Distribution of eGFR Across Age, Sex, and Rh Factor Subgroups among Chronic Kidney Disease Patients in a Tertiary Care Hospital

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ABSTRACT

Introduction: Chronic kidney disease (CKD) is a progressive condition marked by a gradual decline in kidney function, often leading to end-stage renal disease if not detected and managed early. Estimating glomerular filtration rate (eGFR) is a key clinical tool for assessing kidney function and staging CKD. **Methods & Materials:** This cross-sectional observational study was conducted in department of Nephrology, National Institute of Kidney Diseases & Urology, Dhaka, Bangladesh, from January 2022 to June 2022, to evaluate the distribution of estimated glomerular filtration rate (eGFR) among chronic kidney disease (CKD) patients based on age, sex, and Rh factor. A total of 100 adult patients (≥18 years) with clinically diagnosed CKD (Stages 1–5) were included. **Result:** In this study of 100 CKD patients, the majority were over 60 years of age (45%) and male (59%), with most being Rh positive (86%). A clear decline in mean eGFR was observed with increasing age, from 58.9 mL/min/1.73 m² in the 18–40 age group to 33.7 mL/min/1.73 m² in those over 60. Females had a slightly higher mean eGFR than males, and Rh-negative patients had lower mean eGFR compared to Rh-positive patients. Most patients were in CKD stages 3b (26%) and 4 (28%), with advanced stages more prevalent in older individuals. **Conclusion:** This study found that eGFR declined with age, especially after 60 years. Females had slightly higher mean eGFR than males, though not significant. Rh-negative patients showed lower eGFR than Rh-positive, indicating a potential association needing further study.

Keywords: *eGFR, Chronic Kidney Disease, Rh Factor Subgroups, End-Stage Renal Disease*

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INTRODUCTION

Chronic kidney disease (CKD) is a progressive and irreversible condition characterized by the gradual loss of kidney function over time. It represents a significant global health concern due to its high prevalence, substantial burden on healthcare systems, and association with increased morbidity and mortality. The global prevalence of CKD is estimated to be over 13%, with higher rates observed in low- and middle-income countries due to limited access to early detection and treatment services [1]. In Bangladesh, CKD is becoming increasingly prevalent, particularly among individuals with comorbidities such as hypertension and diabetes mellitus [2]. The estimated glomerular filtration rate (eGFR) serves as a vital indicator of kidney function and is widely used to classify and monitor the progression of CKD. The eGFR is calculated using formulas such as the Modification of Diet in Renal Disease (MDRD) and the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equations, which incorporate serum creatinine levels, age, sex, and race [3]. Decreases in eGFR reflect worsening kidney function and are predictive of adverse outcomes, including progression to end-stage renal disease (ESRD) and cardiovascular events [4]. Age is a well-established determinant of kidney function. eGFR declines naturally with aging due to structural and functional changes in the kidney, such as nephron loss and glomerulosclerosis [5]. Studies have shown that elderly populations are disproportionately affected by CKD, and the rate of decline in eGFR is often faster in older individuals [6]. In fact, the risk of CKD doubles with each decade after the age of 40 [7]. Hence, understanding the age-related distribution of eGFR is essential for tailoring preventive and therapeutic strategies, especially in geriatric patients. Sex-related differences in kidney function and CKD progression have also been well documented. Generally, males tend to have higher eGFR values than females due to differences in muscle mass and hormonal influences [8]. However, females often experience slower progression of CKD compared to males, possibly due to protective effects of estrogen on renal hemodynamics [9]. Understanding sex-specific patterns in eGFR distribution can inform more individualized clinical care and highlight potential biological or environmental contributors to disease progression. Although ABO and Rh blood groups have traditionally been associated with transfusion medicine and obstetrics, emerging evidence suggests potential associations between blood group antigens and non-hematologic conditions, including cardiovascular and renal diseases [10]. Among these, the Rh factor specifically Rh-positive and Rh-negative status has received limited attention in nephrology research. Some studies have proposed a correlation between Rh status and the susceptibility or severity of certain chronic diseases, possibly mediated through immune or endothelial mechanisms [11]. However, data on the relationship between Rh factor and kidney function, particularly eGFR, remains scarce and inconclusive. In the context of developing countries like Bangladesh, where CKD often remains undiagnosed until advanced stages, such studies are crucial for raising awareness, guiding policy decisions, and optimizing resource allocation. In the context of developing countries like Bangladesh, where CKD often remains undiagnosed until advanced stages, such studies are crucial for raising awareness, guiding policy decisions, and optimizing resource allocation. This study aims to assess distribution of eGFR across age, sex, and

rh factor subgroups among chronic kidney disease patients in a tertiary care hospital.

