Section: Medicine

Original Research Article

ADIPONECTIN AND LEPTIN LEVELS IN PRE-DIALYSIS PATIENTS OF CHRONIC KIDNEY DISEASE AND IT'S CORRELATION WITH Egfr

Swapnil Dighe[1], Ravindra Singh Ahlawat[2], Deepak Sharma[3], Bhumesh Tyagi[4], Mayank Chandrakar[1]

[1]Post Graduate Resident, Department of Medicine, Sharda Hospital and School of Medical Sciences and Research, Greater Noida, U.P. India
[2]Professor, Department of Medicine, Sharda Hospital and School of Medical Sciences and Research, Greater Noida, U.P. India
[3]Professor & Head, Department of Medicine, Sharda Hospital and School of Medical Sciences and Research, Greater Noida, U.P. India
[4]Associate Professor, Department of Medicine, Sharda Hospital and School of Medical Sciences and Research, Greater Noida, U.P. India

Received : 12/04/2025
Received in revised form : 02/06/2025
Accepted : 18/06/2025

Keywords:
Chronic Kidney Disease, Adiponectin, Leptin, eGFR, Biomarkers, Pre-dialysis etc.

Corresponding Author:
Dr. Bhumesh Tyagi,
Email: bhumeshtyagi@gmail.com

DOI: 10.47009/jamp.2025.7.3.205

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (3); 1061-1065

ABSTRACT

Background: Chronic kidney disease (CKD) is a progressive disorder characterized by declining glomerular filtration rate (GFR), often associated with metabolic disturbances. Adipokines such as adiponectin and leptin, secreted by adipose tissue, play roles in inflammation, metabolism, and energy balance, and may be altered in CKD. Their association with disease severity and renal function has not been clearly established, particularly in Indian pre-dialysis populations. The aim is to evaluate serum adiponectin and leptin levels in pre-dialysis CKD patients and assess their correlation with estimated GFR (eGFR). **Materials and Methods:** This cross-sectional study was conducted at Sharda Hospital between May 2023 and November 2024. Sixty-eight adult CKD patients (Stage II–V, not on dialysis) were enrolled. Clinical data, biochemical parameters, and anthropometry were recorded. Serum adiponectin and leptin levels were measured by ELISA. eGFR was calculated using the CKD-EPI formula. Data analysis was done using SPSS v24. Pearson's correlation was used to evaluate the relationship between adipokines and eGFR. **Result:** The majority were males (72.1%) aged 41–60 years. Advanced CKD (Stage IV/V) was seen in 89.7%. Mean adiponectin and leptin levels were 18.76 ± 2.45 µg/mL and 10.11 ± 2.37 ng/mL, respectively. Both adipokines showed strong negative correlations with eGFR (adiponectin: $r = -0.806$, $p < 0.0001$; leptin: $r = -0.867$, $p < 0.0001$). Levels increased progressively with worsening CKD stage. **Conclusion:** Adiponectin and leptin levels rise significantly with advancing CKD and inversely correlate with eGFR, suggesting their potential as biomarkers for CKD severity in pre-dialysis patients.

INTRODUCTION

Chronic kidney disease (CKD) is a significant global public health issue marked by a progressive, irreversible decline in renal function. It is diagnosed when glomerular filtration rate (GFR) remains below 60 ml/min/1.73 m² for over three months or when there is structural or functional kidney damage, such as albuminuria, abnormal imaging, persistent hematuria, or prior transplantation, even with a GFR above 60.[1] CKD is classified into five stages based on GFR and three categories based on albuminuria levels, which help guide clinical management.[2]

Early detection is crucial for slowing disease progression and reducing associated complications. CKD increases the risk of cardiovascular disease (CVD), which is a leading cause of mortality globally.[3] Timely diagnosis allows intervention, nephrotoxin avoidance, and proper therapy planning, including dialysis or transplantation.

Globally, CKD affects 10–14% of the population, with albuminuria in 7% and GFR <60 ml/min/1.73 m² in 3–5%.[4] In India, due to the lack of a national renal registry, the true burden is unclear. A North Indian study found a 0.79% prevalence of stage 3 CKD among 4,972 individuals,[5] underscoring the need for local epidemiological data and early screening.

