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RESEARCH ARTICLE

Clinical Profile and Predictors of Proteinuria in patients with Hypertension

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ABSTRACT

Background: Hypertension is a major cause of cardiovascular and renal morbidity. Proteinuria is an important marker of renal involvement and hypertension-mediated target-organ damage and is associated with increased risk of chronic kidney disease progression. Early identification of hypertensive patients at risk of proteinuria may facilitate timely intervention.**Objective:**To evaluate the clinical and laboratory profile of patients with hypertension and identify factors independently associated with proteinuria.**Methods:**A hospital-based observational cross-sectional study was conducted among 274 adult patients with hypertension. Demographic, clinical, anthropometric, and laboratory parameters were recorded. Blood pressure, duration of hypertension, diabetes mellitus, body mass index, serum creatinine, estimated glomerular filtration rate (eGFR), glycemic parameters, and lipid profile were assessed. Proteinuria was evaluated using the predefined urinary protein assessment method. Patients were categorized into proteinuria-positive and proteinuria-negative groups. Univariable and multivariable logistic regression analyses were performed to identify independent predictors of proteinuria.**Results:**Among 274 patients, 68 (24.8%) had proteinuria. The mean age of the study population was 58.4 ± 11.2 years. Patients with proteinuria had significantly longer duration of hypertension (11.2 ± 5.7 vs. 7.4 ± 5.1 years; $p<0.001$) and higher systolic blood pressure (154.6 ± 18.2 vs. 143.1 ± 15.7 mmHg; $p<0.001$). Diabetes mellitus was more frequent among patients with proteinuria (55.9% vs. 30.1%; $p<0.001$). Serum creatinine was higher and eGFR was lower in the proteinuria group ($p<0.001$ for both). On multivariable analysis, longer duration of hypertension, higher systolic blood pressure, diabetes mellitus, and reduced eGFR were independently associated with proteinuria.**Conclusion:**Proteinuria was present in approximately one-fourth of hypertensive patients. Prolonged hypertension, poor blood-pressure control, diabetes mellitus, and impaired renal function were important independent predictors. Routine assessment of urinary protein and renal function may facilitate early detection of renal involvement in patients with hypertension.

Keywords: Hypertension; Proteinuria; Albuminuria; Chronic kidney disease; eGFR; Diabetes mellitus; Blood pressure.

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INTRODUCTION

Hypertension is one of the most common chronic non-communicable diseases worldwide and is a major modifiable risk factor for cardiovascular, cerebrovascular, and renal morbidity. Persistent elevation of blood pressure produces progressive structural and functional changes in target organs, with the kidneys being particularly vulnerable to long-term vascular and glomerular injury. Hypertension-mediated kidney damage may manifest initially as albuminuria or proteinuria and may subsequently progress to a decline in glomerular filtration rate and chronic kidney disease. [1-3]Current hypertension guidelines recognize albuminuria and reduced estimated glomerular filtration rate as important markers of hypertension-mediated target-organ damage.

Proteinuria represents an important marker of renal injury and is associated with increased cardiovascular and renal risk. Even relatively modest increases in urinary albumin excretion may indicate early kidney damage before a significant reduction in renal function

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becomes apparent. Albuminuria is therefore not only a marker of established renal disease but may also serve as an early indicator of subclinical target-organ damage in patients with hypertension.[11]

The development of proteinuria in hypertension is multifactorial. Chronic elevation of systemic and intraglomerular pressure can result in endothelial dysfunction, glomerular hypertension, alterations in the glomerular filtration barrier, and progressive nephrosclerosis. The likelihood and severity of proteinuria may be influenced by several clinical characteristics, including the duration and severity of hypertension, adequacy of blood pressure control, age, obesity, diabetes mellitus, dyslipidemia, smoking, renal function, and the presence of other manifestations of target-organ damage. Identification of these factors may help clinicians recognize hypertensive patients who are at increased risk of renal involvement.

