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Original Research Article

Spot Protein/Creatinine Ratio and 24-Hour Urine Protein Excretion in Women with Pre-Eclampsia and Its Association with Feto-Maternal Outcome: A Prospective Study

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Conflict of interest: Nil

Abstract

Background: Pre-eclampsia is a major hypertensive disorder of pregnancy associated with significant maternal and perinatal morbidity and mortality. Although 24-hour urinary protein estimation is the diagnostic reference standard, the spot urine protein/creatinine ratio offers a rapid, practical, and reliable alternative for assessing proteinuria and guiding timely clinical management.

Aims & Objectives: To evaluate the diagnostic accuracy of the spot urine protein/creatinine ratio, compare it with 24-hour urinary protein estimation, and assess its association with adverse fetomaternal outcomes in women with pre-eclampsia.

Material & Methods: A prospective observational study was conducted among 60 pregnant women diagnosed with pre-eclampsia at a tertiary care teaching hospital. Spot urine samples were collected before 24-hour urine collection for estimation of the protein/creatinine ratio and total urinary protein. Maternal demographics, obstetric characteristics, laboratory findings, mode of delivery, and fetomaternal outcomes were recorded. Statistical analysis was performed using Microsoft Excel and SPSS, with data expressed as frequencies and percentages.

Results: Most participants were 21–25 years old (53.3%) and primigravida (65.0%). Maternal complications occurred in 18.3% of women, while fetal complications were observed in 76.7%, with preterm birth being the predominant adverse outcome. The spot urine protein/creatinine ratio demonstrated diagnostic performance comparable to 24-hour urinary protein estimation and showed a significant association with adverse fetomaternal outcomes.

Conclusion: The spot urine protein/creatinine ratio is a reliable, rapid, and practical alternative to 24-hour urinary protein estimation for evaluating proteinuria in pre-eclampsia. Its excellent diagnostic performance and association with adverse fetomaternal outcomes support its routine use for early risk assessment and timely obstetric management.

Keywords: Pre-eclampsia; Spot Urine Protein/Creatinine Ratio; 24-Hour Urinary Protein; Proteinuria; Fetomaternal Outcome; Pregnancy-Induced Hypertension.

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Introduction

Pre-eclampsia is a pregnancy-specific multisystem disorder characterized by new-onset hypertension after 20 weeks of gestation with evidence of maternal organ dysfunction, frequently accompanied by proteinuria. It remains one of the leading causes of maternal and perinatal morbidity and mortality worldwide despite advances in antenatal care. The disease contributes substantially to maternal deaths, preterm birth, fetal growth restriction, and adverse neonatal outcomes, making early diagnosis and appropriate management a major priority in modern obstetric practice. [1-3]

Proteinuria is an important diagnostic hallmark of pre-eclampsia and reflects underlying glomerular endothelial injury resulting from widespread endothelial dysfunction. The severity of proteinuria has also been associated with disease progression and unfavorable fetomaternal outcomes. Accurate assessment of urinary protein excretion is therefore essential for confirming the diagnosis, assessing disease severity, and guiding timely clinical intervention. [4-6]

Traditionally, 24-hour urinary protein estimation has been regarded as the reference standard for quantifying proteinuria. However, the procedure is labor-intensive, time-consuming, inconvenient for patients, and susceptible to incomplete urine collection, which may delay diagnosis and therapeutic decision-making. These practical limitations have encouraged the search for reliable, rapid, and clinically feasible alternatives that can provide comparable diagnostic accuracy while improving patient care. [1,6,8]

The spot urine protein-to-creatinine ratio (UPCR) has emerged as a promising substitute because it estimates protein excretion from a single urine sample, minimizing collection errors and providing faster laboratory results. Several studies have demonstrated a strong correlation between spot UPCR and 24-hour urinary protein estimation, supporting its potential utility in diagnosing significant proteinuria and predicting adverse maternal and fetal outcomes in women with pre-eclampsia. [1,4,6,7,9]

