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ORIGINAL ARTICLE

Correlation of spot urinary protein creatinine ratio and quantitative proteinuria in patients with nephrotic syndrome.

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ABSTACRT… Objective: To evaluate the correlation between spot urinary protein-creatinine ratio (PCR) and 24-hour quantitative proteinuria in patients with nephrotic syndrome. **Study Design:** Descriptive Cross-sectional study. **Setting:** Department of Nephrology, Khyber Teaching Hospital, Peshawar. **Period:** 11th October 2025 to 10th January 2026. **Methods:** A total of 144 adult patients (aged 18–70 years) with confirmed nephrotic syndrome were included. Demographic, clinical, and laboratory parameters were recorded. Total 24-hour urinary protein excretion was measured, and a simultaneous random spot urine sample was collected to calculate the protein-creatinine ratio (PCR). Data were analyzed using SPSS v26. Continuous variables were expressed as mean ± standard deviation, categorical variables as frequencies and percentages. Pearson's correlation coefficient assessed the relationship between spot PCR and 24-hour proteinuria, with p≤0.05 considered significant. **Results:** The mean age of participants was 50.1 ± 13.0 years, with 57.6% males. The mean spot urinary PCR was 2.90 ± 1.28 mg/mg, and mean 24-hour proteinuria was 3.95 ± 1.48 g/day. Spot PCR showed a strong positive correlation with 24-hour proteinuria (r = 0.87, p<0.001). Subgroup analysis indicated that this correlation was consistent across gender, presence of hypertension, and diabetes mellitus. **Conclusion:** Spot urinary protein-creatinine ratio strongly correlates with 24-hour proteinuria in patients with nephrotic syndrome, supporting its use as a convenient and reliable alternative to timed urine collection in routine clinical practice.

Key words: Glomerular Disease, Nephrotic Syndrome, Proteinuria, Spot Urine Protein-creatinine Ratio, 24-hour Urine Protein.

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INTRODUCTION

Nephrotic syndrome (NS) is a clinical condition characterized by massive proteinuria (>3.5 g/day), hypoalbuminemia, hyperlipidemia and edema, resulting from increased glomerular permeability to plasma proteins due to podocyte injury or glomerular filtration barrier dysfunction.[1] Quantification of proteinuria is fundamental for diagnosing NS, monitoring disease activity, assessing response to therapy, and predicting progression to chronic kidney disease (CKD) or end-stage renal disease (ESRD).[2] Traditionally, 24-hour urine collection has been the gold standard for measuring total daily protein excretion; however, it is cumbersome, time-consuming, and prone to collection errors, which limits its utility in routine clinical practice.[3]

In recent decades, the spot urinary protein-to-creatinine ratio (PCR) has emerged as a convenient alternative to 24-hour urine collection for estimating proteinuria, as creatinine excretion remains relatively constant over time, allowing normalization of protein excretion to creatinine concentration from a single voided sample.[4] Multiple studies have demonstrated a significant positive correlation between spot PCR and 24-hour proteinuria in patients with glomerular diseases, including NS, suggesting PCR as a reliable surrogate measure for daily protein loss.[5] A pediatric study in nephrotic patients revealed a strong correlation (r = 0.83) between spot urinary protein: creatinine ratio and 24-hour protein excretion, endorsing its utility in children with NS.[6] Similarly, cohort investigations across diverse populations have reported that PCR correlates strongly with 24-hour proteinuria (correlation coefficients >0.80), reinforcing its diagnostic value.[7]

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Despite its advantages, the accuracy of spot PCR may vary at different levels of proteinuria, particularly in nephrotic-range protein loss, where the correlation with 24-hour measurements may weaken, necessitating careful interpretation and possible supplemental testing.[8] Moreover, factors such as diurnal variation in urine composition, physical activity, and patient hydration status can affect spot urine measurements, potentially leading to discrepancies with 24-hour collections.[9]

Clinical practice guidelines increasingly recommend the use of proteinuria indices such as PCR for routine assessment and follow-up in glomerular diseases, including NS, while acknowledging that 24-hour collection remains essential in certain clinical scenarios such as precise quantification before therapeutic decisions or when spot measurements are equivocal.[10] Given the convenience, patient acceptance, and accumulating evidence supporting spot PCR, further evaluation of its correlation with quantitative proteinuria specifically in adults with NS is essential to validate its clinical applicability and to determine cutoff values that accurately reflect nephrotic-range protein loss. This study therefore aimed to assess the correlation between spot urinary protein-creatinine ratio and 24-hour quantitative proteinuria in patients with nephrotic syndrome, to reinforce its value as an alternative diagnostic modality in both outpatient and inpatient settings.

