Online ISSN 3007-1941
Print ISSN 3007-1933
https://msra.online/index.php/Journal/about

Multidisciplinary Surgical Research Annals
https://msra.online/index.php/Journal/about
Volume 3, Issue 2 (2025)

Evaluation of Estimated Glomerular Filtration Rate as a Diagnostic Marker for Chronic Kidney Disease: A Cross-Sectional Study

[1*]Dr. Amir Hamza, [2]Dr. Abdul Wahid, [3]Dr. Abdul Bari, [4]Dr. Mohammad Azam, [5]Dr. Allah Bakhsh, [6]Dr. Bibi Asma

Article Details

Keywords: Chronic Kidney Disease, Estimated Glomerular Filtration Rate, Proteinuria, Serum Creatinine, Urine Routine Examination

Dr. Amir Hamza*
MBBS, FCPS (Medicine), Assistant Professor Medicine, Bolan Medical College, Quetta.
Corresponding Author Email: hamza4170@gmail.com
Dr. Abdul Wahid
MBBS, FCPS (Medicine), Senior Registrar, Medicine, Jhalwan Medical College, Khuzdar. Email: 2060358az@gmail.com
Dr. Abdul Bari
MBBS, FCPS (Medicine), Assistant Professor, Medicine, Jhalwan Medical College, Khuzdar. Email: bariajo95@gmail.com
Dr. Mohammad Azam
MBBS, FCPS (Medicine), Assistant Professor Medicine, Bolan Medical College, Quetta. Email: drazamraisani71@gmail.com
Dr. Allah Bakhsh
MBBS, M.Phil (Biochemistry), Assistant Professor Biochemistry, Jalawan Medical College, Khuzdar. Email: abumrani17@gmail.com
Dr. Bibi Asma
MBBS, House Officer, Medicine Department, Bolan Medical College/Civil Hospital, Quetta. Email: asmab2886@gmail.com

ABSTRACT

Objective: This study evaluated the accuracy of estimated glomerular filtration rate in diagnosing chronic kidney disease. It compared estimated glomerular filtration rate with serum creatinine levels in local patients.Methodology: This cross-sectional study was conducted in two medical hospitals in Baluchistan from March 2024 to February 2025. Adults with symptoms of chronic kidney disease were included. Written informed consent was taken. Serum creatinine was measured using an automated analyzer. Estimated glomerular filtration rate was calculated using a standard formula. The data were analyzed using statistical software. Sensitivity, specificity, and predictive values were calculated. The findings of estimated glomerular filtration rate were compared with serum creatinine. A p-value less than 0.05 was considered significant. Results: Of 257 participants (mean age 52.8 ± 14.6 years), 143 (55.6%) were male and 114 (44.4%) female. Common complaints included fatigue (68.5%), edema (48.2%), and low urine output (30.7%). Hypertension and diabetes were present in 137 (53.3%) and 114 (44.4%), respectively. Mean symptom duration was 9.3 weeks. Average BP was 144.7/91.2 mmHg; creatinine 2.1 mg/dL, BUN 36.4 mg/dL, and eGFR 52.7 mL/min/1.73 m². CKD stages G3a–G5 occurred in 187 (72.8%). Only 42 (16.3%) had negative urine protein. eGFR outperformed creatinine in detecting CKD in 198 (77%) cases, supporting its role in earlier identification and more accurate classification of renal dysfunction.Conclusion: Estimated glomerular filtration rate showed better diagnostic performance than serum creatinine. It detected early-stage chronic kidney disease more accurately and helped improve disease staging and treatment decisions.

INTRODUCTION

Chronic Kidney Disease (CKD) is a major global health problem. It affects around 10% of the world's population. Most patients remain undiagnosed until the disease reaches advanced stages.[1] This delay in diagnosis leads to severe complications and increases the burden on healthcare systems. Early detection of CKD is very important. It allows timely intervention and slows down disease progression.[1]

CKD leads to many serious health issues. It increases the risk of heart disease, stroke, and early death. It causes poor quality of life, repeated hospital visits, and high treatment costs. In low- and middle-income countries, the burden is even greater. Many patients are diagnosed only when dialysis or kidney transplant is required and condition is called End Stage Renal Disease (ESRD).[3] In Pakistan, the estimated prevalence of CKD ranges from 12% to 15%. Diabetes and hypertension are the most common causes. Other risk factors include kidney infections, nephrotoxic drugs, kidney stones, and family history of kidney disease. Most patients in Pakistan present late with advanced disease, which makes treatment more difficult and expensive.[4]

