



Original Article

Diagnostic Accuracy of Spot Urine Protein-Creatinine Ratio for Pre-Eclampsia among Females Presented to Tertiary Level Hospital with Pregnancy-Induced Hypertension

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ABSTRACT

Preeclampsia is main cause of fetal, maternal and newborn death globally, particularly in low- and middle-income nations. It's usually diagnosed when a pregnant woman shows indicators of hypertension and proteinuria. **Objective:** To determine diagnostic accuracy of spot urine protein-creatinine ratio (P/C ratio) for pre-eclampsia in females presenting with pregnancy induced hypertension, using 24-hour urine protein as gold standard, and to look for a correlation between spot urine P/C ratio and 24-hour urine protein. **Methods:** This was cross sectional study carried out at Department of Obstetrics and Gynecology, Sughra Shafi Medical Complex, Narowal from February 2024 to August 2024. 451 pregnant females after 20 weeks till delivery were admitted through OPD in ward. Simple Random sampling technique was used to collect data. All information was recorded through pre-designed Proforma regarding 24-hour urine collection and spot urine to P/C ration. Data were entered and analyzed by SPSS version 23.0. Spearman's rank correlation coefficient was used to evaluate the relationship between the spot urine P/C ratio and 24-hour urine protein. A p-value <0.05 was considered statistically significant. **Result:** Spearman's correlation showed a strong positive correlation ($r=0.82$, $p<0.05$) between 24-hour protein and spot urine P/C ratio. Moreover, results showed a specificity of 87.8% (83.6%-91.9%), and sensitivity of 97.2% (94.9%-99.4%) based on clinical thresholds for proteinuria. **Conclusions:** The findings showed that urine P/C ratio might replace 24-hour urine protein for detecting proteinuria in preeclampsia. Additionally, it is a standardize, easy to execute and straightforward test and affordable with no requirement of systematic hospitalization.

INTRODUCTION

Approximately 5-8% of pregnancies are affected by pre-eclampsia, a hypertensive disorder [1]. It remains one of the leading cause of fetal and maternal morbidity and mortality around the globe [2, 3]. Pre-eclampsia, if not promptly diagnosed and managed, may result in serious complications, including intrauterine growth restriction, placental abruption, and progression to eclampsia, a life-

threatening condition involving seizures [4]. Accurate and timely diagnosis of pre-eclampsia is extremely critical in ensuring maternal and fetal well-being. The traditional gold standard test to diagnose proteinuria, a key diagnostic criterion for pre-eclampsia, is 24-hour urine collection test [5]. This process is very accurate but time-consuming, burdensome, and often impractical for use in busy clinical



settings [6]. Substantial compliance challenges are faced by the patients. To address these limitations, a faster and simpler diagnostic methods such as spot urine P/C ratio have been explored [7]. P/C ratio that involves measuring protein and creatinine concentration within a single sample spot urine, normalizing the level of protein to creatinine to account for changes in the urine concentration [8, 9]. It provides a reliable estimate of daily protein excretion and offers a very suitable substitute to 24-hour urine collection test. Several studies investigated the accuracy of the diagnostic P/C ratio to predict significant proteinuria in pregnant women, but the results have been varied across clinical context and populations [10]. However, this method shows promise as a fast and non-invasive tool for the identifying pre-eclampsia in women with Pregnancy-Induced Hypertension (PIH) [11]. PIH is characterized by elevation of blood pressure in pregnancy without any previous history hypertension [12]. While PIH may resolve postpartum, it can pose a substantial risk of progressing to pre-eclampsia. Thus, it is crucial to detect pre-eclampsia early on in hypertensive pregnant women to prevent any adverse outcomes [13]. There is growing interest to evaluate the diagnostic precision of the P/C ratio as a dependable alternative to the 24-hour urine collection, given the clinical importance of identifying pre-eclampsia early on in women with PIH [14]. If proven to be effective, it could enhance the efficiency of pre-eclampsia diagnosis and enable timely intervention, reducing the burden of complications [15].

