European Journal of Clinical Pharmacy
Print ISSN: 2385-409X **Online ISSN**: 3105-0409
Website: https://farmclin.com/

Original Research Article

Serum Uric Acid and Liver Enzymes as Predictors of Cardiovascular Risk in Chronic Kidney Disease Patients

Article History:

Name of Author:
Dr Zain Ul Abedeen[1], Dr. Muhammad Tahir[2], Dr Sadia Salman[3], Dr Farooq Ahmad Malik[4], Dr Mariam Azeem[5], Dr. Muhammad Zahid[6], Dr Ahmad Yar[7] and Dr Zahra Ali[8]

Affiliation: *[1]Resident Physician General medicine, Jinnah Postgraduate Medical Centre, Karachi*
[2]Associate Physician Department of Medicine, Federal General Hospital, Islamabad.
[3]Associate Professor Medicine, Fatima Jinnah Medical University/ Sir Ganga Ram Hospital, Lahore
[4]Associate Professor Biochemistry, DG Khan Medical College, DGKHAN
[5]Assistant Professor Internal medicine, Fatima Jinnah Medical University/Sir Ganga ram Hospital, Lahore
[6]Associate Professor Physiology Department, Nowshera Medical College, Nowshera.
[7]Medical Officer DHQ Hospital, Kasur
[8]PGR Obstetrics and Gynaecolgy, Sir Ganga Ram Hospital, Lahore

Corresponding Author:
Dr Ahmad Yar

Received: 01-08-2025
Revised: 10-08-2025
Accepted: 20-09-2025
Published: 29-09-2025

Abstract: ***Background***: Chronic kidney disease (CKD) is strongly associated with increased cardiovascular morbidity and mortality. Beyond traditional risk factors, metabolic and inflammatory biomarkers such as serum uric acid and liver enzymes may provide additional insight into cardiovascular risk stratification. ***Objective***: To evaluate serum uric acid and liver enzymes as predictors of cardiovascular risk among patients with chronic kidney disease. ***Methodology***: This was a descriptive, cross-sectional study conducted at Medicine Department of Fatima Jinnah Medical University/ Sir Ganga Ram Hospital, Lahore from November 2024 to May 2025, including 169 patients diagnosed with chronic kidney disease (CKD). ***Results***: Most patients were aged 41–60 years (48.5%) and male (57.4%). Hypertension (72.8%), diabetes (55.6%), and dyslipidemia (52.1%) were common, and 40.2% had cardiovascular morbidity. Hyperuricemia was present in 63.9% of patients, while elevated ALT, AST, and GGT were observed in 30.8%, 26.6%, and 34.3%, respectively, with 52.7% showing at least one abnormal liver enzyme. High cardiovascular risk was more frequent among patients with elevated uric acid (68.5%) and abnormal liver enzymes, including ALT (71.2%), AST (66.7%), and GGT (72.4%). The strongest association was noted when both uric acid and liver enzymes were elevated, where 80.6% were classified as high risk ($p < 0.05$). ***Conclusion***: Serum uric acid and liver enzymes are significantly associated with cardiovascular risk in CKD patients and may serve as simple, cost-effective biomarkers for early identification of high-risk individuals, enabling timely preventive strategies.

Keywords: chronic kidney disease, serum uric acid, liver enzymes, cardiovascular risk, biomarkers.

INTRODUCTION

Chronic kidney disease (CKD) is becoming an established cause of cardiovascular morbidity and mortality, with the affected patients being predisposed to cardiovascular death more than the renal failure itself [1]. The World Health Organization states that cardiovascular disease is the most common cause of death in the world, and this risk is significantly greater

