Original Article

Impact of Hypertension on Serum Creatinine, eGFR, Albumin and Albumin Creatinine Ratio on Kidney Function among the Employees of Sylhet MAG Osmani Medical College and Hospital

Arun Kumar Chanda[1], Bipul Chandra Ghosh[2], M Enamul Hoq[3], Sadia Afrin Rimi[4], Tonusree Paul[5], Tanusree Bhattacharjee[6], Yeasmin Jui[7]

Abstract:

Background: Urinary albumin levels and hypertension are distinctly linked to a heightened risk of all-cause mortality. The impact of albuminuria on mortality, whether in the presence or absence of hypertension, remains unclear. The objective of this study was to investigate the influence of hypertension on the kidney function of employees at a referral hospital through analyzing the albumin and albumin creatinine ratio. **Method:** This cross-sectional observational study was done in the Department of Physiology in conjunction with the Department of Nephrology at Sylhet MAG Osmani Medical College, from July 2022 to June 2023. Ethical approval was obtained from the ethical committee of Sylhet MAG Osmani Medical College. The study population comprised all voluntarily participating volunteers employed at Sylhet MAG Osmani Medical College and Hospital, aged between 18 and 59 years. A comprehensive medical history was obtained, and a physical examination was conducted. Blood pressure, serum creatinine, estimated glomerular filtration rate (eGFR), urinary albumin, and the ratio of albumin to creatinine in the urine (ACR) were the variables that had been studied. A semi-structured questionnaire was employed for data collection. **Results:** Sixty-seven participants (33.5%) in the study were identified as having hypertension. Urinary albumin levels were significantly elevated, while eGFR values were dramatically reduced in hypertension patients ($p<0.05$). A significant relationship was detected between serum creatinine and urine ACR ($p<0.05$). **Conclusion:** It has been observed that hypertension can have an effect on renal function tests.

Keywords: eGFR, Serum creatinine, ACR. CKD, ESRD, Urinary ACR, Urinary albumin.

J Com Med Col Teachers' Asso Jan 2025; 29(1): 59-64

1. Dr Arun Kumar Chanda
   Lecturer, Department of Physiology
   Sylhet MAG Osmani Medical College
2. Dr Bipul Chandra Ghosh
   Senior Consultant (Orthopedics)
   250 Bed District Sadar Hospital, Sunamganj
3. Dr Md. Enamul Hoq
   Assistant Professor, Department of Medicine
   Comilla Medical College
4. Dr Sadia Afrin Rimi
   Lecturer, Department of Physiology
   Sylhet MAG Osmani Medical College
5. Dr Tonusree Paul
   Lecturer, Department of Biochemistry
   Sylhet MAG Osmani Medical College
6. Dr Tanusree Bhattacharjee
   Lecturer, Department of Physiology
   Sylhet MAG Osmani Medical College
7. Dr Yeasmin Jui
   Lecturer, Department of Physiology
   Sylhet MAG Osmani Medical College

Address of correspondence:
Dr Arun Kumar Chanda
Lecturer, Department of Physiology
Sylhet MAG Osmani Medical College
Mobile: (+88) 01712-630956,
Email: munnichanda950@gmail.com

Introduction:

Chronic kidney disease (CKD) arises from the kidneys' inability to filter waste products, such as urea and creatinine, from the bloodstream.[1,2] Chronic kidney disease (CKD) is characterized by impaired kidney structure or function persisting for over three months, adversely affecting health. Bangladesh is included in the list of countries experiencing an increasing annual prevalence of chronic kidney disease (CKD) or renal insufficiency. The prevalence of CKD in Bangladesh is 22.48%, exceeding the global prevalence rate.[3]

The K/DOQI guideline categorizes chronic kidney disease (CKD) into five categories based on glomerular filtration rate (GFR). Stages 1–3 are regarded as the initial phases of chronic kidney disease

DOI:https://doi.org/10.3329/jcomcta.v29i1.81485

(CKD) and are typically asymptomatic. Stages 4 and 5 of chronic kidney disease are marked by symptoms.[4] End-stage renal disease (ESRD) is typically characterized by multiple complications and is classified as Stages 5 CKD.[2] Stage 3 chronic kidney disease (CKD) is more prevalent than end-stage renal disease (ESRD) worldwide, and the prevalence is increasing over time. The development of ESRD and its complications can be prevented by the early detection and treatment of CKD.[5]