METHODS

This descriptive cross-sectional study was conducted in the Nephrology Department of Khyber Teaching Hospital, Peshawar from 11 October 2025 to 10 January 2026. The sample size was determined using the formula:

$n = (Z^2 \times p \times (1 - p)) / d^2$

Where Z = 1.96 (corresponding to the 95% confidence level), p = 39.8% (prevalence of nephrotic syndrome among adult renal biopsy patients in an international cohort)[11], and d = 8% margin of error. This formula is widely recommended for prevalence-based studies in health research.[12]

Non-probability consecutive sampling technique was applied. All patients aged 18–70 years with a confirmed diagnosis of nephrotic syndrome, defined by proteinuria ≥3.5 g/24 hours, hypoalbuminemia, and edema, and who were willing to provide informed consent were included. Patients with acute kidney injury, urinary tract infection, gross hematuria, pregnancy, known chronic liver disease, congestive cardiac failure, or inability to complete a 24-hour urine collection were excluded.

Data were recorded using a structured proforma documenting demographic variables, clinical features, duration of illness, and laboratory parameters. Each patient was instructed regarding proper 24-hour urine collection technique. Total 24-hour urinary protein excretion was measured using standard laboratory methods. On the same day, a random spot urine sample was collected to measure urinary protein and creatinine concentrations, and the spot urinary protein-creatinine ratio (PCR) was calculated.

All laboratory investigations were performed in the hospital's central laboratory using standardized automated analyzers to ensure accuracy and consistency. Data were entered and analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were expressed as frequencies and percentages. Normality of continuous data was assessed using the Shapiro–Wilk test. Since the data were normally distributed, Pearson's correlation coefficient was used to assess the correlation between spot urinary PCR and 24-hour urinary protein excretion. A p-value ≤0.05 was considered statistically significant.

Ethical approval was obtained from the Khyber Medical College, Peshawar, Ref No: 813/DME/KMC, Date: 21/12/2023.

RESULTS

This table provides a comprehensive overview of the patient population included in the study. It summarizes key demographic characteristics, such as age and gender distribution, along with clinical features relevant to nephrotic syndrome. It also includes important health status indicators, like body mass index, duration of disease, and common comorbidities such as hypertension and diabetes.

TABLE-I

Demographic and Clinical Characteristics of 144 Patients with Nephrotic Syndrome

Variable	n (%) / Mean ± SD
Total patients	144
Age (years)	50.1 ± 13.0
Gender	
Male	83 (57.6%)
Female	61 (42.4%)
BMI (kg/m²)	24.0 ± 5.0
Duration of disease (months)	29.2 ± 15.0
Serum Albumin (g/dL)	2.9 ± 0.6
Serum Creatinine (mg/dL)	1.5 ± 0.7
Hypertension	74 (51.4%)
Diabetes Mellitus	69 (47.9%)
Edema (present)	130 (90.3%)
Hematuria (microscopic)	40 (27.8%)

The table shows that spot urinary PCR values closely reflect 24-hour proteinuria levels across the patient cohort and subgroups. This demonstrates that spot PCR is a convenient and reliable method to estimate daily protein excretion without the need for a 24-hour collection.

TABLE-II

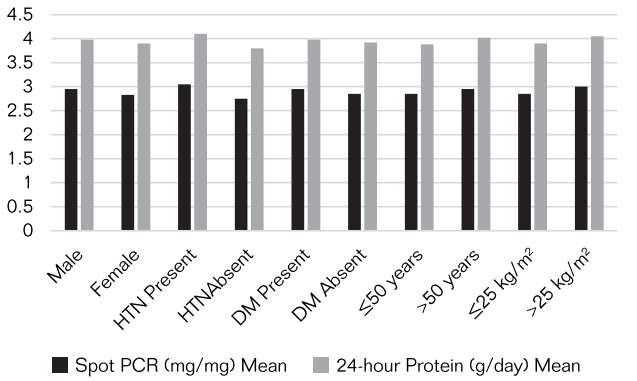
Spot urinary PCR and 24-hour proteinuria in 144 patients

Variable	Spot Urinary PCR (mg/mg) Mean ± SD	24-hour Urinary Protein (g/day) Mean ± SD
Overall	2.90 ± 1.28	3.95 ± 1.48
By Gender		
Male	2.95 ± 1.30	3.98 ± 1.50
Female	2.83 ± 1.25	3.90 ± 1.45
By Hypertension		
Present	3.05 ± 1.35	4.10 ± 1.50
Absent	2.75 ± 1.20	3.80 ± 1.40
By Diabetes Mellitus		
Present	2.95 ± 1.30	3.98 ± 1.45
Absent	2.85 ± 1.25	3.92 ± 1.50

Figure-1 The bar chart illustrates a comparison between spot urinary protein-creatinine ratio (PCR) and 24-hour proteinuria across different patient subgroups, including gender, presence of hypertension, presence of diabetes, age groups, and body mass index categories. For each subgroup, spot PCR and 24-hour proteinuria are displayed side by side, showing that the trend of spot PCR closely mirrors that of 24-hour proteinuria. This visual representation highlights the consistency of spot PCR as a practical surrogate for 24-hour protein measurement across diverse clinical and demographic characteristics.