in those people who have a compromised kidney function [2]. Early falls in glomerular filtration rate are related to endothelial and vascular narrowing, inflammation, and increased atherosclerosis, and place CKD patients in a high-risk group of cardiovascular disease [3]. Besides classic risk factors (hypertension, diabetes, and dyslipidemia), the CKD-associated metabolic imbalances and oxidative stress are also additional factors that facilitate cardiac and vascular damage [4]. Hence, it is necessary to find easy-to-measure and simple biochemical markers to predict cardiovascular risk in this group and prevent the risk at its early stage. Uric acid in the serum has become a possible independent risk factor [5]. In CKD, hyperuricemia occurs because of decreased renal secretion and is associated with endothelial dysfunction, inflammation, and the renin-angiotensin system activation, which leads to high blood pressure and atherosclerosis [6][7]. Uric acid has been found to increase the risk of coronary artery disease, left ventricular hypertrophy, and cardiovascular mortality, which argues in favor of its role in risk stratification [8]. Likewise, liver enzymes, including alanine aminotransferase (ALT), aspartate aminotransferase (AST), and gamma-glutamyl transferase (GGT), are gradually being identified as indicators of systemic inflammation and metabolic stress and not hepatic injury [9]. There is an increase in insulin resistance, metabolic syndrome, and cardiovascular events attributed to raised enzyme levels despite the absence of overt liver disease [10]. These changes in CKD patients can also indicate the ongoing process of inflammation and atherosclerosis [11]. Even though it has been established that both serum uric acid and liver enzymes have individually been associated with cardiovascular disease, there is a paucity of evidence on the joint predictive value of the two in CKD patients, especially in the local contexts [12] [13].

Objective

To evaluate serum uric acid and liver enzymes as predictors of cardiovascular risk among patients with chronic kidney disease

METHODOLOGY

This was a descriptive, cross-sectional study conducted at Medicine Department of Fatima Jinnah Medical University/ Sir Ganga Ram Hospital, Lahore from November 2024 to May 2025. Data were collected from 169 patients. Secondly, the subjects were included in case of age of 18 years and older age with a known diagnosis of chronic kidney disease stages 1-5 according to estimated glomerular filtration rate criteria and a stable renal function recorded over a period of at least three months. Only willing patients were recruited into the study, and only those who gave informed consent were included. The individuals were not included in case of known chronic liver disease or active hepatitis, alcohol abuse in the past, or in case of acute kidney injury. Patients already taking hepatotoxic drugs, pregnant women, and patients with a malignant or acute systemic infection were excluded.

Data Collection

The structured predesigned proforma was used to collect the data. Demographic variables identified at the baseline were age, gender, body mass index, smoking status, and years of CKD. Clinical variables were blood pressure, diabetes mellitus, hypertension, dyslipidemia, and cardiovascular disease. Laboratory researches were conducted in accordance with the regular hospital practice. Blood samples were taken following overnight fasting to determine the serum uric acid, alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma-glutamyl transferase (GGT), serum creatinine, lipid profile, and fasting blood glucose. Standard equations were used to estimate the glomerular filtration rate (eGFR) in order to classify CKD stage. The cardiovascular risk evaluation was according to the presence of hypertension, diabetes, dyslipidemia, high body mass index, and cardiovascular events (ischaemic heart disease or stroke). The number of risk factors determined the classification of patients as low and high risk categories.

Statistical Analysis

Data were entered and analyzed using SPSS version 24.0. Continuous variables such as age and biochemical parameters were summarized using median and interquartile range, while categorical variables were expressed as frequencies and percentages. Associations between serum uric acid, liver enzyme levels, and cardiovascular risk categories were assessed using chi-square. Correlation analysis was performed to determine relationships between biomarkers and cardiovascular parameters. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

Data were collected from 169 patients, the largest proportion belonged to the 41–60-year age group, accounting for 82 individuals (48.5%), followed by those older than 60 years with 48 patients (28.4%), while 39 patients (23.1%) were aged 18–40 years. Males constituted the majority with 97 patients (57.4%), whereas females comprised 72 patients (42.6%). Regarding body mass index, 69 patients (40.8%) were overweight (25–29.9 kg/m²), 66 (39.1%) had normal BMI (<25 kg/m²), and 34 (20.1%) were classified as obese. In terms of smoking status, 51 patients (30.2%) were smokers, while most participants, 118 (69.8%), were non-smokers.