Regular approaches to evaluating kidney function include kidney imaging, urine and blood analysis, urinary protein excretion measurement, and, if required, kidney biopsy. Clinical manifestations in patients with renal disease might vary widely. On routine evaluation, many asymptomatic patients are found to have abnormal urine analysis or increased serum creatinine level.[5] When renal impairment is diagnosed, the extent of renal function impairment, degree of kidney damage, rate of progression, and underlying disorders are evaluated and diagnosed using patient history, physical examination, and laboratory testing. The most valuable information is mostly derived from the calculation of the glomerular filtration rate (GFR) and the evaluation of albuminuria (or proteinuria).[6] The serum creatinine level is used to determine the GFR, and the proteinuria is identified by measuring the urinary albumin creatinine ratio. These tests are commonly used to detect CKD.[4] The primary indicators for diagnosing chronic kidney disease (CKD) are a sustained decrease in estimated glomerular filtration rate (eGFR) below 60 mL/min/1.73 m² and abnormal urinary albumin levels of 30 mg/day or higher.5 Initially, chronic kidney disease (CKD) presents solely as a biochemical imbalance; however, the progressive decline in the excretory, metabolic, and endocrine functions in clinical manifestations and indicators of renal failure, together termed uremia. All phases of chronic kidney disease (CKD) are linked to heightened risks of cardiovascular complications, early mortality, and/or diminished quality of life.[2]

Albuminuria refers to the presence of albumin in urine, serving as an indicator of renal impairment. Albuminuria is characterized by elevated urine albumin excretion, providing as a marker for renal impairment. Healthy individuals excrete negligible amount of protein in the urine.[8] There are numerous complications associated with chronic kidney disease. The most prevalent condition is hypertension.[9] Hypertension serves as both a causative factor and a consequence of chronic kidney disease (CKD), exacerbating its advancement.[10] Hypertension can exacerbate cardiovascular and cerebrovascular outcomes by facilitating the progression of atherosclerosis.[11] For the purpose of monitoring the progression of the disease and evaluating kidney function in people with hypertension, it is essential to detect albumin in the urine and measure the albumin-to-creatinine ratio (ACR). Hence, this study was conducted to evaluate the impact of hypertension on serum creatinine, eGFR, albumin and albumin creatinine levels among employees of a referral hospital.

Methods:

From July 2022 to June 2023, the study was carried out at the Department of Physiology, Sylhet MAG Osmani Medical College. The study was conducted after getting ethical permission from the ethical committee of Sylhet MAG Osmani Medical College. Study population consisted of Sylhet MAG Osmani Medical College and Hospital employees who were between the ages of 18 and 59 and who fulfilled the study's enrollment requirements.

The sample was chosen using a convenient sampling technique. The study involved 200 individuals in total. History was obtained, and a physical examination was conducted. Blood pressure (BP) of the subjects were measured and noted. The study variables were serum creatinine, estimated glomerular filtration rate (eGFR), urinary albumin, and the spot urine albumin-to-creatinine ratio (ACR). The immunofluorescence test method was used to detect urinary albumin levels. Using VITROS 350 chemistry systems, creatinine slides from VITROS Chemistry quantitatively quantified the serum creatinine. The eGFR was calculated using the CKD-EPI formula. A semi-structured questionnaire was employed for data collection. The data was processed and analyzed by using SPSS (Statistical Package for Social Sciences) version 26.0 for Windows. Quantitative data was presented as mean and standard deviation. The qualitative data was represented as frequency and percentage. The Pearson correlation coefficient was employed to observe the relationship between the outcome variables with BP. A probability (p) value of less than 0.05 was taken to be statistically significant.