This study aimed to assess and evaluate the diagnostic accuracy of the spot urine P/C ratio to detect pre-eclampsia in hypertensive women induced by pregnancy. By comparing the P/C ratio to the traditional 24-hour urine collection method, sought to determine its utility as a screening tool for an early and efficient diagnosis of pre-eclampsia in clinical settings.

METHODS

This cross sectional study was carried out at Department of Gynecology and Obstetrics, Sughra Shafi Medical Complex, Narowal from February 2024 to August 2024. Study Population was pregnant females after 20 weeks till delivery were admitted through OPD in ward of Gynecology and Obstetrics, Sughra Shafi Medical Complex, Narowal. Simple random sampling technique was used to take data. Sample size of 451 females was collected using www.raosoft.com with the confidence level 99% and margin of error 5%. All females with age of 16-35 years having 1st time hypertension during pregnancy with Gestational age >20weeks (through LMP) and singleton pregnancy (through USG). PIH (BP \geq 140/90mmHg) having suspicion of pre-eclampsia (PIH + proteinuria \geq +1 on dipstick) were included in study. While females with history of tuberculosis, Diabetes Mellitus (BSR >180mg/dl),

Deranged LFTs (ALT > 40IU, AST > 40IU), Renal insufficiency (serum creatinine >1.2mg/dl), Chronic hypertension (through history and medical record or PIH before 20 weeks of gestation) and with history of urinary tract infection (detect from urine test) were excluded from study. After taking approval from the ethical review board (Ref: SMC/0108), 451 patients meeting the inclusion requirements were admitted from the OPD in ward of Gynecology and Obstetrics, Sughra Shafi Medical Complex, Narowal. Informed consent was taken from all participants. The descriptive data of subjects including sex, age, BMI, height and weight were obtained. 24-hour urine was collected from all patients. Patients were given instructions regarding collection of on-time spot urine on the next day after the 24-hour urine collection in hospital-provided sterile containers. Instructions were given to patients regarding proper sample collection to avoid contamination. Both spot urine and 24-hour samples were analyzed on same day in the hospital laboratory to ensure sample integrity. The analyses were performed using a fully automated biochemical analyzer. Creatinine concentration was determined using the Jaffe kinetic method (Roche) while protein concentration was measured using the immunoturbidimetric method (Roche). P/C ratio was calculated using formula: P/C ratio = Spot Urine Protein (mg) / Spot Urine Creatinine (mmol). All this data was taken through pre designed Proforma. Data were entered and analyzed by using SPSS version 23.0. Mean \pm S.D was used for quantitative variables like age, height, weight, BMI, spot urine and 24-hour urine P/C ratio. Frequency and percentage were calculated for status (positive or negative) of spot and 24 hour's urine P/C ratio. To show correlation between the spot urine P/C ratio and 24-hour urine total protein Spearman's rank correlation coefficient was used to evaluate the relationship between the spot urine P/C ratio and 24-hour urine protein. The p-value for statistical significance was established at $p < 0.05$. Specificity and Sensitivity were calculated to check the diagnostic performance of the spot urine P/C ratio in identifying substantial proteinuria. A 24-hour urine protein excretion >0.3 g/day and spot urine P/C ratio >30 mg/mmol was considered indicative of significant proteinuria.

RESULTS

Table 1 showed descriptive statistics of subjects. The mean maternal age was 31-years (range: 17-35 years), showing diversity in age group. The average BMI of females was 28.2kg/m², suggestive of being overweight, which may highlight an underlying risk factor for pre-eclampsia in this population. The mean gestational age at time of assessment was around 33.4 weeks. It demonstrates that study population was focused on women in third trimester of pregnancy.

Table 1: Descriptive Statistics of Subjects

Variables	Mean ± SD	Median (Min-Max)
Mother Age (Years)	31.0 ± 8.2	30 (17-35)
Body Mass Index (BMI)	28.2 ± 7.7	28 (24-30)
Gestational Age (Weeks)	33.4 ± 8.7	33 (32-34)

Table 2 summarized data on urine protein analysis. The median spot urine P/C was 25 mg/mmol with broad range (0-105 mg/mmol). Likewise, the median of 24-hour urine protein was 1.4 g/day (range: 0.3-10.95 g/day). These findings in proteinuria levels among the pregnant females suggested varying severity of pre-eclampsia, emphasizing importance of accessible and reliable diagnostic tool.

