S, Chandra Kanta. Level of serum uric acid in patients with preeclampsia compared to controls and its relation to feto-maternal outcome. Int J Reprod Contracept Obstet Gynecol 2019; 8:2471-4.
22. Bellos I, Pergialiotis V, Loutradis D, Daskalakis G. The prognostic role of serum uric acid levels in preeclampsia: A meta-analysis. Clin Hypertens. 2020;22: 826–834.
23. Kondareddy T, Prathap T. Uric acid as an important biomarker in hypertensive disorders in pregnancy. Int J Reprod Contracept Obstet Gynecol 2016; 5: 4382-4.
24. Hawkins TA, Roberts JM, Mangos GJ, Davis GK, Roberts LM, Brown MA. Plasma uric acid remains a marker of poor outcome in hypertensive pregnancy: a retrospective cohort study. BJOG: An International Journal of Obstetrics & Gynaecology. 2012 Mar; 119(4): 484-92.
25. Johnson RJ, Kanbay M, Kang DH, Lozada LGS, Feig D. Uric acid: A clinically useful

marker to distinguish preeclampsia from gestational hypertension. Hypertension 2011; 58(4): 548-9.
26. Corominas AI, Medina Y, Balconi S, Casale R, Farina M, Martínez N, Damiano AE. Assessing the Role of Uric Acid as a Predictor of Preeclampsia. Frontiers in Physiology. 2022 Jan 13;12: 785219.
27. Obagah L, Kasia BE, Jeremiah I, Allagoa DO, Aigere EE, Kotingo EL, Oriji CP. Serum uric acid: a biochemical prognostic indicator of pregnancy outcomes among pre-eclampsia patients at the federal medical centre, Yenagoa. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. 2020 Nov 1;9(11):4344.
28. Paula LG, daCosta BE, Poli-de-Fiqueredo CE, Antonello IC. Does uric acid provide information about maternal condition and fetal outcome in pregnant women with hypertension? Hypertens pregnancy 2008;27: 413-20.
29. Ugwuanyi RU, Chiege IM, Agwu FE, Eleje GU, Ifediorah NM. Association between serum uric acid levels and perinatal outcome in women with preeclampsia. Obstetrics and gynecology international. 2021 Apr 16;2021.
30. Magann EF, Chauhan SP, Naef RW, Blake PG, Morrison JC, Martin J. Standard parameters of preeclampsia: can the clinician depend upon them reliably identify the patient with HELP syndrome? Aust NZ/Obset Gynaecology. 1993;33(2):122-6.
31. Zhao X, Frempong ST, Duan T. Uric acid levels in gestational hypertensive women predict preeclampsia and outcome of small for- gestational-age infants. The Journal of Maternal-Fetal and Neonatal Medicine. 2021;34(17):2825-31.