Results:

Frequency of the study subjects according to their gender showed in figure 1. There were more male 133

DOI:https://doi.org/10.3329/jcomcta.v29i1.81485

(66.5%) than female 67 (33.5%) participants observed in this study. The male-female ratio was 1.99:1 found in this study. There were 67 (33.5%) study subjects found to have hypertension and the rest of the study subjects 133 (66.5%) were found normotensive in this study (Table I). The mean serum creatinine was 0.85±0.18 mg/dl, eGFR was 102.92±16.21 ml/min/1.73 m2, ACR was 27.44±12.48 mg/gm and urinary albumin were 23.57 ± 14.99 mg/gm (Figure 2). The urinary albumin were significantly higher and eGFR were significantly lower in hypertensive subjects ($p<0.05$) (Table II). There were no correlation observed between eGFR and urinary albumin with BP ($p>0.05$) (Table III). But significant positive correlation were observed between serum creatinine and urinary ACR ($p<0.05$) (Figure 3; Figure 4)

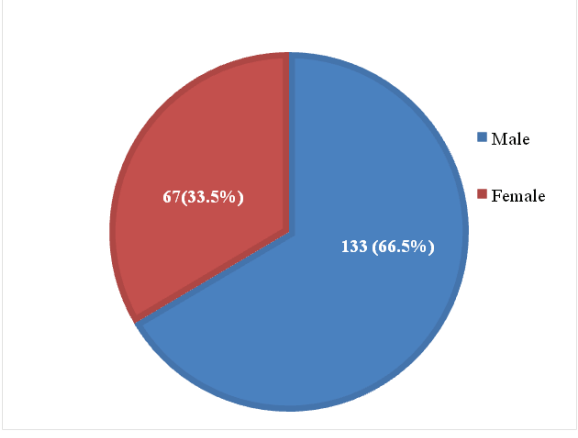

Figure-1: Distribution of study subjects based on their gender (n=200)

Data were expressed as number (%). n=Total number of the subjects

Table-I: Distribution of study subjects based on their status of hypertension (n=200)

Blood pressure status	Frequency	Percent
Normotensive (SBP <140 and DBP <90 mm of Hg)	133	66.5%
Hypertensive (SBP ≥140 or DBP ≥90 or both)	67	33.5%
Total	200	100.0%

Data were expressed as mean ± SD. n=Total number of the subjects.

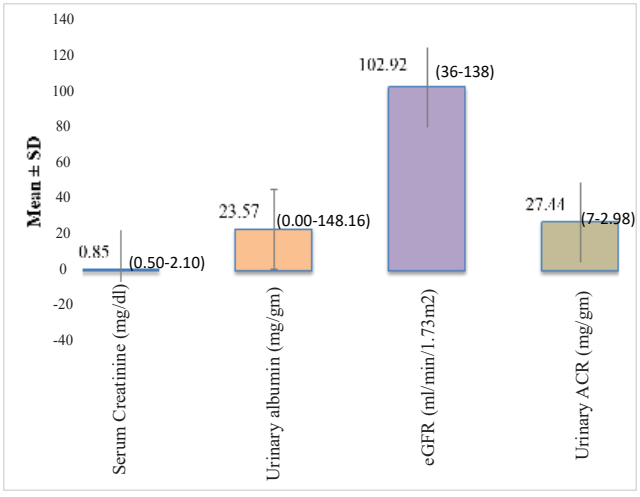

Figure-2: Biochemical measurements of the participants (n=200)

Table-II: Comparison of biochemical tests among between hypertensive and normotensive participants (n=200)

Biochemical analysis	Hypertensive (n=67)	Normotensive (n=133)	P value
Serum Creatinine (mg/dl)	0.8593 ± 0.19 (0.50-2.10)	0.84 ± 0.15 (0.50-1.30)	0.363
Urinary albumin (mg/gm)	25.65 ± 16.19 (0.00-143.16)	21.17 ± 13.21 (0.00-109.98)	0.024*
eGFR (ml/min/1.73 m^2)	100.99 ± 15.13 (36-131)	107.01 ± 16.10 (58-138)	0.018*
Urinary ACR (mg/gm)	27.96 ± 12.20 (0.00-98.0)	25.39 ± 11.35 (0.00-85.92)	0.133

Statistical analyses were done by Unpaired 't' test. n=Total number of the subjects; ACR- albumin creatinine ratio; *- significant.

