ISSN- O: 2458 - 868X, ISSN–P: 2458 – 8687
National Library of Medicine - ID: 101731606

International Journal of Medical Science and Innovative Research (IJMSIR)
IJMSIR : A Medical Publication Hub
Available Online at: www.ijmsir.com
Volume – 11, Issue – 3, June – 2026, Page No. : 107 – 114

Study of Homocysteine Level in Chronic Kidney Disease Patient and Its Correlation with Stages of Chronic Kidney Disease Cross Section Study from Central India

[1]Dr Ratndeep Chakdhare, MD Medicine, Senior Resident, Government Medical College, Gondia
[2]Dr Teena Gupta, DNB Medicine, Assistant Professor, Government Medical College, Nagpur
[3]Dr Rashmi Nagdeve, MD Medicine, Associate Professor, Government Medical College, Nagpur
Corresponding Author: Dr Ratndeep Chakdhare, MD Medicine, Senior Resident, Government Medical College, Gondia.

Citation this Article: Dr Ratndeep Chakdhare, Dr Teena Gupta, Dr Rashmi Nagdeve, "Study of Homocysteine Level in Chronic Kidney Disease Patient and Its Correlation with Stages of Chronic Kidney Disease Cross Section Study from Central India", IJMSIR – June – 2026, Vol – 11, Issue – 3, P. No. 107 – 114.
Type of Publication: Original Research Article
Conflicts of Interest: Nil

Abstract

Background: Chronic kidney disease (CKD) is a progressive disorder associated with significant metabolic disturbances and increased cardiovascular risk. Homocysteine has emerged as an important biomarker, potentially reflecting disease severity and progression. The aim of present study was to evaluate the homocysteine level in CKD patients and its correlation with stages of CKD.

Methods: This hospital-based cross-sectional study was conducted among 54 CKD patients aged ≥18 years at a tertiary care center in Central India. Clinical evaluation and laboratory investigations, including complete blood count, renal function tests, lipid profile, and plasma homocysteine levels (measured by ELISA), were performed. eGFR was calculated to classify CKD stages. Statistical analysis was done to assess associations between homocysteine levels and CKD stages.

Results: The mean age was 55.89±8.65 years, with male predominance (59.26%). Most patients were in stage 5 (48.15%) and stage 4 (25.93%) CKD. The mean plasma homocysteine level was 18.70±6.82 µmol/L. Homocysteine levels showed significant variation across CKD stages (p=0.026), increasing with disease severity. Significant associations were also observed with declining haemoglobin (p=0.006), HDL (p=0.002), eGFR (p=0.026), and rising urea, creatinine (p<0.001), and uric acid (p=0.006). No significant association was found with WBC count, platelet count, lipid parameters (except HDL), or blood sugar. Although higher homocysteine levels were observed in dialysis patients, the association was not statistically significant (p=0.130).

Conclusion: Plasma homocysteine levels are significantly elevated in CKD and increase with advancing disease stages, correlating with declining renal function. Homocysteine may serve as an important biomarker for CKD progression and cardiovascular risk assessment.

Keywords: Chronic Kidney Disease, Homocysteine, EGFR, Renal Function, Cardiovascular Risk

Introduction

Chronic Kidney Disease (CKD) is a progressive disorder characterized by gradual loss of kidney function over time, leading to significant morbidity and mortality

worldwide. It is defined by kidney damage or reduced glomerular filtration rate (GFR) persisting for more than three months, irrespective of the underlying cause. As kidney function declines, the body's ability to maintain homeostasis in various metabolic and biochemical processes becomes impaired. Among the numerous markers that have been studied in CKD, homocysteine has garnered significant attention due to its potential role as a risk factor for cardiovascular disease (CVD) and its possible contribution to the progression of CKD itself.[1,2]