Table 1. Baseline Demographic and Anthropometric Characteristics of CKD Patients (N = 169)

Variable	Category	n (%)
Age (years)	18–40	39 (23.1)
	41–60	82 (48.5)
	>60	48 (28.4)
Gender	Male	97 (57.4)
	Female	72 (42.6)
BMI (kg/m²)	<25	66 (39.1)
	25–29.9	69 (40.8)
	≥30	34 (20.1)
Smoking status	Smoker	51 (30.2)
	Non-smoker	118 (69.8)
Total	All patients	169 (100.0)

The vast majority of patients were of moderate-to-advanced renal impairment with stage 3 CKD being the most prevalent (37.9%), 29.0% at stage 4, and 16.0% at stage 5 with only 17.2% at the early stages. Comorbidity conditions were very high, hypertension was 72.8, diabetes mellitus was 55.6, and dyslipidemia was 52.1. In addition, a previous history of cardiovascular disease was present in 21.3%.

Table 2. Clinical Profile and CKD Severity

Variable	Category	n (%)
CKD Stage	Stage 1–2 (Mild)	29 (17.2)
	Stage 3 (Moderate)	64 (37.9)
	Stage 4 (Severe)	49 (29.0)
	Stage 5 (End stage)	27 (16.0)
Hypertension	Present	123 (72.8)
	Absent	46 (27.2)
Diabetes mellitus	Present	94 (55.6)
	Absent	75 (44.4)
Dyslipidemia	Present	88 (52.1)
	Absent	81 (47.9)
Previous CVD history	Present	36 (21.3)
	Absent	133 (78.7)
Total	All patients	169 (100.0)

Elevated serum uric acid was observed in 63.9% of patients, indicating widespread hyperuricemia. Raised liver enzymes were also frequent, with ALT elevated in 30.8%, AST in 26.6%, and GGT in 34.3%. Overall, more than half of the patients (52.7%) had at least one abnormal liver enzyme. These results suggest that metabolic stress and systemic inflammation were prevalent, supporting the potential role of these biomarkers in cardiovascular risk assessment.

Table 3. Serum Uric Acid and Liver Enzyme Levels

Parameter	Category	n (%)
Serum uric acid	Normal	61 (36.1)
	Elevated	108 (63.9)
ALT	Normal	117 (69.2)
	Elevated	52 (30.8)
AST	Normal	124 (73.4)
	Elevated	45 (26.6)
GGT	Normal	111 (65.7)
	Elevated	58 (34.3)
Any abnormal enzyme	Present	89 (52.7)
	Absent	80 (47.3)
Total	All patients	169 (100.0)

Traditional cardiovascular risk factors were highly prevalent. Hypertension affected 72.8%, diabetes 55.6%, dyslipidemia 52.1%, obesity 20.1%, and smoking 30.2%. Evidence of established cardiac involvement was also noted,

including left ventricular hypertrophy in 24.9%, ischemic heart disease in 17.2%, and stroke in 6.5%. Overall, 40.2% of patients exhibited some form of cardiovascular morbidity.

Table 4. Cardiovascular Risk Factors and Clinical Outcomes

Variable	Category	Frequency n (%)
Hypertension	Present	123 (72.8)
Diabetes	Present	94 (55.6)
Obesity	Present	34 (20.1)
Dyslipidemia	Present	88 (52.1)
Smoking	Present	51 (30.2)
Left ventricular hypertrophy (ECG/Echo)	Present	42 (24.9)
Ischemic heart disease	Present	29 (17.2)
Stroke history	Present	11 (6.5)
Any cardiovascular morbidity	Present	68 (40.2)
	Absent	101 (59.8)
Study Total	All patients	169 (100.0)

High-risk status was observed in 68.5% of those with elevated uric acid compared with 42.6% among those with normal levels. Similarly, elevated ALT (71.2%), AST (66.7%), and GGT (72.4%) were each associated with greater cardiovascular risk. The strongest association was seen when both uric acid and liver enzymes were elevated, where 80.6% fell into the high-risk category, whereas only 23.8% of patients with normal biomarkers showed high risk.