Table-III: Correlations of eGFR with Age, BMI, RBS, serum creatinine, blood pressure and urinary ACR (n=200)

Variables		r value	p value
Serum Creatinine	SBP	0.151	0.034*
	DBP	0.193	0.007*
eGFR	SBP	-0.103	0.150
	DBP	-0.099	0.165
Urinary albumin	SBP	0.106	0.599
	DBP	0.017	0.933
Urinary ACR	SBP	0.182	0.025*
	DBP	0.171	0.039*

Statistical analyses were done by Pearson's correlation test. r=correlation coefficient; n=Total number of the subjects; BP- blood pressure; ACR- albumin creatinine ratio; *- significant.

DOI:https://doi.org/10.3329/jcomcta.v29i1.81485

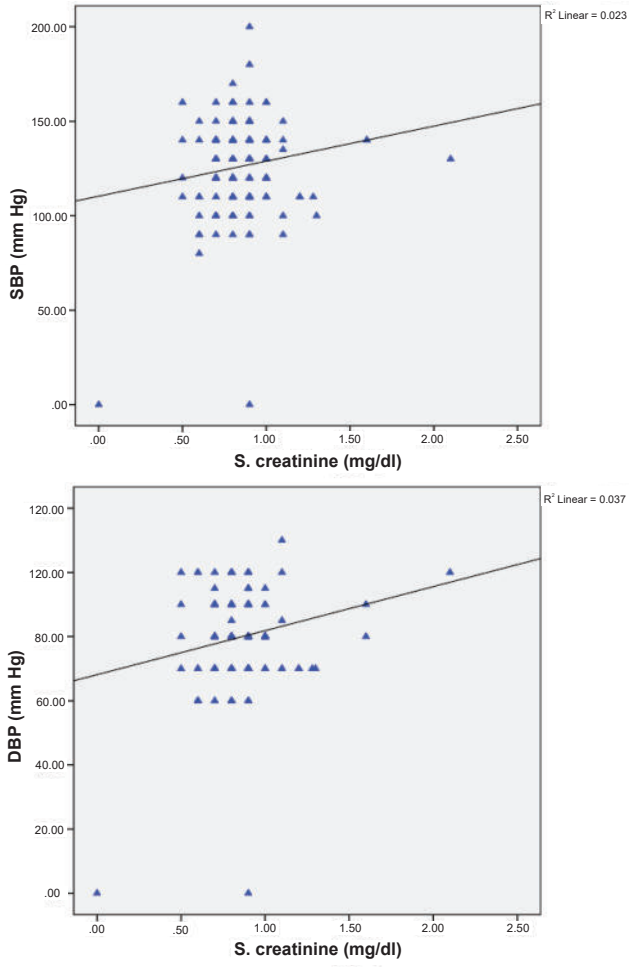

Figure-3: Correlation of BP with serum creatinine

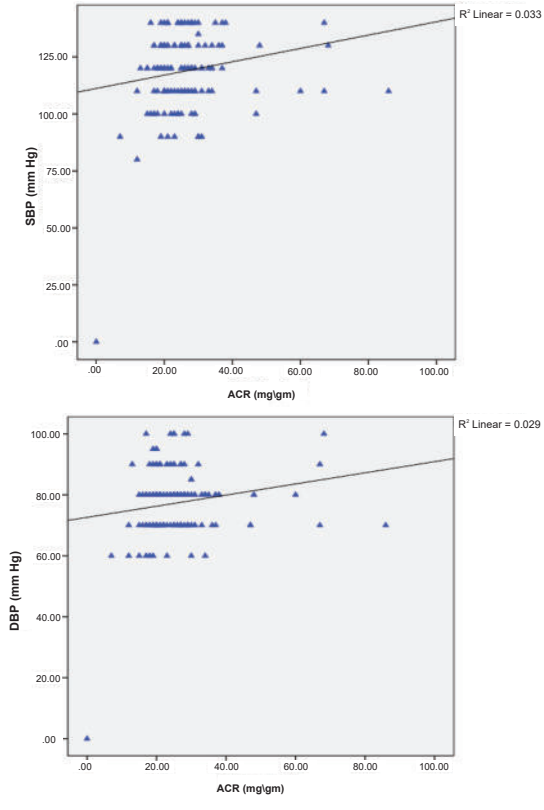

Figure-4: Correlation of BP with ACR

Discussion:

Hypertension (HTN) is a recognized risk factor for all-cause death. It is widely accepted that proteinuria and microalbuminuria, in addition to hypertension, are independent risk factors for cardiovascular disease.[12] The purpose of this present study was to assess the impact of hypertension on albumin and albumin creatinine ratio on kidney function on apparently healthy individuals. The number of male participants in the current study was nearly double that of female participants. A study in New York indicated that women appear to exhibit a slower course of kidney disease compared to men.[13] This study found that 33.5% had hypertension. A research in South-East Nigeria revealed that 36.9% of 328 apparently healthy persons had hypertension.[14] Molla et al. (2020) showed that 82% of individuals were hypertensive in their study.[15]

The kidney may maintain a glomerular filtration rate (GFR) through the mechanisms of hyperfiltration and compensatory hypertrophy of the unaffected nephrons in cases of renal damage.[16] When the kidney is unable to maintain its homeostasis, abnormalities in the kidney can emerge. Hypertension constricts and narrows the renal blood vessels, hence diminishing blood flow. Consequently, the kidneys are incapable of eliminating all waste materials and extra fluid from the body. Excess fluid in the blood vessels elevates blood pressure further, establishing a life-threatening cycle that exacerbates damage and ultimately results in kidney failure.[17]

Individuals with hypertension in our study demonstrate markedly increased urine albumin levels and diminished estimated glomerular filtration rate (eGFR), suggesting renal dysfunction. Research indicates that urine microalbumin is a dependable indicator of renal impairment in individuals with hypertension. In comparison to controls, hypertensive chronic kidney disease patients exhibited higher urinary microalbumin levels ($p<0.05$), as observed by Jabor, Abbass and Mhaimeed, 2023.[16] Our findings were also consistent with Kruthi and Sahana, 2019.[18] They demonstrated that, 62.5% of hypertensive individuals exhibited microalbuminuria, and a reduced eGFR, suggesting the association between hypertension and renal dysfunction. A study conducted by Ozyilmaz et al., 2017 found that those with increased albuminuria exhibited markedly reduced eGFR and elevated.[19] However, Georgianou et al. (2022) recommended that, although albuminuria is a notable indicator of kidney impairment, the reduction in eGFR may not consistently correlate with the severity of hypertension.[20]

DOI:https://doi.org/10.3329/jcomcta.v29i1.81485

No correlation was observed between urinary albumin and eGFR in relation to blood pressure on our study. As per Georgianou et al., 2022, there was no significant correlation between eGFR and urinary albumin with BP. However, a significant positive correlation was observed between serum creatinine and urinary albumin-to-creatinine ratio (ACR).[20] In individuals with hypertension, Kawamoto et al., 2023 found significant correlations between elevated serum creatinine and urinary ACR and elevated blood pressure.21 A study in the United States revealed a positive correlation between urine ACR and the prevalence of hypertension.[22] These findings were well aligned with our observation.

Conclusion:

Current study shows that blood pressure significantly affects eGFR and serum creatinine in hypertensive individuals. High blood pressure was found to be substantially associated with serum creatinine and urine ACR. Damage from hypertension primarily affects the kidneys. To detect kidney disease and prevent it from progressing, it is necessary to identify patients at risk earlier on.

References:

1. Latiwesh OB, Younis MY, Shakila S, Abdulmalik F, Alammari JA, Min Y, Hussain A, Peela JR. Hepatic enzymes changes in chronic kidney disease patients-a need for modified reference values. Journal of Evolution of Medical and Dental Sciences. 2018;7:1949-54.

2. Conway, B., Phelan, P.J., Stewart,G.D. Nephrology and urology, in Ralston, S.H., Penman, I.D., Strachan, M.W., Hobson, R. P. (eds.) Davidson's Principles and Practice of Medicine. 23rd edn. Philadelphia: Elsevier, 2018; 382-440.

3. Banik S, Ghosh A. Prevalence of chronic kidney disease in Bangladesh: a systematic review and meta-analysis. International Urology and Nephrology. 2021;53:713-8.

4. George C, Mogueo A, Okpechi I, Echouffo-Tcheugui JB, Kengne AP. Chronic kidney disease in low-income to middle-income countries: the case for increased screening. BMJ global health. 2017;2(2):e000256.