Homocysteine is a sulfur-containing amino acid derived from the metabolism of methionine and is normally regulated by remethylation and transsulfuration pathways involving folate and B vitamins. Disruption of these pathways due to genetic, nutritional, or pathological factors leads to elevated homocysteine levels (hyperhomocysteinemia).[3] Hyperhomocysteinemia is frequently observed in patients with CKD and increases as kidney function declines due to reduced renal clearance, vitamin deficiencies (folate, B6, B12), and increased oxidative stress and inflammation. Elevated homocysteine is clinically significant as it contributes to cardiovascular disease through endothelial dysfunction and atherosclerosis and also plays a role in CKD progression by promoting renal damage and fibrosis.[4-6]

CKD is classified into five stages based on estimated glomerular filtration rate (eGFR) and markers of kidney damage, as per KDIGO guidelines. Early stages (1 and 2) show normal or mildly reduced eGFR with evidence of kidney damage, while stages 3 to 5 indicate progressive decline in renal function, with stage 5 representing end-stage renal disease requiring dialysis or transplantation.[7-9] Homocysteine levels increase with worsening CKD stages, making it a potential biomarker for disease progression and cardiovascular risk.[10] Monitoring homocysteine may aid in diagnosis, prognosis, and management, although treatments like vitamin supplementation have shown variable impact on clinical outcomes.[11,12] The present study was conducted to evaluate the homocysteine level in chronic kidney disease patients and its correlation with stages of chronic kidney disease.

Materials and Methods

After obtaining approval from the Institutional Ethics Committee and written informed consent from all participants, this hospital-based cross-sectional study was conducted in the Department of General Medicine at a tertiary care center in Central India. A total of 54 patients aged 18 years or above, diagnosed with chronic kidney disease and willing to participate, were enrolled in the study. Patients with urinary tract infection, cardiac abnormalities, liver disease, hemolytic anemia, malignancies, autoimmune disorders, pregnant women, those with a history of drug abuse affecting renal function, and those unwilling to participate were excluded from the study.

All patients had a complete history and physical examination regarding the diagnosis and etiology of chronic kidney disease performed at first presentation. 5 mL venous blood was collected and placed in a tube gel, then the serum was separated by centrifugation (10 min at 4000 rpm) and the serum was divided into four fractions which was kept in clean eppendrof tubes and stored at -20°C in a deep freezer for later use. Routine investigation such as CBC, Serum creatinine, Sr. Albumin, lipid profile was done. EGFR was calculated and classified patients in different stages of CKD. Apart from this serum sample for homocysteine was sent. Determination of homocysteine in serum was done using ELISA technology by spectrophotometer. Study proforma was used to collect data from the patients.

Statistical Analysis

The data were tabulated in Microsoft excel and analysed with SPSS V.24 software. The continuous variables were presented with mean and standard deviation. The categorical variables were presented with frequency and percentage. One way ANOVA and chi square test were used for the statistical analysis. The p value ≤0.05 was considered statistically significant.

Observations and Results

Out of 54 patients, the majority were males (32; 59.26%), while 22 (40.74%) were females. Regarding age distribution, most participants belonged to the 50–60 years age group (42.59%), followed by 40–50 years (31.48%) and 60–70 years (20.37%). The mean age of the participants was 55.89 ± 8.65 years, (Table 1).

Table 1: Demographic profile of patients

Demographic data		No. of patients	Percentage
Gender	Male	32	59.26
	Female	22	40.74
Age group (years)	40–50	17	31.48%
	50–60	23	42.59%
	60–70	11	20.37%
	>70	03	5.56%

Among the symptoms, edema of the feet was the most common (33.33%), followed by decreased urination and pulmonary edema (22.22% each), while dyspnoea and facial puffiness were observed in 11.11% of patients each. Regarding clinical signs, pitting edema was the most frequent (44.44%), followed by chest crepitations and flaps (22.22% each), whereas raised JVP was present in 11.11% of patients, (Table 2).