Table 5. Association of Biomarkers with High Cardiovascular Risk

Risk Factor	High CV Risk n (%)	Low CV Risk n (%)	p-value
Elevated uric acid	74 (68.5)	34 (31.5)	0.001
Normal uric acid	26 (42.6)	35 (57.4)	0.001
Elevated ALT	37 (71.2)	15 (28.8)	0.002
Elevated AST	30 (66.7)	15 (33.3)	0.006
Elevated GGT	42 (72.4)	16 (27.6)	0.001
Any abnormal enzyme	63 (70.8)	26 (29.2)	0.001
Combined uric acid + enzyme elevation	58 (80.6)	14 (19.4)	0.001
Normal biomarkers	19 (23.8)	61 (76.2)	0.001
Study Total	100 (59.2)	69 (40.8)	0.001

DISCUSSION

This paper compared the predictive value of serum uric acid and liver enzymes in cardiovascular risk in 169 patients with chronic kidney disease and found that the predictive value of both metabolic abnormalities and cardiovascular morbidity was considerable. The cohort was mostly middle-aged, with 48.5% comprising of 41-60 years old and mostly males (57.4). The rate of excess weight was prevalent with 40.8 being overweight, 20.1 being obese, and 30.2 being smokers. These demographic and lifestyle characteristics are reported to be the causes of cardiovascular disease and are correlated with what has previously been recorded in other research studies [14][15]. The majority of the patients were of moderate-advanced renal impairment with 37.9 per cent stage 3 CKD, 29.0 per cent stage 4, and 16.0 per cent stage 5. Conventional cardiovascular risk factors were extremely high, with hypertension prevalent in 72.8, diabetes in 55.6, and dyslipidemia in 52.1, and 21.3 already having established cardiovascular disease. Moreover, 40.2% exhibited cardiovascular morbidity: left ventricular hypertrophy (24.9%), ischemic heart disease (17.2%), and stroke (6.5%). The occurrence of high rates of cardiovascular comorbidities among CKD groups has been long-standing, with prior studies providing a strong focus on the close interdependence between cardiac comorbidities and renal dysfunction [16][17]. Biochemical abnormalities were also eminent. Hyperuricemia was also detected in 63.9 percent of patients and raised ALT, AST, and GGT in 30.8 percent, 26.6 percent, and 34.3 percent, respectively and 52.7 percent of the patients had at least one abnormal liver enzyme. These results indicate great oxidative stress and dysfunction of the metabolism. Past studies have also found elevated uric acid and liver enzyme to be an indication of endothelial dysfunction, inflammation, and atherogenesis, and to have a positive correlation with cardiovascular risk [18][19].

Notably, this paper showed a high correlation between these biomarkers and cardiovascular risk. The presence of high-risk status was 68.5 percent in patients with higher uric acid than the 42.6-percent in

patients with normal level. High ALT (71.2%), AST (66.7%), and GGT (72.4%) were also related to increased risk, but with the greatest impact of both uric acid and liver enzyme have a high risk, 80.6% fell in a high-risk category. On the other hand, high risk was demonstrated by only 23.8% of the normal biomarkers. Previous studies have shown that hyperuricemia, abnormal liver enzyme, and elevated cardiovascular events have a similar degree of association which supports their potential use as predictive markers [20][21]. In general, the results suggest that serum uric acid and liver enzymes are cheap, easy, and non-complicated biomarkers, which have a strong association with cardiovascular risk in CKD patients. Their regular checkup could enable the early detection of persons at risk and the prompt preventive measures to curb cardiovascular morbidity and mortality.

CONCLUSION

It is concluded that the majority of patients were middle-aged with a male predominance, and a substantial proportion were either overweight or obese, with nearly one-third identified as smokers. These baseline characteristics indicate a high burden of modifiable cardiovascular and metabolic risk factors within the cohort. The presence of excess body weight and smoking underscores the importance of early risk assessment, lifestyle modification, and preventive strategies to reduce disease progression and improve long-term clinical outcomes.