Considering the need for a rapid, accurate, and practical diagnostic approach, the present study was undertaken to evaluate the diagnostic performance of the spot urine protein-to-creatinine ratio in comparison with 24-hour urinary protein estimation and to determine its association with fetomaternal outcomes in women with pre-eclampsia. This evidence may support earlier risk stratification and facilitate timely obstetric management, ultimately improving maternal and neonatal outcomes. [1,4,6-10]

Literature Review: Pre-eclampsia continues to be a major contributor to adverse maternal and perinatal outcomes, with proteinuria serving as an important indicator of disease severity and progression. Recent evidence has demonstrated that increasing urinary protein excretion is associated with a higher risk of maternal complications, preterm birth, fetal growth restriction, and poor neonatal outcomes, emphasizing the need for accurate and timely assessment of proteinuria. [11,12]

Traditionally, 24-hour urinary protein estimation has been considered the reference standard for quantifying proteinuria; however, its prolonged collection time and susceptibility to collection errors have limited its routine clinical applicability. Comparative studies have reported that the spot urine protein-to-creatinine ratio (UPCR) provides diagnostic accuracy comparable to 24-hour urine protein estimation while offering greater convenience, faster reporting, and improved patient compliance. [13-16]

The National Kidney Foundation has recognized proteinuria as a valuable marker of renal injury and adverse clinical outcomes, supporting the use of standardized quantitative methods for its evaluation. [17] Similarly, contemporary obstetric guidelines advocate prompt recognition and management of hypertensive disorders of pregnancy to reduce maternal and fetal complications. [18,19] Risk prediction studies have further identified maternal characteristics and clinical parameters that facilitate early identification of women at increased risk of developing pre-eclampsia. [20]

Evidence-based obstetric practice increasingly supports rapid and reliable diagnostic strategies that facilitate timely intervention without compromising diagnostic accuracy. [21] Collectively, these findings suggest that spot UPCR is a practical and dependable alternative to 24-hour urinary protein estimation and may enhance early diagnosis, risk stratification, and overall fetomaternal outcomes in women with pre-eclampsia.

Aims & Objectives: The aim of this study is to-

1. To evaluate the diagnostic accuracy of the spot urine protein/creatinine ratio, compare it with 24-hour urinary protein estimation.
2. To assess its association with adverse fetomaternal outcomes in women with pre-eclampsia.

Methodology:

Study Design: The present study was designed as a prospective observational study to evaluate the diagnostic utility of the spot urine protein/creatinine ratio in comparison with 24-hour urinary protein estimation and its association with fetomaternal outcomes in women with pre-eclampsia.

Study Type: This was a hospital-based prospective observational study conducted in the Department of Obstetrics and Gynaecology at a tertiary care teaching hospital over the study period. A total of 60 eligible pregnant women diagnosed with pre-eclampsia were enrolled consecutively after obtaining informed consent.

Study Population: The study population comprised pregnant women diagnosed with pre-eclampsia after 20 weeks of gestation who attended the antenatal outpatient department or were

admitted to the obstetric ward. All participants fulfilled the diagnostic criteria for pre-eclampsia and underwent both spot urine protein/creatinine ratio estimation and 24-hour urinary protein measurement.

Inclusion Criteria:

- Pregnant women diagnosed with pre-eclampsia after 20 weeks of gestation.
- Singleton pregnancy.
- Women willing to provide written informed consent.
- Patients undergoing both spot urine protein/creatinine ratio and 24-hour urinary protein estimation.

Exclusion Criteria:

- Patients with chronic kidney disease or nephrotic syndrome.
- Chronic hypertension diagnosed before pregnancy.
- Diabetes mellitus with nephropathy.
- Urinary tract infection or known renal pathology.
- Multiple pregnancy or women unwilling to participate.

Data Collection Methods: Data were collected using a structured case record form. Demographic details, obstetric history, blood pressure, laboratory investigations, spot urine protein/creatinine ratio, 24-hour urinary protein estimation, maternal complications, fetal outcomes, and mode of delivery were recorded prospectively for each participant.

Procedure: The spot urine sample was collected immediately before initiation of the 24-hour urine collection.

The protein/creatinine ratio and total urinary protein were estimated using standard laboratory methods. Participants were followed until delivery, and maternal and neonatal outcomes were documented for correlation with the biochemical findings.