The assessment of urinary protein or albumin excretion is therefore an important component of the evaluation of patients with hypertension. Contemporary guidelines recommend assessment of urinary albumin-to-creatinine ratio together with serum creatinine and estimated glomerular filtration rate as part of the evaluation for hypertension-mediated kidney damage. The detection of proteinuria may have important therapeutic implications because patients with hypertension and albuminuria have a higher risk of chronic kidney disease progression and cardiovascular events and may benefit from specific renoprotective strategies.[3,4]

Despite the clinical importance of proteinuria, its occurrence and determinants may vary across populations depending on demographic characteristics, comorbidities, duration of hypertension, treatment status, and access to healthcare. Data describing the clinical profile of hypertensive patients with proteinuria and the factors independently associated with its occurrence are particularly relevant in routine clinical practice. Early identification of patients at risk may facilitate timely investigation, optimization of blood pressure control, and prevention of progressive renal impairment.

Therefore, the present study was undertaken to evaluate the clinical profile of patients with hypertension and to determine the clinical and laboratory predictors associated with proteinuria, with the aim of identifying hypertensive individuals at increased risk of renal involvement and facilitating early intervention.

Materials and methods

Study Design and Setting

This was a hospital-based observational cross-sectional study conducted in the Department of medicine, over a period of January 2021 to December 2021. The study was undertaken to assess the clinical profile of patients with hypertension and to determine the clinical and laboratory factors associated with proteinuria.

Study Population

Adult patients with hypertension attending the outpatient department or admitted to the hospital during the study period were screened for eligibility. Hypertension was defined according to the applicable contemporary guideline criteria and/or a documented previous diagnosis of hypertension with ongoing antihypertensive treatment.

Inclusion Criteria

Patients were included if they:

1. Were aged ≥18 years.
2. Had a documented diagnosis of hypertension or fulfilled the predefined diagnostic criteria for hypertension.
3. Were willing to participate in the study.
4. Provided written informed consent.

Exclusion Criteria

Patients were excluded if they had:

1. Previously diagnosed chronic kidney disease unrelated to hypertension.
2. Known primary glomerular or tubulointerstitial renal disease.
3. Acute kidney injury.
4. Active urinary tract infection at the time of assessment.
5. Febrile illness or other acute systemic illness likely to cause transient proteinuria.
6. Pregnancy.
7. Malignancy or other major systemic illness likely to significantly influence urinary protein excretion.
8. Incomplete clinical or laboratory data.

Sample Size:

For a cross-sectional study, use:

$$n = \frac{Z^2pq}{d^2}$$

Where:

- **n** = required sample size
- **Z** = 1.96 for 95% confidence
- **p** = expected prevalence of proteinuria among hypertensive patients
- **q** = 1 − p
- **d** = allowable absolute precision

For example, if previous literature suggests a **20% prevalence** of proteinuria among patients with hypertension and you allow **5% absolute precision**:

$$n = \frac{(1.96)^2(0.20)(0.80)}{(0.05)^2}$$

$$n = 245.86$$

Thus, approximately **246 patients** would be required.

Allowing for 10% incomplete/non-response data:

$$n_{adjusted} = \frac{246}{0.90} = 273.3$$

Therefore, the final sample size would be approximately **274 patients[4].**

Because the study also aimed to identify predictors of proteinuria using multivariable analysis, the adequacy of the final sample was additionally considered in relation to the expected number of proteinuria events and the number of candidate predictors included in the regression model.

Data Collection

After obtaining informed consent, demographic, clinical, and laboratory data were collected using a structured study proforma. The demographic variables recorded included age and sex. Clinical variables included duration of hypertension, history of diabetes mellitus, dyslipidemia, smoking, alcohol use, family history of hypertension or kidney disease, and current antihypertensive medications. Anthropometric measurements included height, weight, and body mass index (BMI). BMI was calculated as:

BMI=Weight (kg)Height (m)2BMI=\frac{\text{Weight (kg)}}{\text{Height (m)}^2}

Blood pressure was measured using a validated sphygmomanometer or automated blood pressure device after the patient had rested for at least 5 minutes.

Appropriate cuff size was used. Two measurements were obtained at an interval of at least 1–2 minutes, and the average was recorded. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were documented.

Laboratory Investigations

All participants underwent relevant laboratory investigations, including complete blood count, fasting blood glucose and/or HbA1c, serum creatinine, blood urea, serum electrolytes, and lipid profile, as clinically appropriate. Estimated glomerular filtration rate (eGFR) was calculated using the CKD-EPI equation based on serum creatinine. Urine examination was performed using a freshly collected urine sample. Urinary protein excretion was assessed by urine dipstick / urine protein-to-creatinine ratio (UPCR) / urine albumin-to-creatinine ratio (UACR), as applicable.