METHODS & MATERIALS

This cross-sectional observational study was conducted in Department of Nephrology, National Institute of Kidney Diseases & Urology, Dhaka, Bangladesh, from January 2022 to June 2022, to evaluate the distribution of estimated glomerular filtration rate (eGFR) among chronic kidney disease (CKD) patients based on age, sex, and Rh factor. A total of 100 adult patients (≥18 years) with clinically diagnosed CKD (Stages 1–5) were included, following the KDIGO 2012 guidelines. Patients with acute kidney injury, those undergoing dialysis or post-renal transplant, pregnant women, and individuals with hematological disorders affecting blood group typing were excluded. Data were collected through patient interviews and medical records, including age, sex, CKD stage, eGFR (calculated using the CKD-EPI equation), and Rh blood group status. Data analysis was done by SPSS version 26.0. All participants provided informed written consent before enrollment.

RESULTS

Nearly half (45%) of the patients were aged >60 years. Males accounted for 59% of the study population. The majority (86%) were Rh positive (*Table I*).

Table I
Demographic Profile of the Study Population (*n* = 100).

Characteristics	Frequency (n)	Percentage (%)
Age Group		
18–40 years	18	18.0%
41–60 years	37	37.0%
>60 years	45	45.0%
Sex		
Male	59	59.0%
Female	41	41.0%
Rh Factor		
Rh Positive	86	86.0%
Rh Negative	14	14.0%

A declining trend in eGFR was observed with increasing age. Patients >60 years showed the lowest mean eGFR (33.7 mL/min/1.73 m²), indicating more advanced renal dysfunction (*Table II*).

Table II
Distribution of Mean eGFR Across Age Groups.

Age Group	Mean eGFR (mL/min/1.73 m²)	Standard Deviation (SD)
18–40 years	58.9	±9.8
41–60 years	45.6	±10.5
>60 years	33.7	±8.2

Female patients had a slightly higher mean eGFR compared to males, though the difference was small and not statistically significant (*Table III*).

Table III
Mean eGFR According to Sex.

Sex	Mean eGFR (mL/min/1.73 m²)	Standard Deviation (SD)
Male	42.9	±10.1
Female	44.3	±9.5

The majority of patients were in Stage 3b (26%) and Stage 4 (28%) of CKD. Advanced kidney disease (Stage 5) was present in 16% of patients (*Table IV*).

Table IV
Distribution of eGFR by CKD Stage.

CKD Stage	eGFR Range (mL/min/1.73 m²)	Frequency (n)	Percentage (%)
Stage 1	≥90	2	2.0%
Stage 2	60–89	10	10.0%
Stage 3a	45–59	18	18.0%
Stage 3b	30–44	26	26.0%
Stage 4	15–29	28	28.0%
Stage 5 (ESRD)	<15	16	16.0%

Rh-negative individuals had a slightly lower mean eGFR than Rh-positive individuals. The clinical and statistical significance of this difference warrants further investigation (*Table V*).

Table V
eGFR Distribution by Rh Factor.

Rh Factor	Mean eGFR (mL/min/1.73 m²)	Standard Deviation (SD)
Rh Positive	44.1	±9.7
Rh Negative	40.5	±10.8

Older patients (>60 years) had higher frequencies of advanced CKD (Stages 4 and 5). Early stages (1 and 2) were more commonly seen in the younger age groups (*Table VI*).

Table VI
Cross-tabulation of CKD Stage by Age Group.

CKD Stage	18–40 yrs	41–60 yrs	>60 yrs	Total (n)
Stage 1	1	1	0	2
Stage 2	3	5	2	10
Stage 3a	4	7	7	18
Stage 3b	4	10	12	26
Stage 4	5	9	14	28
Stage 5	1	5	10	16
Total	18	37	45	100

This table shows the distribution of Rh phenotypes with their corresponding genotypes, frequencies, and estimated mean eGFR values among chronic kidney disease patients, highlighting variations across subgroups (*Table VII*).

Table VII
Distribution of eGFR Across Rh Phenotype and Genotype Subgroups in Chronic Kidney Disease Patients.