Data Analysis: All collected data were entered into Microsoft Excel and analyzed using SPSS statistical software. Descriptive statistics were expressed as frequencies, percentages, means, and standard deviations wherever appropriate.

The diagnostic performance of the spot urine protein/creatinine ratio was compared with 24-hour urinary protein estimation, and its association with fetomaternal outcomes was evaluated.

Observations & Results:

Demographic and Clinical Characteristics

Table 1: Distribution of Study Participants According to Age (n = 60)

Age group (years)	Frequency (n)	Percentage (%)	Mean Age ± SD
≤20	9	15	19.55 ± 0.53
21–25	32	53.33	23.47 ± 1.34
26–30	16	26.67	28.25 ± 1.39
31–35	2	3.33	33.00 ± 1.41
36–40	1	1.67	38.00 ± 0
Total	**60**	**100**	**24.71 ± 5.10**

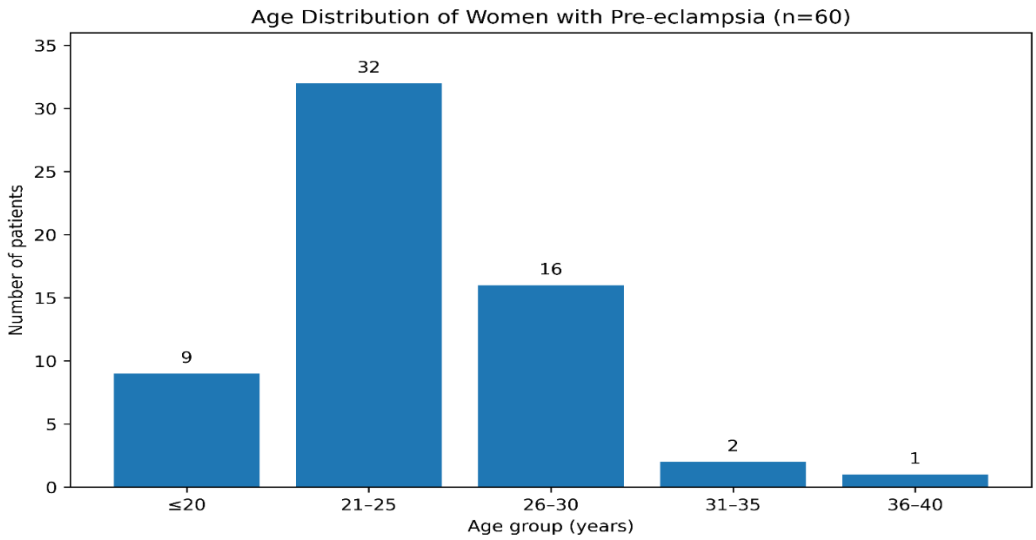

Figure 1: Age distribution of women with pre-eclampsia (n=60)

Interpretation: The age distribution demonstrated a clear predominance of younger pregnant women, with more than half of the study population belonging to the 21–25-year age group. The overall mean age was 24.71 ± 5.10 years, indicating that pre-eclampsia in this cohort was primarily encountered during early reproductive age. Women aged 26–30 years constituted the second largest group. The statistically significant age distribution highlights the importance of careful antenatal surveillance among younger pregnant women presenting with hypertensive disorders.

Table 2: Distribution According to Spot PCR and 24-Hour Urinary Protein Estimation (n = 60)

Proteinuria assessment	Category	n	Percentage (%)	Mean ± SD
Spot PCR	Absent (≤0.3)	19	31.67	0.18 ± 0.09
	Present (>0.3)	41	68.33	1.00 ± 0.60
24-hour urinary protein	Absent (≤300 mg)	33	55	190.39 ± 50.95
	Present (>300 mg)	27	45	504.63 ± 148.14