REFERENCES

1. Debela DT, Muzazu SG, Heraro KD, et al. New approaches and procedures for cancer treatment: current perspectives. SAGE Open Med. 2021;9:20503121211034366.
2. Bray F, Laversanne M, Sung H, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2024;74:229–63.
3. Shu C, Mei Z, Yu B, et al. Cardiovascular disease risk in cancer survivors: a population-based cohort study from the UK Biobank, and meta-analysis of cohort studies. BMJ Public Health. 2025;3:e001303.
4. Florido R, Daya NR, Ndumele CE, et al. Cardiovascular disease risk among cancer survivors: the atherosclerosis risk in communities (ARIC) study. J Am Coll Cardiol. 2022;80:22–32.
5. Masoudkabir F, Sarrafzadegan N, Gotay C, et al. Cardiovascular disease and cancer: evidence for shared disease pathways and pharmacologic prevention. Atherosclerosis. 2017;263:343–51.
6. Nicholls SJ, Fujino M. HDL cholesterol and cardiovascular risk: teasing the answer from the complexity. Eur J Prev Cardiol. 2023;30:644–5.
7. Ding L, Guo H, Zhang C, et al. Serum uric acid to high-density lipoprotein cholesterol ratio is a predictor for all-cause and cardiovascular disease mortality in patients with diabetes: evidence from NHANES 2005–2018. Nutr Metab Cardiovasc Dis. 2024;34:2480–8.
8. Wang H, Ba Y, Gao X, et al. Association between serum uric acid to high density lipoprotein-cholesterol ratio and arterial stiffness in a Japanese population. Medicine (Baltimore). 2023;102:e34182.
9. Ren Z, Xue Y, Zhang H, et al. Association between probiotic consumption and periodontitis: evidence from NHANES 2009-2014. J Clin Periodontol. 2023;50:1476–86.
10. Huang X, Hu L, Tao S, Xue T, Hou C, Li J. Relationship between uric acid to high-density cholesterol ratio (UHR) and circulating α-klotho: evidence from NHANES 2007-2016. Lipids Health Dis. 2024;23:244.
11. Yao J, Chen X, Meng F, Cao H, Shu X. Combined influence of nutritional and inflammatory status and depressive symptoms on mortality among US cancer survivors: findings from the NHANES. Brain Behav Immun. 2024;115:109–17.
12. Zhang Q, Xiao S, Jiao X, Shen Y. The triglyceride-glucose index is a predictor for cardiovascular and all-cause mortality in CVD patients with diabetes or pre-diabetes: evidence from NHANES 2001-2018. Cardiovasc Diabetol. 2023;22:279.
13. Mahoney DW, Jacobsen SJ, Rodeheffer RJ. Agreement between self-report questionnaires and medical record data was substantial for diabetes, hypertension, myocardial infarction and stroke but not for heart failure. J Clin Epidemiol. 2004;57:1096–103.
14. Martin LM, Leff M, Calonge N, Garrett C, Nelson DE. Validation of self-reported chronic conditions and health services in a managed care population. Am J Prev Med. 2000;18:215–8.
15. Haapanen N, Miilunpalo S, Pasanen M, Oja P, Vuori I. Agreement between questionnaire data and medical records of chronic diseases in middle-aged and elderly Finnish men and women. Am J Epidemiol. 1997;145:762–9.
16. Wang X, Yang S, He G, Xie L. The association between weight-adjusted-waist index and total bone mineral density in adolescents: NHANES 2011-2018. Front Endocrinol (Lausanne). 2023;14:1191501.
17. Dong G, Gan M, Xu S, Xie Y, Zhou M, Wu L. The neutrophil-lymphocyte ratio as a risk factor for all-cause and cardiovascular mortality among individuals with diabetes: evidence from the NHANES 2003-2016. Cardiovasc Diabetol. 2023;22:267.

18. Zhang Z. Multiple imputation with multivariate imputation by chained equation (MICE) package. Ann Transl Med. 2016;4:30.
19. Nie Y, Zhou H, Wang J, Kan H. Association between systemic immune-inflammation index and diabetes: a population-based study from the NHANES. Front Endocrinol (Lausanne). 2023;14:1245199.
20. Gu L, Xia Z, Qing B, et al. Systemic inflammatory response index (SIRI) is associated with all-cause mortality and cardiovascular mortality in population with chronic kidney disease: evidence from NHANES (2001-2018). Front Immunol. 2024;15:1338025.
21. Yang Y, Zhang J, Jia L, Su J, Ma M, Lin X. Uric acid to high-density lipoprotein cholesterol ratio predicts adverse cardiovascular events in patients with coronary chronic total occlusion. Nutr Metab Cardiovasc Dis. 2023;33:2471–8.