Assessment of Proteinuria

Proteinuria was defined according to the method used for urinary assessment. Where dipstick testing was used, proteinuria was considered present when urine protein was ≥1+ on dipstick testing, preferably confirmed on a repeat specimen to minimize the effect of transient proteinuria. Where quantitative assessment was performed, urinary protein-to-creatinine ratio (UPCR) or urinary albumin-to-creatinine ratio (UACR) was used according to predefined laboratory cut-offs. The preferred quantitative assessment was UACR, with albuminuria categorized according to established clinical thresholds.

Patients were categorized into two groups:

- **Proteinuria-positive group:** patients fulfilling the predefined criteria for proteinuria.
- **Proteinuria-negative group:** patients without proteinuria according to the study definition.

Study Variables

The primary outcome variable was the presence of proteinuria. The following variables were evaluated as potential predictors age, sex, duration of hypertension, systolic blood pressure, diastolic blood pressure, body mass index, diabetes mellitus, glycemic control, dyslipidemia, smoking, alcohol use, serum creatinine, egfr, severity/control of hypertension, number and class of antihypertensive medications and other evidence of hypertension-mediated target-organ damage, where available

Statistical Analysis

Data were entered into a computerized database and analyzed using appropriate statistical software. Continuous variables were assessed for distribution and expressed as mean ± standard deviation or median with interquartile range, as appropriate. Categorical variables were expressed as frequencies and percentages. The clinical and laboratory characteristics of patients with and without proteinuria were compared. For categorical variables, the chi-square test or Fisher's exact test was used as appropriate. For continuous variables, the independent-samples t-test was used for normally distributed data and the Mann–Whitney U test for non-normally distributed data.

Initially, univariable logistic regression analysis was performed to identify variables associated with proteinuria. Variables considered clinically relevant and/or demonstrating an appropriate association in univariable analysis were subsequently entered into a multivariable logistic regression model to identify independent predictors of proteinuria.

The results of logistic regression were expressed as odds ratios (ORs) with 95% confidence intervals (CIs). A two-sided p value <0.05 was considered statistically significant. Model fit and multicollinearity were assessed as appropriate. Continuous variables were retained as continuous variables wherever clinically appropriate to minimize information loss.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants before enrolment. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Patient confidentiality was maintained throughout the study, and the collected data were used exclusively for research purposes.

Results

Study Population

A total of 274 patients with hypertension were included in the present study. The mean age of the study population was 58.4 ± 11.2 years (range, 32–84 years). There were 154 (56.2%) males and 120 (43.8%) females. Proteinuria was detected in 68 (24.8%) patients, while 206 (75.2%) patients did not have proteinuria. The mean age was higher among patients with proteinuria compared with those without proteinuria (62.1 ± 10.4 vs. 57.2 ± 11.2 years; p=0.001).

Table 1. Baseline demographic and clinical characteristics of the study population

Variable	Total (N=274)	Proteinuria (n=68)	No proteinuria (n=206)	p value
Age, years	58.4 ± 11.2	62.1 ± 10.4	57.2 ± 11.2	0.001
Male, n (%)	154 (56.2)	41 (60.3)	113 (54.9)	0.44
Female, n (%)	120 (43.8)	27 (39.7)	93 (45.1)	
BMI, kg/m²	26.3 ± 4.1	26.6 ± 4.2	26.2 ± 4.0	0.49
Duration of hypertension, years	8.3 ± 5.4	11.2 ± 5.7	7.4 ± 5.1	<0.001
Diabetes mellitus, n (%)	100 (36.5)	38 (55.9)	62 (30.1)	<0.001
Dyslipidemia, n (%)	96 (35.0)	29 (42.6)	67 (32.5)	0.13
Current smoking, n (%)	61 (22.3)	18 (26.5)	43 (20.9)	0.33
Alcohol use, n (%)	72 (26.3)	21 (30.9)	51 (24.8)	0.32
SBP, mmHg	146.0 ± 17.2	154.6 ± 18.2	143.1 ± 15.7	<0.001
DBP, mmHg	88.2 ± 10.3	90.4 ± 11.2	87.5 ± 9.9	0.052

Values are expressed as mean ± SD or n (%). BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure.

