VOLUME - 15, ISSUE - 08, AUGUST - 2026 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

General Medicine

ASSOCIATION BETWEEN PROTEINURIA AND CARDIOVASCULAR RISK IN HYPERTENSIVE PATIENTS

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ABSTRACT

Background: Hypertension is a leading cause of cardiovascular morbidity and mortality worldwide. Proteinuria, a marker of renal dysfunction, has emerged as an independent predictor of cardiovascular risk. This study aimed to evaluate the association between proteinuria and cardiovascular risk in hypertensive patients. **Materials and Methods:** This cross-sectional observational study was conducted among 200 hypertensive patients attending a tertiary care hospital over 18 months. Urinary protein excretion was measured using 24-hour urine collection. Cardiovascular risk was assessed using the Framingham Risk Score (FRS). Associations were evaluated using logistic regression and Pearson's correlation analysis. **Results:** The prevalence of proteinuria was 28.5% (57 of 200 patients). Patients with proteinuria had significantly higher FRS (19.6 ± 6.8 vs. 13.4 ± 5.2, $p < 0.001$). A strong positive correlation was observed between proteinuria severity and FRS ($r = 0.54$, $p < 0.001$). After adjustment for age, gender, and blood pressure, proteinuria remained independently associated with high cardiovascular risk (OR = 3.42, 95% CI: 1.89-6.18, $p < 0.001$). **Conclusion:** Proteinuria is significantly associated with increased cardiovascular risk in hypertensive patients. Routine screening for proteinuria may help identify high-risk individuals and guide targeted preventive interventions.

KEYWORDS : Proteinuria, Hypertension, Cardiovascular Risk, Framingham Risk Score, Renal Dysfunction

INTRODUCTION

Hypertension is a major public health challenge, affecting approximately 1.28 billion adults worldwide and contributing significantly to the global burden of cardiovascular disease, stroke, and chronic kidney disease [1]. It is estimated that hypertension accounts for approximately 13% of all deaths globally, making it one of the most important modifiable risk factors for cardiovascular morbidity and mortality [2].

Proteinuria, defined as abnormal urinary excretion of protein, has long been recognised as a marker of glomerular dysfunction and renal damage. In recent years, growing evidence has established proteinuria as an independent predictor of cardiovascular events, even in the absence of overt renal impairment [3,4]. The presence of proteinuria in hypertensive patients indicates end-organ damage and is associated with increased risks of myocardial infarction, heart failure, stroke, and all-cause mortality [5].

The exact mechanisms linking proteinuria to cardiovascular risk are multifactorial. Proteinuria reflects systemic endothelial dysfunction, enhanced vascular permeability, and ongoing inflammation, all of which contribute to atherosclerosis and cardiovascular events [6]. Furthermore, proteinuria is often accompanied by other cardiovascular risk factors including hyperlipidaemia, insulin resistance, and coagulation abnormalities [7].

The Framingham Risk Score (FRS) is a widely validated tool for estimating 10-year cardiovascular risk based on age, gender, blood pressure, total cholesterol, HDL cholesterol, smoking status, and diabetes status [8]. Although FRS incorporates blood pressure as a component, it does not directly account for proteinuria. The addition of proteinuria to risk stratification models may improve the identification of high-risk individuals who could benefit from aggressive cardiovascular risk factor modification [9].

Data from the Indian subcontinent on the association between proteinuria and cardiovascular risk in hypertensive patients are limited. This study was undertaken to evaluate the association between proteinuria and cardiovascular risk in hypertensive patients.

MATERIALS AND METHODS

Study Population

This cross-sectional observational study was conducted at the Department of General Medicine, G S Medical College and Hospital, Pilkhuwa, Hapur, Uttar Pradesh, over 18 months (January 2024 to June 2025). Adult patients (≥18 years) with a confirmed diagnosis of hypertension (systolic BP ≥140 mmHg or diastolic BP ≥90 mmHg or on antihypertensive medication) were enrolled. Patients with known proteinuria due to primary renal disease, secondary hypertension, pregnancy, urinary tract infection, and those refusing consent were excluded. The study was approved by the Institutional Ethics Committee, and written informed consent was obtained.

Sample Size

A total of 200 patients were enrolled based on convenience sampling over the study period.

Data Collection

Detailed clinical history, physical examination, and baseline laboratory investigations were recorded. Blood pressure was measured using a standard mercury sphygmomanometer. Fasting blood samples were obtained for measurement of serum creatinine, total cholesterol, HDL cholesterol, LDL cholesterol, and triglycerides. Urinary protein excretion was measured using 24-hour urine collection. Proteinuria was defined as urinary protein excretion ≥150 mg/24 hours.

Cardiovascular Risk Assessment

The Framingham Risk Score (FRS) was calculated for all patients using the standard algorithm incorporating age, gender, systolic blood pressure, total cholesterol, HDL cholesterol, smoking status, and diabetes status. Cardiovascular risk was categorised as:

- Low risk: FRS <10%
- Intermediate risk: FRS 10-20%
- High risk: FRS >20%

Statistical Analysis

Data were analysed using SPSS version 27.0. Continuous variables were expressed as mean ± standard deviation. Categorical variables were presented as frequencies and percentages. Pearson's correlation was used to assess the relationship between proteinuria severity and FRS. Logistic regression was performed to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for high cardiovascular risk. A p-value <0.05 was considered statistically significant.