Table 2: Distribution of clinical symptoms and signs among study participants

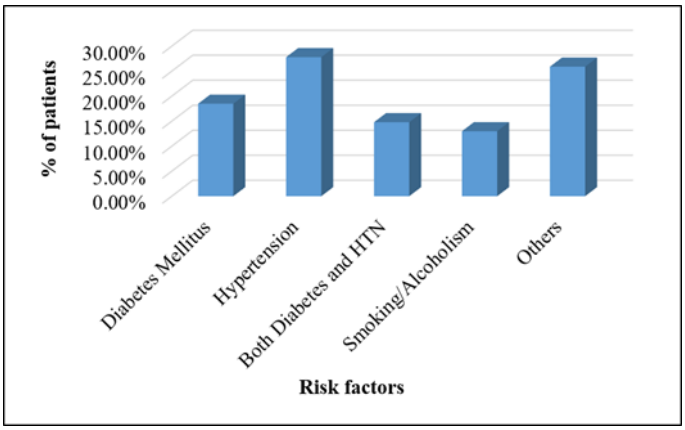
Demographic data		No. of patients	Percentage
Symptoms	Dyspnoea	06	11.11%
	Facial puffiness	06	11.11%
	Decrease urination	12	22.22%
	Pulmonary edema	12	22.22%
	Edema feet	18	33.33%
Signs	Raised JVP	06	11.11%
	Chest crepitation	12	22.22%
	Flaps	12	22.22%
	Pitting edema	24	44.44%

Hypertension was the most common risk factor (27.8%) followed by other risk factors (25.9%). Diabetes mellitus alone was seen in 18.5% of cases, while 14.8% of patients had both diabetes and hypertension. Smoking and alcoholism were reported in 13.0% of the study population as shown in figure 1.

The mean BMI was 20.31 ± 1.42 kg/m², mean systolic blood pressure was 143.52 ± 12.46 mmHg, mean

diastolic blood pressure was 94.44 ± 6.91 mmHg, and mean blood sugar level was 148.37 ± 38.01 mg/dl.

Figure 1: Distribution of risk factors among study participants



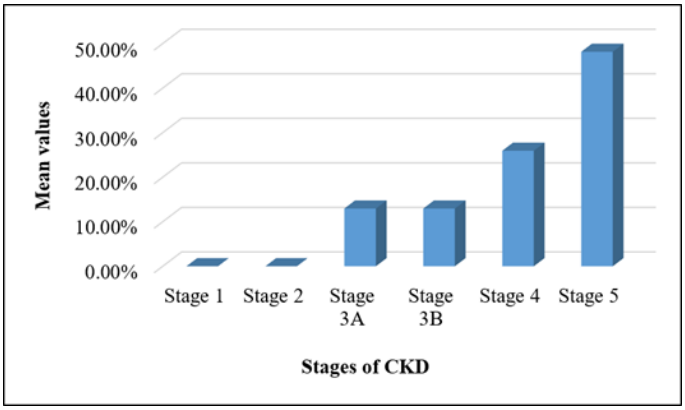
The mean haemoglobin level was low (7.87±1.08 g/dL), indicating anemia. Mean WBC count and platelet count were 9711.11±5082.51 and 1.59±0.58 lakhs, respectively. Lipid profile values were within moderate range, while mean uric acid (6.01±1.52 mg/dL) and plasma homocysteine (18.70±6.82 µmol/L) were elevated. Renal parameters showed increased urea and creatinine with reduced eGFR, indicating impaired renal function, (Table 3).

Table 3: Distribution of laboratory and renal parameters among study participants

Laboratory and Renal Parameters		Mean	SD
Laboratory Parameters	Haemoglobin	7.87	1.08
	WBC count	9711.11	5082.51
	Platelet count (lakhs)	1.59	0.58
	Total Cholesterol	156.63	33.47
	Triglycerides	152.26	38.44
	HDL	28.09	8.01
	LDL	48.22	20.80
	Uric Acid	6.01	1.52
	Plasma Homocysteine	18.70	6.82
Renal Parameters	Urea	144.02	47.22
	Creatinine	9.38	4.79
	eGFR	21.52	15.00

Stage 5 CKD was the most common, accounting for 48.15% of participants, followed by stage 4 with 25.93%, stage 3A and stage 3B each with 12.96%, while no participants were in stage 1 or stage 2, (Figure 2).