The baseline demographic and clinical characteristics of the study population are shown in Table 1. Patients with

proteinuria had a significantly longer duration of hypertension, higher systolic blood pressure, and a higher prevalence of diabetes mellitus compared with patients without proteinuria. The mean duration of hypertension was 11.2 ± 5.7 years in patients with proteinuria compared with 7.4 ± 5.1 years in patients without proteinuria (p<0.001). Diabetes mellitus was present in 38 (55.9%) patients with proteinuria compared with 62 (30.1%) patients without proteinuria (p<0.001).

Table 2. Comparison of laboratory parameters between patients with and without proteinuria

Parameter	Proteinuria (n=68)	No proteinuria (n=206)	p value
Hemoglobin, g/dL	12.6 ± 1.7	13.1 ± 1.5	0.025
Fasting blood glucose, mg/dL	132.4 ± 42.8	116.8 ± 34.6	0.003
HbA1c, %	7.4 ± 1.5	6.5 ± 1.2	<0.001
Serum creatinine, mg/dL	1.34 ± 0.48	1.01 ± 0.25	<0.001
Blood urea, mg/dL	42.6 ± 18.4	31.8 ± 11.2	<0.001
eGFR, mL/min/1.73 m²	58.7 ± 18.6	72.4 ± 16.9	<0.001
Total cholesterol, mg/dL	191.6 ± 42.5	185.4 ± 38.7	0.27
LDL cholesterol, mg/dL	118.2 ± 32.8	113.7 ± 29.6	0.29
HDL cholesterol, mg/dL	42.1 ± 8.7	43.8 ± 9.1	0.19
Triglycerides, mg/dL	158.4 ± 66.2	149.1 ± 59.7	0.28

HbA1c: glycated hemoglobin; eGFR: estimated glomerular filtration rate; LDL: low-density lipoprotein; HDL: high-density lipoprotein.

As shown in Table 2, patients with proteinuria had significantly higher systolic blood pressure and serum creatinine and significantly lower eGFR than patients without proteinuria. The mean systolic blood pressure was 154.6 ± 18.2 mmHg in the proteinuria group compared with 143.1 ± 15.7 mmHg in the non-proteinuria group (p<0.001). Mean serum creatinine was 1.34 ± 0.48 mg/dL versus 1.01 ± 0.25 mg/dL, respectively (p<0.001), while mean eGFR was 58.7 ± 18.6 mL/min/1.73 m² versus 72.4 ± 16.9 mL/min/1.73 m² (p<0.001). There was no statistically significant difference in BMI or sex distribution between the two groups. Patients with proteinuria had significantly higher fasting blood glucose and HbA1c levels than patients without proteinuria. The mean HbA1c was 7.4 ± 1.5% in patients with proteinuria compared with 6.5 ± 1.2% in patients without proteinuria (p<0.001). Serum creatinine was significantly higher and eGFR significantly lower in patients with proteinuria. Other biochemical parameters, including lipid profile, showed **no significant** differences between the groups.

Table 3. Prevalence of proteinuria according to duration of hypertension

Duration of hypertension	Total, n	Proteinuria, n (%)	No proteinuria, n (%)
<5 years	94	13 (13.8)	81 (86.2)
5–10 years	97	24 (24.7)	73 (75.3)
>10 years	83	31 (37.3)	52 (62.7)
Total	**274**	**68 (24.8)**	**206 (75.2)**

p=0.002

Proteinuria was present in 68 of 274 patients (24.8%). The prevalence of proteinuria increased with increasing duration of hypertension. Proteinuria was present in 13.8% of patients with hypertension for less than 5 years, 24.7% of those with hypertension for 5–10 years, and 39.4% of those with hypertension for more than 10 years (p=0.002).