Table 2: Descriptive Statistics of Urine Analysis

Variables	Median (Min-Max)
Spot Urine P/C Ratio (mg/mmol)	25 (0-105)
24 Hour Urine Protein (g/Day)	1.4 (0.30-10.95)

Table 3 classified participants based on proteinuria status using spot and 24-hour urine tests. Spot urine protein tests classified 47.7% as positive, while 52.3% were negative closely aligning with 24-hour urine results i.e. 47.2% negative and 52.8% positive. These results showed that the spot urine P/C ratio closely supports results of 24-hour urine collection, confirming its possibility as an alternative diagnostic mean.

Table 3: Urine Protein Quantification

Variables	Category	Median (Min-Max)
Spot Urine Protein (mg/mmol)	Positive	215 (47.7%)
	Negative	236 (52.3%)
24-Hour Urine Analysis (g/Day)	Positive	238 (52.8%)
	Negative	213 (47.2%)

Sensitivity that is aptitude to spot true positives of the spot urine test was 97.2% (94.9%–99.4%), means it correctly identifies 97.2% of cases with proteinuria. The specificity which is ability to detect true negatives was 89.9% (83.6%–91.9%), showing that it successfully ruled out proteinuria in 89.9% of cases. The positive predictive value which is probability that positive result is truly positive was 87.7%, while negative predictive value that is probability that a negative result is truly negative was 97.2%. The accuracy of the test was 92.2%, representing that the spot urine protein-to-creatinine ratio is very effective diagnostic tool (Table 4).

Table 4: Specificity, Sensitivity, Positive and Negative Predictive Value and Accuracy

Variables	Category	Frequency (%)
-	True Positive (TP)	207 (45.9%)
	False Positive (FP)	29 (6.5%)
	False Negative (FN)	6 (1.3%)
	True Negative (TN)	209 (46.3%)
Sensitivity	TP/(TP + FN)	207/(207 + 6) = 97.2

Specificity	TN/(TN + FP)	209/(209 + 29) = 89.9
Positive Predictive Value	TP/(TP + FP)	207/(207 + 29) = 87.7
Negative Predictive Value	TN/(TN + FN)	209/(209 + 6) = 97.2
Accuracy	(TP+TN)/(TP + TN + FP + FN)	(207 + 209)/(207+ 209+29+6) = 92.2

Table 5 showed that there is positive correlation between the spot urine P/C ratio and the 24-hour urinary protein, (r=0.82, p<0.05). This strong correlation coefficient shows that the spot urine test aligns well with the results of 24-hour urine test in detecting proteinuria. So it supported use of spot urine P/C ratio as a diagnostic alternate for diagnosing significant proteinuria.

Table 5: Correlation between P/C Ratios Versus 24 hours Urinary Protein

Variables	Correlation Co-Efficient	p-Value
P/C Ratio Versus 24 hour Urinary Correlation	r = 0.82 (Strong Positive Correlation)	<0.05

DISCUSSION

The present study results reported the efficacy of spot urine P/C ratio in diagnosing pre-eclampsia, demonstrating a significant correlation (r=0.82) with 24-hour urine protein test. The median value of P/C ratio in current cohort was reported as 25 (0-105mg/mmol), reflecting a significant prevalence of proteinuria. Mdunge and Baloyi in 2021 carried out a prospective cross-sectional study and highlighted that spot urine P/C ratio is an effective alternative for 24-hour proteinuria with a correlation coefficient of r=0.74(p<0.001). However, cut-off of 30mg/mmol and area under curve (AUC=0.8506) propose produces lower sensitivity of 81.4% and specificity of 77.7% compared to our findings. These variations may be due to population differences in clinical threshold. Though, it is concluded that spot urine P/C ratio shortens hospital stays and speed up treatment commencement, the lower specificity reported warrants caution in interpreting borderline results [16]. A study conducted by Talukdar DS et al., in 2023 revealed that there was a significant association between abnormal serum lipid levels and higher P/C ratio values in females with gestational hypertension compared to pregnant females with normal blood pressure. The findings of present study showed that 52.8% of the participants tested positive for 24-hour urine protein test but did not find its association with serum lipid levels. Thus, their findings showed that serum lipid indicators such as cholesterol and triglycerides exhibited unique patterns in patients with gestational hypertension besides raised P/C ratio values. This suggest an opportunity for future research to check these biomarkers along with P/C ratio to improve precision and prognostic value in PIH [17]. In present study a sensitivity of 97.2% closely aligns with findings from Nyota PK et al., (96.6%) however specificity (89.9%) was slightly lower than