Figure 2: Distribution of stages of chronic kidney disease



Haemoglobin levels showed a significant decline with advancing CKD stages (p=0.006). Among laboratory parameters, HDL, uric acid, and homocysteine also showed significant associations with CKD stages (p<0.05), indicating worsening metabolic alterations with disease progression. In contrast, WBC count, platelet count, total cholesterol, triglycerides, LDL, and blood sugar did not show significant associations. Among renal parameters, urea and creatinine levels increased significantly, while eGFR decreased significantly with advancing CKD stages (p<0.05), reflecting progressive deterioration of renal function, (Table 4).

Table 4: Association of stages of CKD with laboratory and renal parameters

Laboratory and renal parameters		Stages of Chronic Kidney Disease				P value
		Stage 3A	Stage 3B	Stage 4	Stage 5	
Laboratory Parameters	Haemoglobin	8.76±1.30	8.47±0.89	7.97±0.76	7.42±1.02	0.006
	WBC count	6928.5±3642.2	9371.4±4859.9	9014.2±3999.9	10926.9±5795.0	0.279
	PLT (lakhs)	1.79±0.50	1.87±0.27	1.66±0.60	1.42±0.61	0.174
	TC	164.14±35.83	144.29±47.70	149.07±36.33	162.00±26.73	0.453
	Triglycerides	145.43±22.41	128.57±56.17	159.79±45.33	156.42±31.08	0.299
	HDL	33.57±5.47	30.29±9.76	31.93±2.43	23.96±8.20	0.002
	LDL	45.71±7.25	54.00±38.95	40.43±14.21	51.54±19.47	0.360
	Uric Acid	5.00±0.82	5.14±0.90	5.64±1.08	6.71±1.70	0.006
	Hcy	18.29±8.79	16.71±7.32	14.93±4.81	21.38±6.22	0.026
	Blood Sugar	150.00±35.53	157.43±34.58	148.71±46.17	145.31±36.48	0.906
Renal Parameters	Urea	83.43±5.56	102.57±6.00	114.07±17.93	187.62±23.56	<0.001
	Creatinine	3.63±0.39	3.90±0.95	7.69±1.21	13.31±3.52	<0.001
	eGFR	32.43±21.87	26.14±15.20	24.57±14.02	15.69±11.17	0.026

Platelet count = PLT; Total Cholesterol=TC; High-Density Lipoprotein= HDL; Low-Density Lipoprotein=LDL; Plasma Homocysteine= Hcy

There was statistically significant association was observed between CKD stages and dialysis requirement (p<0.001). The need for dialysis increased with advancing CKD stages, with all patients in stage 5 requiring dialysis, while none in stage 3B required it. A majority of stage 4 patients required dialysis, whereas most patients in stage 3A did not undergo dialysis, (Table 5). Mean plasma homocysteine levels were higher in patients undergoing dialysis (19.74 ± 6.50 μmol/L) compared to those not on dialysis (16.79 ± 7.15 μmol/L), but the difference was not statistically significant (p = 0.130).