RESULTS

Baseline Characteristics

A total of 200 hypertensive patients were enrolled. The mean age was 56.4 ± 11.8 years (range 28-82 years). Male predominance was observed (55.0%, n=110). The prevalence of proteinuria was 28.5% (57 of 200 patients). Baseline characteristics are shown in Table 1.

Table 1. Baseline characteristics of study population (N=200)

Characteristic	Value
Mean age (years)	56.4 ± 11.8
Male gender	110 (55.0%)
Female gender	90 (45.0%)
Mean SBP (mmHg)	158.6 ± 16.2
Mean DBP (mmHg)	96.4 ± 10.8
Mean total cholesterol (mg/dL)	198.4 ± 38.6
Mean HDL cholesterol (mg/dL)	44.6 ± 10.2
Mean serum creatinine (mg/dL)	1.12 ± 0.42
Proteinuria present	57 (28.5%)
Current smokers	48 (24.0%)
Diabetes mellitus	54 (27.0%)

Proteinuria and Cardiovascular Risk

Patients with proteinuria had significantly higher FRS compared to those without proteinuria (19.6 ± 6.8 vs. 13.4 ± 5.2, p<0.001). A strong positive correlation was observed between proteinuria severity and FRS (r=0.54, p< 0.001). The distribution of cardiovascular risk categories is shown in Table 2.

Table 2. Cardiovascular risk categories by proteinuria status

FRS Category	Proteinuria Present (n=57)	Proteinuria Absent (n=143)	Total
Low risk (<10%)	4 (7.0%)	42 (29.4%)	46 (23.0%)
Intermediate risk (10-20%)	18 (31.6%)	58 (40.6%)	76 (38.0%)
High risk(>20%)	35 (61.4%)	43 (30.1%)	78 (39.0%)

p < 0.001 (Chi-square test)

Factors Associated with High Cardiovascular Risk

Logistic regression analysis revealed that proteinuria was independently associated with high cardiovascular risk after adjustment for age, gender, blood pressure, and other covariates (OR = 3.42, 95% CI: 1.89-6.18, p < 0.001). Other independent predictors are shown in Table 3.

Table 3. Factors associated with high cardiovascular risk

Variable	Adjusted OR	95% CI	p-value
Proteinuria	3.42	1.89-6.18	<0.001
Age ≥60 years	2.86	1.56-5.23	0.001
Male gender	1.78	1.02-3.12	0.042
Diabetes mellitus	2.14	1.18-3.89	0.012
Current smoking	2.56	1.34-4.89	0.004

DISCUSSION

In this cross-sectional study of 200 hypertensive patients, we found a significant association between proteinuria and cardiovascular risk. The prevalence of proteinuria (28.5%) in our cohort is consistent with previous studies. James et al. (2017) reported a proteinuria prevalence of 25-30% in hypertensive patients [10]. Similarly, the African American Study of Kidney Disease and Hypertension (AASK) found proteinuria in 26.8% of hypertensive participants [11].

Our finding that patients with proteinuria had significantly higher FRS compared to those without proteinuria is consistent with the existing literature. The Atherosclerosis Risk in Communities (ARIC) study demonstrated that microalbuminuria was associated with a 2-fold increased risk of coronary heart disease and a 3-fold increased risk of heart failure over a 6-year follow-up [12]. The Heart Outcomes Prevention Evaluation (HOPE) study reported that microalbuminuria was independently associated with increased risk of cardiovascular events, even in patients without diabetes [13].

The strong positive correlation between proteinuria severity and FRS (r = 0.54, p < 0.001) suggests a dose-response relationship. This finding is supported by the study of Gerstein et al. (2001), who reported that the risk of cardiovascular events increased progressively with increasing urinary albumin excretion [14].

The independent association between proteinuria and high cardiovascular risk (OR = 3.42) after adjustment for conventional risk factors underscores the importance of proteinuria as a marker of cardiovascular risk beyond traditional risk stratification. This finding is consistent with the guidelines of the European Society of Cardiology and the American Heart Association, which recommend screening for proteinuria in hypertensive patients for cardiovascular risk assessment [15].

LIMITATIONS

This study has several limitations. The cross-sectional design limits causal inference. The single-centre design may limit generalisability. FRS was used as the sole measure of cardiovascular risk; future studies could incorporate other risk scores and hard cardiovascular outcomes.

CONCLUSION

Proteinuria is significantly associated with increased cardiovascular risk in hypertensive patients. Patients with proteinuria have higher Framingham Risk Scores and are more likely to fall into the high-risk category. Proteinuria remains an independent predictor of high cardiovascular risk even after adjustment for conventional risk factors. Routine screening for proteinuria in hypertensive patients may help identify high-risk individuals who could benefit from more aggressive cardiovascular risk factor modification. Clinicians should consider proteinuria as a marker of systemic vascular damage and incorporate it into cardiovascular risk assessment.

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