Traditionally, CKD is diagnosed using serum creatinine levels and urine tests. However, serum creatinine is not a perfect marker. It is affected by age, gender, muscle mass, diet, and hydration status. Two individuals with the same level of kidney function can have different serum creatinine levels. This makes it difficult to detect early kidney damage.[5]

Estimated Glomerular Filtration Rate (eGFR) gives a better estimate of kidney function. It is calculated from serum creatinine using formulas CKD openEPI equations.[6] The formulas consider factors such as age, sex, and body size. The eGFR helps detect kidney dysfunction at earlier stages. It is widely recommended for CKD screening and monitoring. It also helps in staging the disease and guiding treatment.[5-7]

Many international studies have shown that eGFR is more accurate than serum creatinine alone. It improves the detection of CKD, especially in early stages. It also helps monitor disease progression and evaluate response to treatment.[8] In many developed countries, eGFR is routinely reported along with serum creatinine. However, in Pakistan, especially in underdeveloped areas like Baluchistan, its use remains limited. Most health facilities still rely on creatinine alone, and eGFR is not commonly calculated.[9]

There is a clear gap in local data regarding the use of eGFR in CKD detection. This study aims to evaluate the diagnostic value of eGFR in our population. It will compare eGFR with traditional markers to assess its accuracy. The findings will help improve early detection, guide better management, and reduce complications related to CKD in our region.[10]

MATERIALS AND METHODS

This cross-sectional study was carried out in the Medicine Department of two medical institutions, Bolan Medical College and Jhalawan Medical College Hospitals from March 2024 to February 2025. Both institutions are located in Baluchistan, Pakistan. The study was carried out in both outpatient and inpatient settings. Patients presenting with symptoms suggestive of CKD were included. The study period was one year. Approval for the study was obtained from the Institutional Review Board (IRB) of Bolan University of Medical and Health Sciences, prior to its commencement. IRB Approval number was 1173 BUMHS/IRB/24, Dated: 15-02-2024 (Annexure-I).

The ethical approval ensured that the rights, privacy, and safety of the participants were protected. Written informed consent was obtained from each participant before enrollment. The consent form is attached as Annexure-II. Participants were briefed about the objectives,

methods, and their right to withdraw at any time. Confidentiality of patient information was maintained throughout the study. Each participant was assigned a unique study code. No identifying personal data were entered in the final database.

The sample size was calculated using the OpenEpi sample size calculator. The expected prevalence of CKD was taken as 39.3% based on literature.[5] A 5% margin of error and a 95% confidence interval were applied. The calculated sample size was 257 participants. The sampling technique used was non-probability consecutive sampling. All eligible patients presenting during the study period and meeting the inclusion criteria were selected until the required sample size was reached.

Inclusion criteria included adults aged 18 years or older of either gender. Participants needed to have signs and symptoms suggestive of CKD, such as fatigue, swelling of feet, or changes in urine volume or color. Both indoor and outdoor patients were included. No patient was excluded based on ethnicity or socioeconomic background. The exclusion criteria were strictly followed. Patients with acute kidney injury, those on dialysis, pregnant women, and those suffering from muscle-wasting diseases such as muscular dystrophy were excluded. These conditions could alter serum creatinine levels and eGFR values, affecting the study outcome. After taking informed consent, a complete history was recorded. This included details of comorbid conditions such as diabetes, hypertension, and cardiovascular diseases. A thorough physical examination was done. Blood samples were collected using aseptic techniques. Serum creatinine was measured using an automated biochemical analyzer (Roche Diagnostics GmbH, Sandhofer Strasse 116, 68305 Mannheim, Germany). The samples were analyzed in the central laboratory of the respective hospitals. All instruments were calibrated before testing.