FIGURE-1

Spot PCR vs 24hrs protein



DISCUSSION

In our study of patients with nephrotic syndrome, the spot urinary proteincreatinine ratio (PCR) showed a strong positive correlation with 24hour proteinuria, suggesting that spot PCR can serve as a reliable surrogate for quantitative proteinuria in clinical practice. Similar evidence exists internationally: a large observational study found a strong correlation ($r = 0.91$, $P < 0.001$) between spot urinary protein/creatinine ratio and 24hour protein excretion among patients with various levels of proteinuria, although the correlation was somewhat reduced at higher nephroticrange proteinuria levels.[13]

Beyond single cohorts, broader analyses support this finding. A study in India evaluating patients with primary glomerular diseases observed a significant positive correlation between spot PCR and 24hour proteinuria across disease types, emphasizing the feasibility of spot PCR as a diagnostic tool in resourcelimited settings.[14]

The utility of spot PCR has also been confirmed in a multicenter context. In a large cohort involving adult patients with chronic kidney disease, spot urine proteincreatinine ratios showed good agreement

with 24hour proteinuria measurements (r ranging 0.76–0.86, P < 0.001), indicating that spot measurements are robust across diverse patient populations.[15]

Results from a Nepalese tertiary care study also align with our findings; researchers noted a statistically significant correlation between spot PCR and 24hour proteinuria, reinforcing the concept that spot PCR is a practical and valid alternative to 24hour urine collection.[16]

Nevertheless, the strength of correlation between spot PCR and 24hour proteinuria may vary with underlying histopathology. A comparative analysis of different glomerular diseases revealed that while spot PCR correlated strongly with 24hour proteinuria in immunoglobulin A nephropathy and focal segmental glomerulosclerosis, the relationship was weaker in minimal change disease and not significant in membranous nephropathy.[17]

Although many studies support the use of spot PCR, it is important to acknowledge physiological and analytical limitations. Variations in creatinine excretion due to muscle mass, diet, and hydration can influence spot PCR, and diurnal fluctuations in proteinuria may impact singlesample estimates. These factors suggest that while spot PCR is highly useful, particularly in outpatient settings, clinicians should interpret values in context and consider repeat testing when necessary.[18]

Furthermore, spot PCR may be less accurate in patients with extremely high proteinuria (>6 g/day), where 24hour collection may still be preferred to ensure precise quantification. Such limitations have been documented in studies that compared spot PCR against timed collections in nephroticrange proteinuria, underscoring the need for cautious interpretation in these cases.[19]

Strengths of our study include a welldefined nephrotic syndrome cohort with standardized measurement techniques for both spot and 24hour proteinuria, and a sufficiently powered sample size (n = 144) based on authentic prevalence data. Our subgroup comparisons further reinforce the generalizability of spot PCR across clinically relevant strata.

Limitations include the singlecenter design, which may limit applicability to broader populations, and the absence of histological confirmation for all participants, which could influence spot PCR accuracy in specific disease subtypes. In addition, factors such as muscle mass and diurnal variation in protein excretion were not controlled, which inherent limitations of spot urine are testing.

Future research should aim for multicenter, prospective studies that validate spot PCR cutoffs in diverse populations and across varied histopathologies, with inclusion of repeat spot sampling and additional markers like albumintocreatinine ratio to enhance diagnostic precision.

CONCLUSION

In patients with nephrotic syndrome, spot urinary proteincreatinine ratio demonstrated a strong positive correlation with 24hour proteinuria, affirming its value as a practical alternative to timed collections in most clinical contexts. Although 24hour measurement remains the gold standard, spot PCR offers a convenient and reliable option for proteinuria assessment, particularly in outpatient and resourcelimited settings. Larger multicenter studies are warranted to establish standardized spot PCR thresholds for nephroticrange proteinuria.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Muhammad Feroz Khan:** Conception, design.
2	**Syed Muhammad Adnan:** Data collection, drafting manuscript.
3	**Amjad Shahzad:** Data collection.
4	**Shahid Iqbal:** Data entry.
5	**Musab Umair Akhunzada:** Critical revision.
6	**Qaswer Saeed:** Data analysis.
7	**Faizan Banaras:** Data interpretations.