Nayota PK et al., at optimum threshold of 30.8mg/mmol. The low specificity in present study might highlight differences in proteinuria severity. Thus, it is established P/C ratio's role in reducing diagnostic delays and improving results, predominantly in developing countries with economic constraints [18]. Tian M et al., carried out a study in 2021 to evaluate the PCR test diagnostic accuracy in detecting severe proteinuria in pre-eclamptic females. The findings of their study demonstrated significant correlation ($r = 0.802$, $p < 0.001$). The overall results support the use of the P/C ratio to predict clinically significant proteinuria in outpatient settings, even though the correlation was weak in cases with proteinuria < 300 mg ($r = 0.69$, $p = 0.044$). This method reduces unnecessary hospitalizations while offering a useful and less burdensome alternative to 24-hour urine collection. It also gives important information for monitoring renal function in pre-eclamptic women [19]. Similarly, cross-sectional study was carried out in 2021 by Bindu, which highlighted strong correlation ($r = 0.7$, $p < 0.001$), slightly lower than these results ($r = 0.82$, $p < 0.05$). Moreover, the findings of this study endorse the use of spot urine P/C ratio test as a quick, easy, valid, and time-efficient alternate for laborious 24-hour urine protein test, specifically in nations such as India where there is high patient to staff ratio [20]. Furthermore, the results of the present study demonstrated that in participants the value of median 24-hour urine protein was 1.4g/day; whereas, the median value of P/C ratio was found to be 25 mg/mmol. Kamińska J et al., conducted a systematic review in 2020 to estimate the diagnostic value of the spot P/C ratio test regarding spectrum of clinical diseases, like kidney disease, hypertension, gestational hypertension, and preeclampsia. Their outcomes exhibited a significant correlation between the two tests, accentuating reliability and efficacy of spot urine P/C ratio. The recommended values of cut point such as 30 mg/mmol are crucial for precise diagnosis of preeclampsia. However, 24-hour urine protein test is gold standard test in doubtful cases as it increases the efficacy of patient care by accurately diagnosing proteinuria [14]. DEĞER SM et al., carried out a study in 2023 reinforced spot urine P/C ratio validity and correlation with 24-hour urine protein [21]. Furthermore, they reported that this test in simple, quick, valid and convenient substitute of 24-hour urine protein test which is laborious and time consuming. Hence, their study mirrors our results further validating its reliability. The findings of this study have significant implications for clinical practice. The spot P/C ratio offer rapid and cost-effective choice mainly in resource limited settings. Moreover, Spot urine P/C ratio testing can aid in timely diagnosis, enabling early intervention and management of pre-eclampsia. Additionally, integrating P/C ratio with other biomarkers, such as lipid profiles, could improve

diagnostic accuracy and offer a more comprehensive assessment of PIH risk.

CONCLUSIONS

In conclusion, these results showed that the spot urine P/C ratio is a highly specific, sensitive, and accurate method for diagnosing proteinuria in pre-eclampsia. Spot urine P/C ratio's strong correlation with 24-hour urine protein and high diagnostic accuracy makes it an effective alternative in both resource-rich and resource-limited settings.

Authors Contribution

Conceptualization: AA

Methodology: AA

Formal analysis: SA

Writing, review and editing: AK, MH, AH, SC, MN

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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