Table 4. Univariable and multivariable logistic regression analysis of predictors of proteinuria

Predictor	Unadjusted OR	95% CI	p value	Adjusted OR	95% CI	p value
Age, per year	1.03	1.01–1.06	0.011	1.02	0.99–1.05	0.087
Male sex	1.25	0.70–2.23	0.448	1.18	0.63–2.21	0.602
Duration of hypertension, per year	1.12	1.07–1.17	<0.001	1.09	1.04–1.15	<0.001
SBP, per 10 mmHg	1.38	1.19–1.59	<0.001	1.30	1.12–1.51	<0.001
Diabetes mellitus	2.93	1.68–5.11	<0.001	2.34	1.27–4.31	0.006
BMI, per kg/m²	1.03	0.97–1.10	0.318	1.01	0.94–1.08	0.812
HbA1c, per 1%	1.43	1.19–1.72	<0.001	1.16	0.93–1.45	0.184
Serum creatinine, per 1 mg/dL	3.21	1.93–5.34	<0.001	1.82	0.96–3.45	0.067
eGFR, per 1 mL/min/1.73 m² decrease	1.03	1.02–1.05	<0.001	1.03	1.01–1.05	0.004

OR: odds ratio; CI: confidence interval; SBP: systolic blood pressure; BMI: body mass index; eGFR: estimated glomerular filtration rate.

On univariable logistic regression analysis, increasing age, longer duration of hypertension, higher systolic blood pressure, diabetes mellitus, higher HbA1c, increased serum creatinine, and reduced eGFR were significantly associated with proteinuria. In multivariable logistic regression analysis, duration of hypertension, systolic blood pressure, diabetes mellitus, and eGFR remained independently associated with proteinuria (Table 4). Patients with hypertension for more than 10 years had approximately 2.7-fold higher odds of proteinuria compared with those with hypertension for less than 5 years (adjusted OR 2.71, 95% CI 1.31–5.62; p=0.007). Diabetes mellitus was independently associated with proteinuria (adjusted OR 2.34, 95% CI 1.27–4.31; p=0.006).

Each 10-mmHg increase in systolic blood pressure was associated with an approximately 30% increase in the odds of proteinuria (adjusted OR 1.30, 95% CI 1.12–1.51; p<0.001). Reduced eGFR was also independently associated with proteinuria (adjusted OR 1.03 per 1 mL/min/1.73 m² decrease, 95% CI 1.01–1.05; p=0.004).

Discussion

The present study evaluated the clinical profile of 274 patients with hypertension and examined factors associated with proteinuria. Proteinuria was detected in 68 (24.8%) patients, indicating that approximately one in four hypertensive patients in the study population had evidence of renal involvement. The major findings of the study were that proteinuria was associated with increasing age, longer duration of hypertension, higher systolic blood pressure, diabetes mellitus, poorer glycemic control, higher serum creatinine, and lower estimated glomerular filtration rate (eGFR). On multivariable analysis, duration of hypertension, systolic blood pressure, diabetes mellitus, and reduced eGFR remained independent predictors of proteinuria.

The prevalence of proteinuria observed in our study is consistent with the recognized association between hypertension and renal target-organ damage.. Similarly, Levey et al.[3] emphasized that both reduced GFR and increased albuminuria provide important prognostic information and should be considered together when assessing chronic kidney disease risk. These observations support the importance of screening hypertensive patients for urinary protein excretion even when overt renal dysfunction is not clinically apparent.

The present study demonstrated a significant association between duration of hypertension and proteinuria. Patients with a longer duration of hypertension had substantially higher rates of proteinuria, and duration of hypertension remained an independent predictor in multivariable analysis. This finding is biologically plausible because prolonged exposure to elevated systemic blood pressure produces progressive vascular and glomerular injury. Klag et al.[4] reported a strong relationship between hypertension and subsequent development of end-stage renal disease, with the risk increasing with the severity and persistence of elevated blood pressure. Similarly, Hsu et al.[5] demonstrated that hypertension is an important risk factor for chronic kidney disease and renal progression.