The eGFR was calculated using the CKD openEPI formula. This equation considers serum creatinine, age, and sex. The CKD-EPI formula is recognized internationally for its accuracy and reliability. It adjusts for age and gender, reducing the impact of muscle mass on renal function estimates. The eGFR was expressed in mL/min/1.73 m^2. CKD staging was based on eGFR values: Stage 1 (>90), Stage 2 (60–89), Stage 3a (45–59), Stage 3b (30–44), Stage 4 (15–29), and Stage 5 (<15). CKD was defined as eGFR <60 mL/min/1.73 m^2 for at least three months, with or without signs of kidney damage.

All data were recorded in a data collection tool/ proforma,[10] designed by authors of this study specially made for this research article. The proforma included demographic details, clinical findings, serum creatinine, and eGFR values. Data were entered into Microsoft Excel and later exported to SPSS version 25 for analysis. Data entry was double-checked for accuracy. Descriptive statistics were used to summarize the data. Mean and standard deviation were calculated for continuous variables like age and serum creatinine. Frequencies and percentages were calculated for categorical variables such as gender and CKD stages.

Inferential statistics were used to evaluate the diagnostic accuracy of eGFR. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of eGFR in detecting CKD were calculated. Chi-square test was used for comparison of proportions. A p-value of less than 0.05 was considered statistically significant. Graphs and tables were prepared to present the findings. The results of eGFR were compared to traditional serum creatinine-based diagnosis.

The methods and procedures followed in this study can be replicated by other researchers. The use of standard laboratory equipment and validated formulas ensured reliability. The structured design and proper data handling contributed to the validity of the findings.

RESULTS

Presenting complaints and comorbidities of the study participants are outlined in Table 1. The study involved 257 individuals with a mean age of 52.8 ± 14.6 years. Of these, 143 (55.6%) were male and 114 (44.4%) were female. The average systolic blood pressure was 144.7 ± 18.3 mmHg, and the diastolic blood pressure averaged 91.2 ± 12.1 mmHg. Anthropometric data revealed a mean body weight of 70.1 ± 11.5 kg and a mean height of 164.3 ± 8.7 cm.

TABLE 1: PRESENTING COMPLAINTS AND COMORBIDITIES OF STUDY PARTICIPANTS (N = 257)

Variable	n (%)
Presenting Complaints	
• Fatigue	176 (68.5)
• Edema	124 (48.2)
• Decreased Urine Output	79 (30.7)
• Nausea/Vomiting	88 (34.2)
• Loss of Appetite	96 (37.4)
• No Specific Complaints	34 (13.2)
Comorbidities	
• History of Hypertension	137 (53.3)
• History of Diabetes Mellitus	114 (44.4)
• Family History of Kidney Disease	39 (15.2)

Proteinuria based on routine urine examination and CKD staging determined by estimated glomerular filtration rate (eGFR) are shown in Table 2. Among the 257 participants, the mean serum creatinine level was 2.1 ± 1.3 mg/dL, and the mean blood urea nitrogen (BUN) was 36.4 ± 15.7 mg/dL. The average eGFR was 52.7 ± 21.9 mL/min/1.73 m^2. A total of 187 participants (72.8%) had an eGFR below 60 mL/min/1.73 m^2, consistent with CKD. Additionally, 153 individuals (59.5%) had serum creatinine levels above 1.5 mg/dL, further indicating CKD.

TABLE 2: PROTEINURIA, AND CKD STAGING BY EGFR (N = 257)

Parameter	n (%)
Proteinuria (Urine Dipstick)	
• Negative	42 (16.3)
• Trace	51 (19.8)
• +	63 (24.5)
• ++	61 (23.7)
• +++	40 (15.6)
CKD Stages by eGFR	
• G1 (>90)	23 (8.9)
• G2 (60–89)	47 (18.3)
• G3a (45–59)	54 (21.0)
• G3b (30–44)	61 (23.7)
• G4 (15–29)	45 (17.5)

Parameter	n (%)
• G5 (<15)	27 (10.5)

The diagnostic performance and statistical comparison between eGFR and serum creatinine for CKD diagnosis are detailed in Table 3. CKD was identified in 72.8% of participants based on an eGFR of less than 60 mL/min/1.73 m², whereas 59.5% met the diagnostic criteria using serum creatinine levels greater than 1.5 mg/dL. The mean serum creatinine among CKD patients was 2.6 ± 1.1 mg/dL, compared to 1.1 ± 0.3 mg/dL in non-CKD individuals. These findings suggest that eGFR may offer greater sensitivity than serum creatinine alone in detecting CKD in this population.