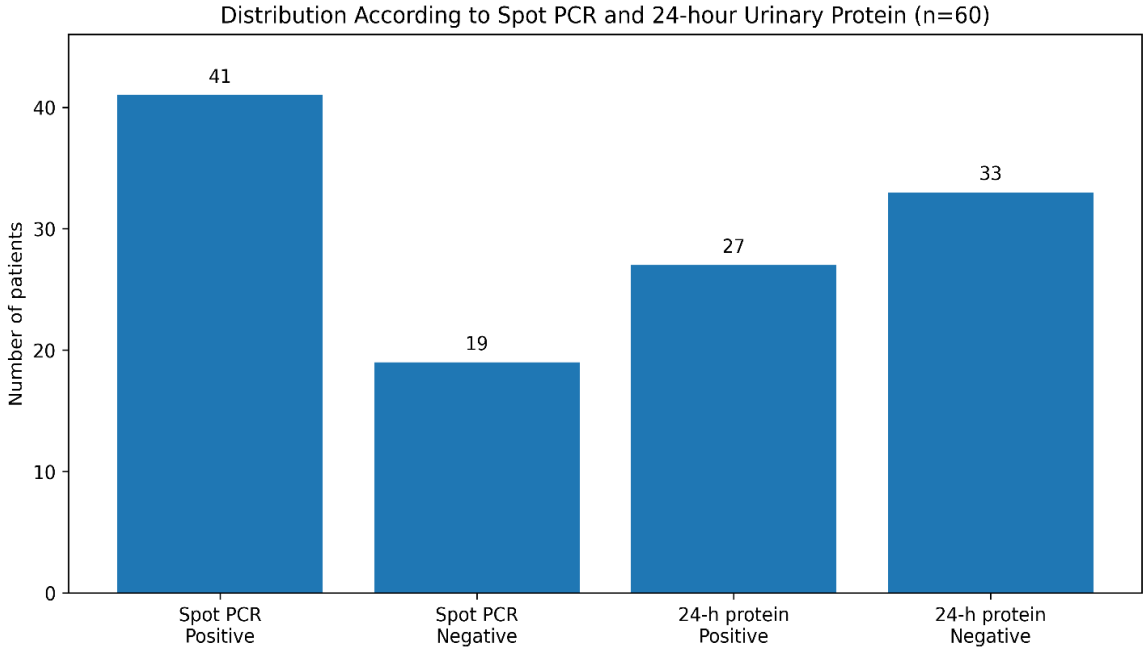

Figure 2: Distribution according to spot PCR and 24-hour Urinary protein (n=60)

Interpretation: Spot PCR identified significant proteinuria in 41 (68.33%) women, compared with 27 (45.0%) identified by 24-hour urinary protein estimation. Mean Spot PCR was 1.00 ± 0.60 among positive cases, whereas the mean 24-hour urinary protein concentration among positive participants was 504.63 ± 148.14 mg. The higher proportion of positive results obtained through Spot PCR emphasizes its potential clinical usefulness as a rapid proteinuria assessment method, while maintaining direct comparison with the conventional 24-hour collection technique.

Table 3: Distribution of Maternal Complications among Affected Women (n = 11)

Maternal complication	N	Percentage (%)
Abruption	6	54.55
Elevated liver enzymes	1	9.09
HELLP syndrome	1	9.09
Elevated renal function test	0	0
Pulmonary edema	0	0
Eclampsia	3	27.27
Systemic hypertension	0	0
Neurological symptoms	0	0
Total	**11**	**100**