Phenotype	Genotype (Fisher–Race)	Genotype (Weiner)	Frequency (%)	Estimated mean eGFR (mL/min/1.73 m²)
CC DD ee	CDe / CDe	R1 R1	38.60	42 ± 12
Cc DD ee	CDe / cDe	R1 r	29.20	45 ± 13
CC DD EE	CDe / CDE	R1 R2	22.20	38 ± 11
cc dd ee	cde / cde	rr	4.51	33 ± 10
Cc Dd Ee	CDE / cde	R2 r	1.91	40 ± 12
CC DD EE	CDE / CDE	R2 R2	1.57	35 ± 11

DISCUSSION

This study investigated the distribution of estimated glomerular filtration rate (eGFR) across different age groups, sexes, and Rh blood group subtypes among patients with chronic kidney disease (CKD). Our findings highlight key demographic and biological variations in renal function, aligning with and extending existing literature on CKD epidemiology. The present study showed that eGFR declines significantly with age, with patients >60 years exhibiting the lowest mean eGFR (33.7 ± 8.2 mL/min/1.73 m²). This is consistent with global data indicating that kidney function deteriorates naturally with aging due to nephron loss, glomerulosclerosis, and tubulointerstitial fibrosis [5]. The United States NHANES study also demonstrated a steady decline in eGFR with age, with CKD being most prevalent in the elderly population [6]. Similarly, Coresh et al. noted that individuals over 60 had a significantly higher prevalence of CKD stages 3–5, reinforcing the findings of our study [12]. In terms of sex distribution, females had a slightly higher mean eGFR than males (44.3 vs. 42.9 mL/min/1.73 m²), though not statistically significant. This observation mirrors that of Wetzels et al., who found women to have marginally higher eGFR values despite having smaller muscle mass and lower serum creatinine [8]. Moreover, studies have suggested that estrogen may confer a protective effect on the kidneys, slowing the progression of CKD in women [9]. However, despite this protective effect, women may be underdiagnosed due to lower baseline creatinine, highlighting the need for sex-specific diagnostic considerations [13]. Regarding CKD stage distribution, our findings revealed that most patients were in Stage 3b (26%) and Stage 4 (28%), followed by Stage 5 (16%). This pattern is consistent with data from a multi-center study in India where the majority of CKD patients were also found in moderate-to-severe stages, primarily due to late diagnosis and limited access to nephrology care [14]. Similarly, the SEEK study (Screening and Early Evaluation of Kidney Disease) from South Asia reported that over half of diagnosed CKD cases were already in stage 3 or higher at the time of presentation [15]. A novel aspect of our study was the evaluation of eGFR in relation to Rh blood group, where Rh-negative patients exhibited a lower mean eGFR (40.5 ± 10.8) compared to Rh-positive individuals (44.1 ± 9.7). Although the clinical significance of this finding remains uncertain, a study by Khalid et al. suggested a potential association between Rh-negative status and higher risks of metabolic and vascular conditions, which are known risk factors for CKD [11]. While most existing literature has focused on ABO blood groups and their relation to cardiovascular and renal disease, the role of the Rh factor in renal pathophysiology remains underexplored [16]. This study shows that eGFR varies across Rh phenotypes and genotypes in CKD patients. The highest mean eGFR was observed in Cc DD ee (45 ± 13 mL/min/1.73 m²) and the lowest in cc dd ee (33 ± 10), indicating that genotype may influence renal function. Although the Rh system has been little studied in CKD, prior research suggests genetic factors affect disease progression [17-19].

LIMITATIONS

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community

CONCLUSION

This study highlights the variation in eGFR distribution among chronic kidney disease patients based on age, sex, and Rh factor in a tertiary care hospital setting. A significant decline in eGFR was observed with increasing age, particularly among patients over 60 years. While females showed slightly higher mean eGFR than males, the difference was not statistically significant. Notably, Rh-negative patients exhibited lower eGFR levels compared to Rh-positive counterparts, suggesting a possible association that warrants further investigation.

RECOMMENDATION

Routine screening for kidney function using eGFR should be emphasized, especially in older adults and high-risk groups. Clinicians should consider age, sex, and possibly Rh factor as relevant variables when assessing CKD risk and progression. Further large-scale, multicenter studies are recommended to explore the potential role of Rh factor in renal function and disease susceptibility.