Among CKD complications, protein-energy wasting (PEW) is common and stems from inflammation, acidosis, hormonal imbalance, and poor intake. PEW

ISSN (O): 2687-5365; ISSN (P): 2753-6556

prevalence ranges from 18–48% in stages 3–4 and up to 75% in stage 5, contributing to higher morbidity and mortality.[6]

Recently, adipokines—leptin and adiponectin—have been explored for their roles in metabolism and their association with CKD. These adipose-derived hormones regulate appetite, glucose, and lipid metabolism and may influence CKD progression through inflammatory and metabolic pathways.[7]

Leptin, cleared by glomerular filtration and tubular metabolism, accumulates in CKD due to impaired clearance. This hyperleptinemia is linked with inflammation, oxidative stress, and fibrosis, which may exacerbate renal injury. Conventional dialysis does not effectively remove leptin, though high-flux hemodialysis may reduce its levels modestly. In peritoneal dialysis, higher leptin levels inversely correlate with creatinine clearance.[8]

Adiponectin, generally anti-inflammatory and anti-atherogenic, shows paradoxically elevated levels in CKD, likely due to reduced renal clearance and systemic inflammation. While often protective, high adiponectin levels have yielded conflicting associations with CKD progression—some studies suggest benefit, while others associate it with adverse outcomes.[9]

Sex-based differences in adipokine behavior have been observed. For instance, Kollerits et al. reported adiponectin predicted CKD progression in men but not women,[10] and similar trends were seen in type 1 diabetes cohorts.[11]

Adipokines also relate to PEW. Leptin promotes energy expenditure and suppresses appetite but also induces inflammation and fibrosis. Adiponectin's role in metabolism and CKD remains complex and inconsistently defined.[9]

Despite inconsistencies, adipokines may serve as biomarkers or therapeutic targets in CKD. This study aims to evaluate leptin and adiponectin levels in pre-dialysis CKD patients and assess their correlation with estimated GFR (eGFR). Understanding these relationships may aid early detection, prognostication, and targeted interventions in CKD management.

MATERIALS AND METHODS

This cross-sectional analytical study was conducted in the Department of General Medicine, in collaboration with the Departments of Biochemistry and Nephrology, at SMS&R, Sharda Hospital, Sharda University, from May 2023 to November 2024. A total of 500 adult patients attending the outpatient department (OPD) were screened, out of which 68 participants with chronic kidney disease (CKD), diagnosed according to KDIGO guidelines (stages 1 to 5), were enrolled using Cochran's formula, considering a 17.2% national prevalence and 9% precision. Inclusion criteria comprised patients over 18 years of age, of either gender, with CKD not requiring dialysis. Exclusion criteria included abnormal thyroid function, pregnancy, protein-catabolic comorbidities, recent radiotherapy or chemotherapy, and acute cardiovascular, pulmonary, or hepatic conditions.

Eligible participants underwent detailed clinical and demographic assessment, including evaluation of age, gender, height, weight, CKD stage, diabetes status, and primary renal disease. Estimated glomerular filtration rate (eGFR) was calculated using the CKD-EPI equation. After overnight fasting, venous blood samples were collected, centrifuged, and plasma was stored at -20°C. Serum adiponectin and leptin levels were measured using the ELISA method. Other laboratory parameters such as hemoglobin, serum albumin, lipid profile, glucose, uric acid, urea, creatinine, calcium, and phosphate were analyzed using an automated chemistry analyzer.

Data were entered into Microsoft Excel and analyzed using SPSS version 24.0. Descriptive statistics were used to summarize demographic and clinical data. The unpaired t-test was used to compare continuous variables, and Pearson's correlation coefficient was applied to assess the association between eGFR and adipokine levels. A p-value <0.05 was considered statistically significant. Ethical approval was obtained from the Institutional Ethics Committee, and written informed consent was taken from all participants. Confidentiality and the right to withdraw at any stage were assured to all subjects.