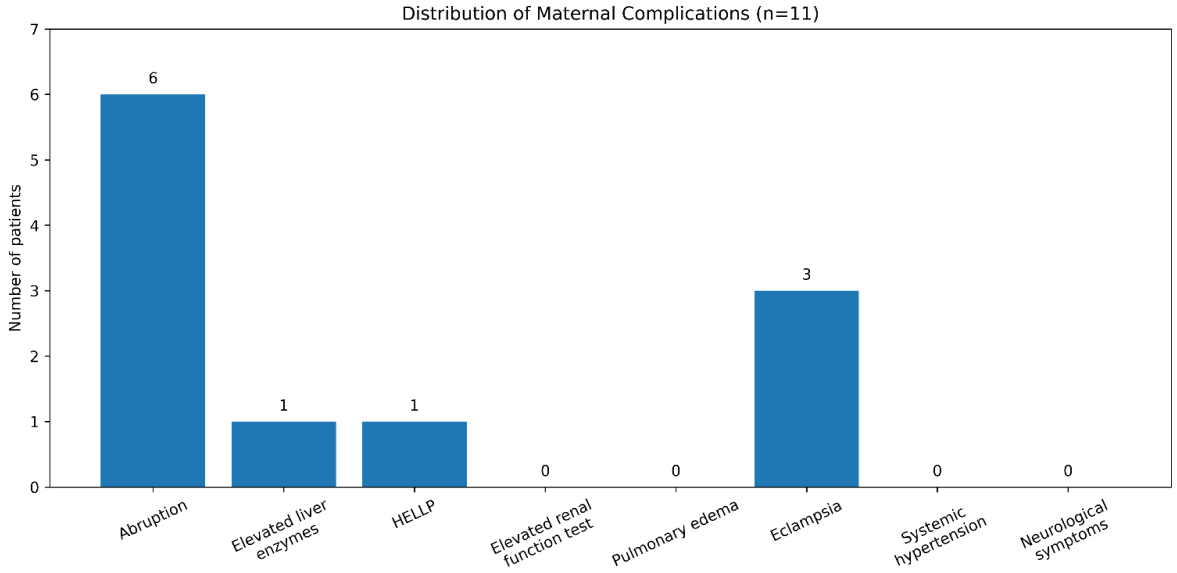

Figure 3: Distribution of maternal complications (n=11)

Interpretation: Maternal complications developed in 18.33% of the study population, while the majority experienced no recorded maternal complication. Among affected women, placental abruption was the predominant event, accounting for 54.55%, followed by eclampsia in 27.27%. Elevated liver enzymes and HELLP syndrome were each noted in 9.09%. The absence of pulmonary edema, neurological complications, and abnormal renal function in this cohort is encouraging and suggests that systematic surveillance and timely obstetric intervention may contribute to limiting severe maternal morbidity.

Table 4: Distribution of Fetal Complications among Affected Pregnancies (n = 46)

Fetal outcome	**N**	**Percentage (%)**
Intrauterine death (IUD)	7	15.22
Preterm birth	22	47.82
Intrauterine growth restriction (IUGR)	7	15.22
Fetal distress	7	15.22
Small for date	3	6.52
Total	**46**	**100**