TABLE 3: DIAGNOSTIC PERFORMANCE AND STATISTICAL COMPARISON OF EGFR VS SERUM CREATININE FOR CKD DIAGNOSIS

Variable	Value
Chi-square (eGFR vs Creatinine)	$\chi^2 = 10.92$, **p = 0.001**
Sensitivity of eGFR	91.5%
Specificity of eGFR	87.2%
Positive Predictive Value (PPV)	94.1%
Negative Predictive Value (NPV)	81.1%
t-test for Serum Creatinine (CKD vs non-CKD)	**p < 0.001**

DISCUSSION

This study highlights the diagnostic value of eGFR for early detection of CKD in a population from Balochistan, Pakistan. Our findings show that eGFR detected CKD in 72.8% of participants. In contrast, elevated serum creatinine levels identified CKD in only 59.5% of cases.[11] This confirms that eGFR is more sensitive than serum creatinine in identifying CKD, especially in its early stages. These findings support previous global research and provide local evidence for routine eGFR reporting.[12]

Our data showed that many patients with normal or mildly raised serum creatinine had significantly reduced eGFR. This is consistent with findings from large international studies such as the National Health and Nutrition Examination Survey (NHANES), where eGFR identified a higher prevalence of early CKD stages compared to creatinine alone. In a study by Coresh et al., early-stage CKD was often missed using only creatinine. Our results are similar and confirm that eGFR helps detect CKD earlier, which may allow better clinical outcomes.[13]

In our study, only 8.9% of patients were in stage G1 (normal eGFR >90 mL/min/1.73 m²), and 18.3% were in G2. A significant number were already in moderate to severe stages (G3–G5). This pattern mirrors other studies from developing regions. For instance, research from India and Bangladesh showed that late-stage CKD presentation is common.[14] This is due to poor awareness, lack of screening, and limited use of eGFR in routine care. Similar challenges exist in Pakistan, especially in under-resourced areas like Balochistan. The findings emphasize the urgent need for early detection strategies using eGFR.[15]

The average serum creatinine level in our study was 2.1 mg/dL, while the average eGFR was 52.7 mL/min/1.73 m². This difference highlights the poor correlation between serum creatinine and actual kidney function. Factors such as age, sex, muscle mass, and hydration influence creatinine levels. Hence, relying on creatinine alone leads to underdiagnosis.[16] Our results support the use of eGFR formulas like CKD-EPI, which consider these factors and

provide a more accurate assessment. This is in agreement with studies by Levey et al. and KDIGO guidelines, which recommend eGFR-based CKD staging.[17]

Most of our participants had symptoms such as fatigue, edema, and nausea. These symptoms often appear in later CKD stages. Routine eGFR testing may help detect kidney disease before symptoms begin. Proteinuria was also common, seen in over 80% of participants.[18] This supports the combined use of eGFR and proteinuria as better tools for CKD diagnosis. This approach aligns with international guidelines and has been validated in other regional studies. For example, a study from Lahore found similar patterns of proteinuria and late CKD presentation. The dual use of eGFR and proteinuria improves diagnostic accuracy and risk stratification.[19]

A major strength of our study is its practical setting in two tertiary hospitals serving diverse populations. The sample size was adequate, and standard lab procedures were followed. However, there were limitations. This was a cross-sectional study. Long-term outcomes could not be assessed. Also, the study excluded patients with acute kidney injury and those on dialysis, which limits generalizability. Some variables such as diet, medications, and hydration were not controlled. These factors can affect creatinine and eGFR values. Despite this, the results are consistent with broader evidence supporting eGFR.[18-20]

Another limitation was the lack of cystatin C testing. Cystatin C is a newer marker for kidney function and may be more reliable in certain populations. Future studies can compare creatinine-based eGFR with cystatin C-based eGFR[21] to further improve diagnostic accuracy. Also, longitudinal studies can track CKD progression and validate the role of eGFR in predicting long-term outcomes. Research should also explore the impact of routine eGFR reporting in clinical practice across different regions in Pakistan.[22]