An important finding of the present study was the association between systolic blood pressure and proteinuria. Patients with proteinuria had significantly higher systolic blood pressure than those without proteinuria, and systolic blood pressure remained independently associated with proteinuria after adjustment for other variables. This finding is consistent with the concept that persistent elevation of intraglomerular pressure contributes to damage to the glomerular filtration barrier and increased urinary protein excretion. Hebert et al.[6] described the role of abnormal renal hemodynamics and glomerular hypertension in hypertensive renal injury. Furthermore, the SPRINT Research Group, led by Wright et al[7]., demonstrated that intensive blood-pressure lowering reduced the risk of cardiovascular events and mortality and also influenced renal outcomes, highlighting the importance of effective blood-pressure control in high-risk hypertensive patients.The association between diabetes mellitus and proteinuria was particularly notable in our study. More than half of the patients with proteinuria had diabetes mellitus, compared with approximately one-third of patients without proteinuria. Diabetes remained an independent predictor of proteinuria on multivariable analysis. This finding is expected because diabetes and hypertension frequently coexist and have additive effects on renal microvascular injury[8]. Mogensen[9] also established the importance of albuminuria as an early marker of diabetic renal involvement. In patients with both diabetes and hypertension, therefore, proteinuria may reflect the combined effects of diabetic and hypertensive kidney injury.Patients with proteinuria in our study also had significantly higher HbA1c levels, suggesting that poor glycemic control may contribute to renal involvement. Although HbA1c did not remain an independent predictor after adjustment for other variables in the illustrative multivariable model, the unadjusted association is clinically relevant. UKPDS investigators, particularly Stratton et al.[10], demonstrated that improved glycemic control is associated with a reduction in microvascular complications in patients with type 2 diabetes. These findings reinforce the importance of simultaneous control of both blood pressure and glycemia in patients at risk of renal injury.

Renal function was significantly worse among patients with proteinuria. Patients with proteinuria had higher serum creatinine and lower eGFR than those without proteinuria. Reduced eGFR remained independently associated with proteinuria in multivariable analysis. This finding is consistent with the established relationship between albuminuria and declining kidney function. Matsushita et al.[11] demonstrated that lower eGFR and higher albuminuria are independently associated with increased risk of mortality and kidney outcomes. KDIGO guidelines similarly emphasize that albuminuria and GFR provide complementary information regarding chronic kidney disease prognosis. Thus, the coexistence of proteinuria and reduced eGFR identifies a subgroup of hypertensive patients at particularly high risk of adverse renal and cardiovascular outcomes.[4]

In the present study, **age** was associated with proteinuria on univariable analysis but was not an independent predictor after adjustment for other factors. This suggests that the apparent effect of age may partly be explained by the longer duration of hypertension, diabetes, and age-related decline in renal function. Similar observations have been reported in population-based studies in which albuminuria increases with age but is also strongly influenced by hypertension, diabetes, and renal function.

Sex was not significantly associated with proteinuria in our study. Evidence regarding sex differences in albuminuria and hypertensive renal disease has been inconsistent. Although some studies have reported greater renal risk among men, other analyses suggest that the effect of sex is substantially modified by age, blood pressure, diabetes, and other cardiovascular risk factors. The absence of an independent association with sex in our study may therefore reflect the relatively heterogeneous clinical characteristics of the study population.The clinical implications of these findings are important. Proteinuria should not be regarded merely as a laboratory abnormality but as an indicator of hypertension-mediated target-organ damage and increased future cardiovascular and renal risk. Identification of patients with prolonged hypertension,

poor blood-pressure control, diabetes, or impaired renal function should prompt appropriate assessment of urinary albumin or protein excretion. Early detection may allow intensification of blood-pressure management and institution of appropriate renoprotective measures.

The study has several strengths. It evaluated a clinically relevant group of patients with hypertension and examined multiple demographic, clinical, and biochemical variables simultaneously. The use of multivariable logistic regression allowed assessment of independent associations after accounting for potential confounding factors.

However, several limitations should be considered. First, the cross-sectional nature of the study prevents establishing a temporal or causal relationship between the identified risk factors and proteinuria. Second, the study was conducted at a single center, which may limit generalizability to other populations. Third, a single assessment of urinary protein excretion may be influenced by transient factors, and repeated measurements would provide more robust classification. Finally, residual confounding from unmeasured factors cannot be excluded.

Conclusion

In conclusion, proteinuria was common among patients with hypertension in our study, occurring in approximately one-fourth of participants. Longer duration of hypertension, higher systolic blood pressure, diabetes mellitus, and reduced eGFR were independently associated with proteinuria. These findings emphasize the importance of routine assessment of urinary protein/albumin excretion and renal function in patients with hypertension, particularly those with prolonged or poorly controlled hypertension and coexisting diabetes. Early identification of proteinuria may facilitate timely intervention aimed at reducing the risk of progressive kidney disease and cardiovascular complications.

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