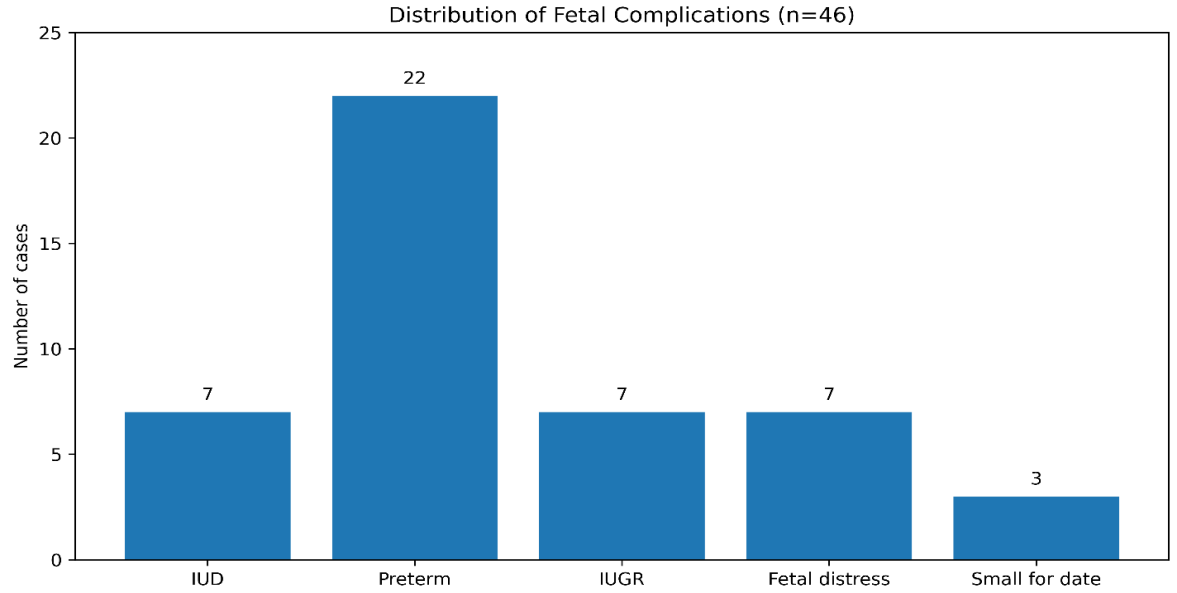

Figure 4: Distribution of fetal complications (n=46)

Interpretation: Fetal complications were observed in a substantial proportion of pregnancies, emphasizing the considerable perinatal burden associated with pre-eclampsia. Preterm birth was the most common complication, occurring in 22 (47.82%) affected pregnancies. IUD, IUGR, and fetal distress each accounted for 15.22%, while 6.52% were small for gestational date.

These findings reinforce the importance of close fetal surveillance, timely assessment of maternal disease severity, and appropriately planned delivery to improve neonatal outcomes in women affected by pre-eclampsia.

Table 5: Diagnostic Performance of Spot PCR Compared with 24-Hour Urinary Protein for Maternal and Fetal Outcome (n = 60)

Outcome / Diagnostic statistic	Spot PCR (%)	24-hour Urinary Protein (%)
Maternal complications		
Sensitivity	54.55	54.55
Specificity	28.57	57.14
Positive Predictive Value	14.63	22.22
Negative Predictive Value	73.68	84.85
Accuracy	33.33	56.67
Fetal complications		
Sensitivity	**71.74**	47.83
Specificity	42.86	**64.29**
Positive Predictive Value	80.49	**81.48**
Negative Predictive Value	**31.58**	27.27
Accuracy	**65**	51.67

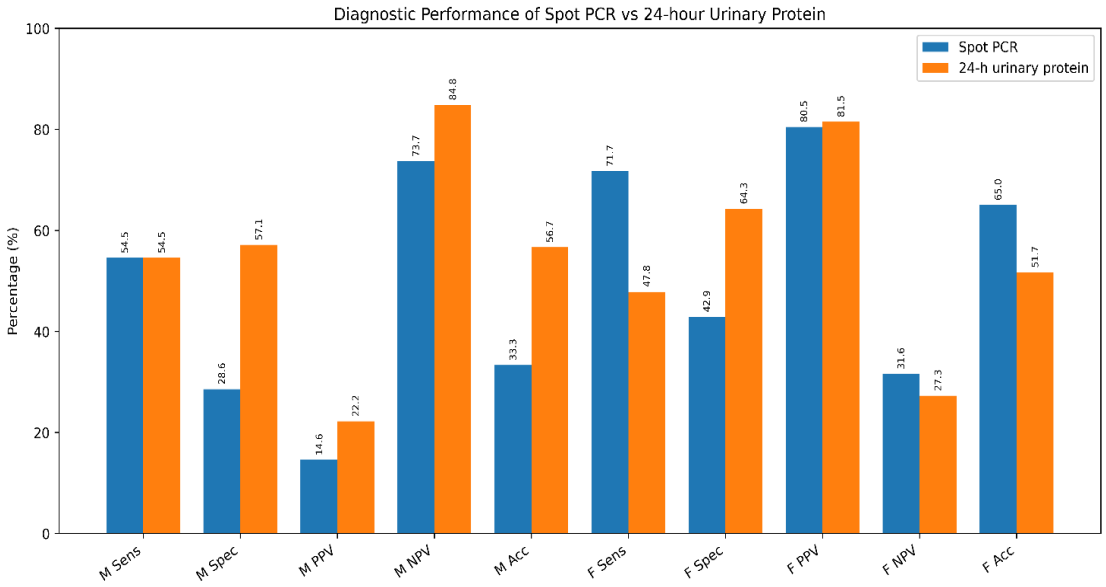

Figure 5: Diagnostic performance of spot PCR vs 24-hour urinary protein

Interpretation: Diagnostic comparison demonstrated complementary performance between the two proteinuria assessment methods. For maternal complications, 24-hour urinary protein showed greater specificity, negative predictive value, and overall accuracy, while sensitivity was identical for both tests. Importantly, for fetal complications, Spot PCR demonstrated substantially higher sensitivity (71.74%) and overall accuracy (65.0%) than 24-hour urinary protein (47.83% and 51.67%, respectively). This favorable fetal-outcome performance, together with rapid availability, supports the clinical usefulness of Spot PCR for early risk assessment in pre-eclampsia.