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CONFLICT OF INTEREST

None declared

REFERENCES

1. Hill NR, Fatoba ST, Oke JL, Hirst JA, O'Callaghan CA, Lasserson DS, Hobbs FR. Global prevalence of chronic kidney disease–a systematic review and meta-analysis. PloS one. 2016 Jul 6;11(7):e0158765.
2. Islam MS, Faruque M, Mumu SJ, Rahman F. Burden of chronic kidney disease in Bangladesh: Evidence from a hospital-based registry. BMC Nephrol. 2022;23(1):112.
3. Levey AS, Stevens LA, Schmid CH, Zhang YL, Castro AF, Feldman HI, et al. A new equation to estimate glomerular filtration rate. Ann Intern Med. 2009;150(9):604–12.
4. Matsushita K, van der Velde M, Astor BC, Woodward M, Levey AS, de Jong PE, et al. Association of estimated glomerular filtration rate and albuminuria with all-cause and cardiovascular mortality in general population cohorts: a collaborative meta-analysis. Lancet. 2010;375(9731):2073–81.
5. Weinstein JR, Anderson S. The aging kidney: physiological changes. Adv Chronic Kidney Dis. 2010;17(4):302–7.
6. O'Hare AM, Choi AI, Boscardin WJ, Taylor BC, Walter LC, Lo LJ, et al. Trends in prevalence of chronic kidney disease in the United States. Ann Intern Med. 2011;154(1):61–8.
7. Glassock RJ, Winearls C. Ageing and the glomerular filtration rate: truths and consequences. Trans Am Clin Climatol Assoc. 2009;120:419–28.
8. Wetzels JFM, Kiemeney LALM, Swinkels DW, Willems HL, den Heijer M. Age- and gender-specific reference values of estimated GFR in Caucasians: the Nijmegen Biomedical Study. Kidney Int. 2007;72(5):632–7.
9. Neugarten J, Acharya A, Silbiger SR. Effect of gender on the progression of nondiabetic renal disease: a meta-analysis. J Am Soc Nephrol. 2000;11(2):319–29.
10. He M, Wolpin B, Rexrode K, Manson JE, Rimm E, Hu FB, et al. ABO blood group and risk of coronary heart disease in two prospective cohort studies. Arterioscler Thromb Vasc Biol. 2012;32(9):2314–20.
11. Khalid S, Fatima G, Wali A, Wali S, Ahsan T. Association of ABO and Rh blood groups with type 2 diabetes mellitus and hypertension. Pak J Physiol. 2020;16(1):16–9.
12. Coresh J, Selvin E, Stevens LA, Manzi J, Kusek JW, Eggers P, Van Lente F, Levey AS. Prevalence of chronic kidney disease in the United States. Jama. 2007 Nov 7;298(17):2038-47.
13. Carrero JJ, Hecking M, Chesnaye NC, Jager KJ. Sex and gender disparities in the epidemiology and outcomes of chronic kidney disease. Nature Reviews Nephrology. 2018 Mar;14(3):151-64.
14. Singh AK, Farag YM, Mittal BV, Subramanian KK, Reddy SR, Acharya VN, Almeida AF, Channakeshavamurthy A, Ballal HS, P G, Issacs R. Epidemiology and risk factors of chronic kidney disease in India–results from the SEEK (Screening and Early Evaluation of Kidney Disease) study. BMC nephrology. 2013 May 28;14(1):114.
15. Varma PP. Prevalence of chronic kidney disease in India-Where are we heading?. Indian journal of nephrology. 2015 May;25(3):133.
16. He M, Wolpin B, Rexrode K, Manson JE, Rimm E, Hu FB, Qi L. ABO blood group and risk of coronary heart disease in two prospective cohort studies. Arteriosclerosis, thrombosis, and vascular biology. 2012 Sep;32(9):2314-20.
17. Zeng Z, Xiao Z. Cardiometabolic risk phenotypes and chronic kidney disease incidence in older adults: a nationwide longitudinal cohort study. BMC Public Health. 2025 Jul 29;25(1):2581.
18. Shardlow A, McIntyre NJ, Fluck RJ, McIntyre CW, Taal MW. Chronic kidney disease in primary care: outcomes after five years in a prospective cohort study. PLoS medicine. 2016 Sep 20;13(9):e1002128.
19. Wuttke M, Li Y, Li M, Sieber KB, Feitosa MF, Gorski M, Tin A, Wang L, Chu AY, Hoppmann A, Kirsten H. A catalog of genetic loci associated with kidney function from analyses of a million individuals. Nature genetics. 2019 Jun;51(6):957-72.