Based on our findings, we recommend that all laboratories report eGFR automatically with serum creatinine. Training programs for doctors and lab staff should be conducted. Public awareness campaigns can educate patients about kidney health. Primary care settings should include eGFR testing for all high-risk individuals such as diabetics and hypertensives. Policymakers should ensure that the CKD-EPI formula is used uniformly. These steps can improve early detection and reduce CKD complications in Pakistan. Future research should explore the cost-effectiveness of eGFR testing and its impact on healthcare burden.[23-25]

CONCLUSION

This study shows that eGFR is a better test than serum creatinine alone for detecting CKD. It finds more patients with CKD, especially in early stages. Early diagnosis helps to start treatment sooner and may slow disease progress. Using eGFR can reduce missed cases and improve patient care. Our results support the use of eGFR in clinical practice, especially in areas where CKD is common and diagnosis is delayed. We recommend including eGFR routinely in labs to help detect CKD early and reduce complications. This will improve health outcomes for patients with kidney disease.

ACKNOWLEDGMENT: We sincerely thank all participants and the Medicine Departments of Bolan Medical College Hospital for their support. Special gratitude to Prof. Dr. Abdul Baqi Durrani for her critical review and guidance, which strengthened the quality of this study.

DISCLAIMER: This study is for academic purposes only. The views expressed are those of the authors. It does not substitute professional medical advice. Readers are advised to verify data independently. The authors are not responsible for any consequences arising from its use.

CONFLICT OF INTEREST: The authors declare no conflict of interest. No financial or personal influences affected the study's design, analysis, or reporting.

FUNDING DISCLOSURE: This research received no external funding. All costs were covered by the authors independently.

REFERENCES

1. Imtiaz S, Alam A. Epidemiology and demography of chronic kidney disease in Pakistan: a review of Pakistani literature. *Pak J Kidney Dis.* 2023;7(1). doi:10.53778/pjkd71209.
2. Ahmed S, Subash T, Ahmed H, Sadiqa A, Yaqub S, Jafri L, et al. Diagnostic accuracy of creatinine-based equations for eGFR estimation in Pakistanis: evaluation of the European Kidney Function Consortium equation vs the CKD-EPI Pakistan equation. *EJIFCC.* 2024;35(4):285–93. doi:10.5603/ejifcc.2024.0045.
3. Alam A, Iftikhar S, Baig-Ansari N. Comparison of glomerular filtration rate estimated by three methods in a Pakistani community cohort. *Eur J Clin Med.* 2021;2(3):81–6. doi:10.24018/clinicmed.2021.2.3.60.
4. Zsom L, Zsom M, Salim SA, Fülöp T. Estimated glomerular filtration rate in chronic kidney disease: a critical review of estimate-based predictions of individual outcomes in kidney disease. *Toxins (Basel).* 2022;14(2):127. doi:10.3390/toxins14020127.
5. Delgado C, Baweja M, Crews DC, et al. A unifying approach for GFR estimation: recommendations of the NKF-ASN Task Force on reassessing the inclusion of race in diagnosing kidney disease. *Am J Kidney Dis.* 2022;79(2):268–88.e1. doi:10.1053/j.ajkd.2021.08.003.
6. Aklilu AM. Diagnosis of chronic kidney disease and assessing glomerular filtration rate. *Med Clin North Am.* 2023;107(4):641–58. doi:10.1016/j.mcna.2023.03.001.
7. Inker LA, Titan S. Measurement and estimation of GFR for use in clinical practice: core curriculum 2021. *Am J Kidney Dis.* 2021;78(5):736–49. doi:10.1053/j.ajkd.2021.04.016.
8. Abenavoli C, Provenzano M, Ksiazek SH, et al. Role of estimated glomerular filtration rate in clinical research: the never-ending matter. *Rev Cardiovasc Med.* 2024;25(1):1. doi:10.31083/j.rcm2501001.
9. Khan MS, Bakris GL, Shahid I, et al. Potential role and limitations of estimated glomerular filtration rate slope assessment in cardiovascular trials: a review. *JAMA Cardiol.* 2022;7(5):549–55. doi:10.1001/jamacardio.2021.5151.
10. Itano S, Kanda E, Nagasu H, et al. eGFR slope as a surrogate endpoint for clinical study in early stage of chronic kidney disease: from the Japan Chronic Kidney Disease Database. *Clin Exp Nephrol.* 2023;27(10):847–56. doi:10.1007/s10157-023-02376-4.
11. KDIGO 2023 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease [Internet]. Available from: https://kdigo.org/wp-content/uploads/2017/02/KDIGO-2023-CKD-Guideline-Pu...
12. Siddiqui A, Lakhani S, Khan FA, et al. Performance evaluation of estimated glomerular filtration rate (eGFR) equations in Asia: a systematic review. *Malays J Pathol.* 2025;47(1):31–62. PMID:40302474.
13. Hundemer GL, White CA, Norman PA, et al. Performance of the 2021 race-free CKD-EPI creatinine- and cystatin C-based estimated GFR equations among kidney transplant recipients. *Am J Kidney Dis.* 2022;80(4):462–72.e1. doi:10.1053/j.ajkd.2022.03.014.
14. Zhao L, Li HL, Liu M, et al. GFRs in Chinese CKD: a systematic review. *Clin Chim Acta.* 2025;568:120124. doi:10.1016/j.cca.2025.120124.
15. Liyanage T, Toyama T, Hockham C, et al. Prevalence of chronic kidney disease in Asia: a systematic review and analysis. *BMJ Glob Health.* 2022;7(1):e007525. doi:10.1136/bmjgh-2021-007525.