Discussion

The present study evaluated the clinical utility of spot urine protein/creatinine ratio (UPCR) in women with pre-eclampsia and compared its performance with 24-hour urinary protein estimation, while also examining maternal and fetal outcomes. Pre-eclampsia is a complex multisystem disorder in which abnormal placentation, systemic inflammation, endothelial dysfunction, and vascular injury contribute to disease progression.

Maternal inflammatory states and vascular susceptibility have been linked with increased risk of pre-eclampsia, supporting the concept that the disorder results from interacting maternal and placental mechanisms. [22,23]

In the present cohort, the majority of women were young and primigravida, and a substantial proportion developed fetal complications. These findings are consistent with the established understanding that pre-eclampsia can adversely affect both maternal and placental circulation, leading to complications such as abruption, eclampsia, preterm birth, fetal growth restriction, and fetal distress. [24-26] The observed predominance of preterm birth among fetal complications further emphasizes the significant perinatal burden associated with hypertensive disorders of pregnancy.

Proteinuria in pre-eclampsia reflects renal endothelial injury and altered glomerular permeability. Endothelial activation, oxidative stress, antiangiogenic imbalance, and circulating vasoactive mediators are central to the pathophysiology of the disease and can contribute to progressive maternal organ dysfunction. [27-29] In this study, spot UPCR identified proteinuria in a greater proportion of women than 24-hour urinary protein estimation and demonstrated higher sensitivity and overall accuracy for fetal complications. This finding is clinically encouraging because spot UPCR provides a rapid assessment without the delay and inconvenience associated with prolonged urine collection.

Although 24-hour urinary protein showed relatively better specificity and negative predictive value for maternal complications, spot UPCR offered practical advantages and useful discriminatory performance for fetal outcomes. Taken together, the findings support the role of spot UPCR as a convenient adjunct for early risk assessment in pre-eclampsia. Its rapid availability may facilitate timely obstetric decision-making, closer fetal surveillance, and prompt intervention in women at increased risk of adverse fetomaternal outcomes.

Implications for Clinical Practice: Spot urine protein/creatinine ratio offers a rapid, convenient, and clinically useful approach for assessing proteinuria in women with pre-eclampsia. Its favorable sensitivity for fetal complications may facilitate early risk stratification, closer fetomaternal surveillance, and timely obstetric intervention, reducing dependence on prolonged 24-hour urine collection and supporting efficient clinical decision-making.

Limitations: The present study was limited by its relatively small sample size of 60 participants and single-centre design, which may restrict the generalizability of the findings. The observational nature of the study limits assessment of causal relationships. Variations in urine collection and laboratory measurements may also influence proteinuria estimation. Furthermore, the study primarily evaluated short-term fetomaternal outcomes without extended postpartum or neonatal follow-up. Larger multicentric studies with diverse populations and longitudinal assessment are warranted to validate these findings further.

Conclusion

The present study demonstrates that the spot urine protein/creatinine ratio is a rapid, convenient, and clinically useful method for assessing proteinuria in women with pre-eclampsia. Spot UPCR identified proteinuria in a substantial proportion of participants and demonstrated higher sensitivity and overall accuracy than 24-hour urinary protein estimation for predicting fetal complications. Preterm birth emerged as the predominant fetal complication, while placental abruption was the most frequent maternal complication. Although 24-hour urinary protein showed better specificity for certain outcomes, spot UPCR offers important practical advantages. Its incorporation into clinical practice may facilitate timely assessment, closer surveillance, appropriate risk stratification, and improved fetomaternal management.

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