Table 5: Association of stages of CKD with dialysis status

Stages of CKD	Dialysis		P value
	Yes	No	
Stage 3A	01 (14.30%)	06 (85.70%)	<0.001
Stage 3B	00 (0.000%)	07 (100.0%)	

Stage 4	08 (57.10%)	06 (42.90%)	
Stage 5	26 (100.0%)	00 (0.000%)	
Total	35 (64.80%)	19 (35.20%)	

Discussion

In the present study, the majority of participants were male (59.26%) with a mean age of 55.89 ± 8.65 years, most falling in the 50–60-year range. This demographic trend is consistent with epidemiological data showing a higher prevalence of CKD in middle-aged and older males, likely influenced by both biological susceptibility and lifestyle-related exposures. Hypertension emerged as the most common comorbidity, followed by diabetes and combined hypertensive-diabetic status, highlighting the major etiological role of these conditions in the development and progression of CKD. The predominance of advanced stages in our study, with most patients in stage 4 or 5 and none in stages 1 or 2, reflects the frequent underdiagnosis of early CKD in clinical practice and parallels observations from other Indian hospital-based studies, where patients often present late with overt symptoms such as pedal edema, oliguria, and pulmonary congestion.

Biochemical analysis revealed a progressive increase in serum urea, creatinine, uric acid, and homocysteine levels with advancing CKD stages, along with a decline in eGFR, hemoglobin, and HDL cholesterol. In the present study, the mean plasma homocysteine level was 18.70 ± 6.82 µmol/L, showing a significant stage-wise increase, with the highest levels observed in stage 5 CKD. This strong association between declining renal function and rising homocysteine levels is consistent with the stage-dependent increase reported by Aren SK et al[13] and Cohen E et al.[14] These similar findings across different studies suggest that hyperhomocysteinemia is a consistent biochemical marker of CKD progression.

The positive correlation between serum creatinine and homocysteine in this study is consistent with findings by Yadav V et al[15] and Hudiakova NV et al[16] who reported higher homocysteine levels in CKD patients and a clear association with creatinine, even in early stages. Although homocysteine levels were higher in dialysis patients, the difference was not statistically significant, likely due to limited removal of protein-bound homocysteine during hemodialysis. The progressive increase in homocysteine with advancing CKD stages in our study is consistent with findings by Zhang H et al[17], who showed that lower eGFR predicts a faster rise in homocysteine over time. Similarly, Xiao W et al[18] reported that elevated homocysteine levels are associated with the development and progression of CKD. In current study, increased homocysteine levels even in stage 3 suggest that its elevation occurs early and may contribute to disease progression rather than being solely a consequence of reduced renal clearance.

Most patients in our study had low or borderline BMI along with anemia and hypoalbuminemia, indicating poor nutritional status in advanced CKD. These deficiencies, especially of folate and vitamin B12, may contribute to elevated homocysteine levels. This is relevant in light of the genetic predispositions described by Hudiakova NV et al.[16] where polymorphisms in enzymes of homocysteine metabolism were responsible for hyperhomocysteinemia in up to 90% of men with CKD and metabolic syndrome. Taken together, the integration of our findings with the broader evidence base indicates that hyperhomocysteinemia is not only prevalent in CKD but closely linked to disease stage, renal function decline, and possibly underlying genetic and nutritional factors.

Our results are congruent with both cross- sectional and longitudinal studies from diverse populations, reinforcing the role of homocysteine as an important biochemical marker in CKD evaluation and a potential target for early intervention.

Despite sincere efforts, the present study has certain limitations. The sample size was relatively small, which may affect the generalizability of the findings. Being a single-center study, the results may not represent the broader population. Additionally, as the study was conducted in a tertiary care hospital, the possibility of hospital-based bias cannot be ruled out.

Conclusion

The present study demonstrates that plasma homocysteine levels are significantly elevated in patients with chronic kidney disease and increase progressively with advancing stages of renal impairment. The strong positive correlation between homocysteine and serum creatinine, along with its inverse relationship with eGFR, highlights the role of declining renal function in the accumulation of this metabolite. These findings are consistent with previous cross-sectional and longitudinal studies, suggesting that hyperhomocysteinemia is a common biochemical abnormality in CKD, independent of dialysis status, and may contribute to increased cardiovascular risk and disease progression.