16. Khalid UB, Haroon ZH, Aamir M, Ain QU, Mansoor K, Jaffar SR. Comparison of estimated glomerular filtration rate with both serum creatinine and cystatin C (eGFRcr-cys) versus single analyte (eGFRcr or eGFRcys) using CKD-EPI and MDRD equations in tertiary care hospital settings. *J Coll Physicians Surg Pak.* 2020;30(7):701–6. doi:10.29271/jcpsp.2020.07.701.
17. Ahmed S, Jafri L, Khan AH. Evaluation of 'CKD-EPI Pakistan' equation for estimated glomerular filtration rate (eGFR): a comparison of eGFR prediction equations in Pakistani population. *J Coll Physicians Surg Pak.* 2017;27(7):414–7. doi:10.29271/jcpsp.2017.07.414.
18. Jessani S, Bux R, Jafar TH. Prevalence, determinants, and management of chronic kidney disease in Karachi, Pakistan – a community-based cross-sectional study. *BMC Nephrol.* 2014;15:90. doi:10.1186/1471-2369-15-90.
19. Ahmed S, Yaqub S, Siddiqui A, Jafri L. An evaluation of the new 2021 creatinine-based equation for estimating glomerular filtration rate (eGFR) in Pakistanis. *J Coll Physicians Surg Pak.* 2023;33(8):889–93. doi:10.29271/jcpsp.2023.08.889.
20. Saleem T, Masood A, Khan AA, et al. General practitioners' knowledge and approach to chronic kidney disease in Karachi, Pakistan. *BMC Nephrol.* 2013;14:180. doi:10.1186/1471-2369-14-180.
21. Al-Ali K, Al-Kharabsheh M, Al-Kilani M, et al. Comparison and evaluation of the 2009 and 2021 chronic kidney disease epidemiology collaboration equations to estimate glomerular filtration rate among Jordanian patients with type 2 diabetes mellitus. *Acta Diabetol.* 2023;60(12):1234–42. doi:10.1007/s00592-023-02191-z.
22. Al-Harbi A, Al-Sayyari A, Al-Ghamdi A, et al. Saudi consensus report on chronic kidney disease management. *Int J Clin Med.* 2025;16(1):50–62. doi:10.4236/ijcm.2025.161004.
23. Momenan A, Ghanbarian A, Azizi F. Incidence of chronic kidney disease and its risk factors, results of over 10-year follow-up in an Iranian cohort. *PLoS One.* 2012;7(9):e45304. doi:10.1371/journal.pone.0045304.
24. Mula-Abed WA, Al Rasadi K, Al-Riyami D. Estimated glomerular filtration rate (eGFR): a serum creatinine-based test for the detection of chronic kidney disease and its impact on clinical practice. *Oman Med J.* 2012;27(2):108–13. doi:10.5001/omj.2012.87.