5. Bargman,J.M., Skorecki, K. Chronic Kidney Disease, in Kasper, D.L., Fauci, A.S., Hauser, S.L., Longo, D.L.,Jameson, J.L., Loscalzo, J.(eds) Harrison's principles of internal medicine.20th edn. New York, USA: Mc Graw-Hill, 2, 2015; 1811-1812.

6. Filler G, Yasin A, Medeiros M. Methods of assessing renal function. Pediatric nephrology. 2014;29:183-92.

7. Inker LA, Perrone RD. Assessment of kidney function. 2022. [Internet]. Cited: 30, November 2022. Available at: https:// www. uptodat e.com/contents/assessment-of-kidney-function.

8. Levey AS, Becker C, Inker LA. Glomerular filtration rate and albuminuria for detection and staging of acute and chronic kidney disease in adults: a systematic review. Jama. 2015;313 (8):837-46

9. Ansari, F.A., Latief, M., Karnik, N.D. Study of clinico-etiologic and biochemical profile of incident end stage kidney disease patients. International Journal of Health and Clinical Research. 2021; 4(9): 136- 140.

10. Pugh D, Gallacher PJ, Dhaun N. Management of hypertension in chronic kidney disease. Drugs. 2019;79(4):365-79.

11. Thomas R, Kanso A, Sedor JR. Chronic kidney disease and its complications. Primary care: Clinics in office practice. 2008;35(2):329-44.

12. Seo MH, Lee JY, Ryu S, Won YS, Sung KC. The effects of urinary albumin and hypertension on all-cause and cardiovascular disease mortality in Korea. American Journal of Hypertension. 2017;30(8):799-807.

13. Silbiger S, Neugarten J. Gender and human chronic renal disease. Gender medicine. 2008;5:S3-10.

14. Okwuonu CG, Chukwuonye II, Adejumo OA, Agaba EI, Ojogwu LI. Prevalence of chronic kidney disease and its risk factors among adults in a semi-urban community of South-East Nigeria. Nigerian Postgraduate Medical Journal. 2017;24(2):81-7.

DOI:https://doi.org/10.3329/jcomcta.v29i1.81485

15. Molla MD, Degef M, Bekele A, Geto Z, Challa F, Lejisa T, Getahun T, Sileshi M, Tolcha Y, Ashebir G, Seifu D. Assessment of serum electrolytes and kidney function test for screening of chronic kidney disease among Ethiopian Public Health Institute staff members, Addis Ababa, Ethiopia. BMC nephrology. 2020;21:1-1.

16. Jabor ZR, Abbass IS, Mhaimeed AJ. Evaluation and Correlation of Urinary Micro Albumin in Early Diagnosis of Patients with Hypertension Related Chronic Kidney Disease. Karbala Journal of Pharmaceutical Sciences. 2023;14(23):44-53.

17. National Kidney Foundation. 2022. [Internet]. Cited: 30, July; 2022.Available from: https://www.kidney.org/

18. Kruthi BN, Sahana KR. Study on Essential Hypertension and Renal Impairment: A Descriptive Cross-Sectional Study International Journal of Research & Review. 2019; 6(11):19-25.

19. Özyilmaz A, de Jong PE, Bakker SJ, Visser ST, Thio C, Gansevoort RT, PREVEND Study Group. Screening for elevated albuminuria and subsequently hypertension identifies subjects in which treatment may be warranted to prevent renal function decline. Nephrology Dialysis Transplantation. 2017;32(suppl_2):ii200-8.

20. Georgianou E, Markakis K, Georgianos P, Zografou I, Sachinidis A, Sabanis C, Doumas M. The association of egfr and albuminuria with systolic hypertension in patients with diabetes. Journal of Hypertension. 2022;40(Suppl 1):e192

21. Kawamoto R, Kikuchi A, Ninomiya D, Tokumoto Y, Kumagi T. Serum uric acid to creatinine ratio is a useful predictor of all-cause mortality among hypertensive patients. Clinical Hypertension. 2023;29(1):10.

22. Ming L, Wang D, Zhu Y. Association between urinary albumin-to-creatinine ratio within normal range and hypertension among adults in the United States: Data from the NHANES 2009–2018. Clinical Cardiology. 2023;46(6):622-31.

DOI:https://doi.org/10.3329/jcomcta.v29i1.81485