References

1. Agarwal SK, Srivastava RK. Chronic kidney disease in India: challenges and solutions. Nephr Clini Pract. 2009;111(3):c197-203.
2. Shipchandler MT, Moore EG. Rapid, fully automated measurement of plasma homocysteine with the Abbott IMxanalyzer. Clin Chem. 1995 Jul 1;41(7):991-4.
3. Graham IM, Daly LE, Refsum HM, Robinson K, Brattström LE, Ueland PM, et al. Plasma homocysteine as a risk factor for vascular disease: the European Concerted Action Project. JAMA. 1997 Jun 11;277(22):1775-81.
4. Refsum H, Helland S, Ueland PM. Radioenzymic determination of homocysteine in plasma and urine. Clini Chem. 1985 Apr 1;31(4):624-8.
5. House JD, Brosnan ME, Brosnan JT. Renal uptake and excretion of homocysteine in rats with acute hyperhomocysteinemia. Kidney Int. 1998 Nov 1;54(5):1601-7.
6. Van Guldener C, Donker AJ, Jakobs C, Teerlink T, de Meer K, Stehouwer CD. No net renal extraction of homocysteine in fasting humans. Kidney Int. 1998 Jul 1;54(1):166-9.
7. Garibotto G, Sofia A, Saffioti S, Russo R, Deferrari G, Rossi D, et al. organ exchange of aminothiols in humans. Am J Physiol- Endocrinol Metab. 2003;284(4):E757-63.
8. Tizianello A, De Ferrari G, Garibotto G, Gurreri G, Robaudo C. Renal metabolism of amino acids and ammonia in subjects with normal renal function and in patients with chronic renal insufficiency. J Clin Invest. 1980;65(5):1162-73.
9. Vieira AD, Baptista A, Malho A, Pinho A, Silva AP, Bernardo I, et al. Homocysteine is a risk factor in predialysis patients when associated with malnutrition and inflammation. Int J Nephrol.2010;10:4061.
10. Prakash S, O'Hare AM. Interaction of aging and chronic kidney disease. SeminNephrol. 2009 Sep;29(5): 497-503.
11. Heinz J, Kropf S, Luley C, Dierkes J. Homocysteine as a risk factor for cardiovascular disease in patients treated by dialysis: a meta-analysis. Am J Kidney Dis. 2009; 54(3): 478-489.
12. Salinas FM, Letelier SLM. Effect of homocysteine

lowering on mortality and vascular disease in advanced chronic kidney disease and end-stage renal disease. Rev Med Chil. 2009; 137: 982.

13. Aren SK, Bhardwaj V. Association between chronic kidney disease and plasma homocysteine level - a hospital based study. International Journal of Medical and Biomedical Studies. 2019;3(8):137-139
14. Cohen E, Margalit I, Shochat T, Goldberg E, Krause I. The relationship between the concentration of plasma homocysteine and chronic kidney disease: a cross sectional study of a large cohort. Journal of Nephrology. 2019;32(5):783–9.
15. Yadav V, Prakash V, Fiza B, Sinha M. Study of serum homocysteine level in patients with chronic kidney disease and its association with renal function and serum albumin. Int J Res Med Sci. 2020; 8:2195-8.
16. Hudiakova NV, Pchelin IY, Shishkin AN, Smirnov VV, Ivanov NV, Makarenko MV, et al. Hyperhomocysteinemia in men with metabolic syndrome and early stages of chronic kidney disease. Arterial'naya Gipertenziya‖ (Arterial Hypertension‖). 2017;23(2):141–149.
17. Zhang H, Li Y, Hao M, Jiang X, Wang J, Jin L, et al. Kidney function decline is associated with an accelerated increase in plasma homocysteine in older adults: a longitudinal study. British Journal of Nutrition. 2021 May 24;127(7):993–9.
18. Xiao W, Ye P, Wang F, Cao R, Bai Y, Wang X. Plasma Homocysteine Is a Predictive Factor for Accelerated Renal Function Decline and Chronic Kidney Disease in a Community-Dwelling Population. Kidney and Blood Pressure Research. 2021;46(5):541–9.