RESULTS

The majority of participants were middle-aged males (72.1%) from urban areas (73.5%), with the largest age group being 41-60 years (48.5%). Business professionals (32.4%) and housewives (27.9%) were the most common occupations. A high prevalence of comorbidities was observed, with diabetes mellitus being most common (39.7%), followed by hypertension (30.9%) and combined diabetes with hypertension (29.4%).[Table1]

Participants showed elevated blood pressure (mean SBP 144.56 mmHg, DBP 91.58 mmHg) with normal BMI range (22.36 ± 1.73). The majority had advanced CKD with 64.7% in Stage V and 25% in Stage IV. Most participants (44.1%) had CKD duration >2 years, and proteinuria was present in 86.8% of cases, indicating significant kidney damage. [Table 2]

Key findings include anemia (mean Hb 8.70 g/dL), severe renal dysfunction (mean creatinine 6.02 mg/dL, eGFR 16.21), elevated urea (117.91 mg/dL), and hyperglycemia (mean RBS 192.21 mg/dL). Lipid abnormalities were evident with high triglycerides (203.97 mg/dL) and low HDL (40.31 mg/dL). [Table 3]

Mean adiponectin levels were 18.76 ± 2.45 µg/mL (range: 13.16-24.15) and mean leptin levels were 10.11 ± 2.37 ng/mL (range: 4.62-14.45). [Table 4]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Strong negative correlations were found between eGFR and both adiponectin (r = -0.806) and leptin (r = -0.867), indicating that as kidney function declines, both biomarkers increase significantly. The association analysis shows progressive elevation of both biomarkers across advancing CKD stages, with Stage V patients having the highest levels (adiponectin: 20.01 µg/mL, leptin: 11.32 ng/mL), confirming their potential as markers of CKD progression.[Table 5A,B]

Table 1: Baseline Demographics and Clinical Characteristics (n=68)

Parameter	Categories	Frequency (%) / Mean ± SD
Age (years)	Mean ± SD	49.56 ± 14.28
	≤40 years	20 (29.4%)
	41-60 years	33 (48.5%)
	>60 years	15 (22.1%)
Gender	Male	49 (72.1%)
	Female	19 (27.9%)
Residence	Urban	50 (73.5%)
	Rural	18 (26.5%)
Occupation	Business	22 (32.4%)
	Housewife	19 (27.9%)
	Shopkeeper	8 (11.8%)
	Farmer	6 (8.8%)
	Others	13 (19.1%)
Comorbidities	Diabetes Mellitus	27 (39.7%)
	Hypertension	21 (30.9%)
	DM + HTN	20 (29.4%)

Table 2: Clinical Parameters and CKD Characteristics (n=68)

Parameter	Mean ± SD	Range
Vital Signs		
Pulse Rate (per min)	89.76 ± 9.97	70-115
Respiratory Rate (per min)	18.07 ± 1.46	16-22
Systolic BP (mmHg)	144.56 ± 11.13	122-180
Diastolic BP (mmHg)	91.58 ± 5.49	82-110
Anthropometrics		
Height (cm)	167.74 ± 2.98	160-174
Weight (kg)	62.99 ± 5.87	52-76
BMI (kg/m²)	22.36 ± 1.73	18.87-25.39
CKD Characteristics	Frequency (%)	
CKD Duration: Up to 1 year	22 (32.4%)	
CKD Duration: 1-2 years	16 (23.5%)	
CKD Duration: >2 years	30 (44.1%)	
CKD Stage II	1 (1.5%)	
CKD Stage III	6 (8.8%)	
CKD Stage IV	17 (25.0%)	
CKD Stage V	44 (64.7%)	
Proteinuria Present	59 (86.8%)	

Table 3: Laboratory Investigations (n=68)

Parameter	Mean ± SD	Range
Hematological		
Hemoglobin (g/dL)	8.70 ± 1.50	5.40-12.50
Total Leukocyte Count	8.52 ± 5.03	1.76-34.00
Renal Function		
Creatinine (mg/dL)	6.02 ± 2.76	1.30-11.90
Urea (mg/dL)	117.91 ± 54.64	41.00-350.00
eGFR (mL/min/1.73m²)	16.21 ± 10.32	6.00-55.00
Electrolytes		
Sodium (mEq/L)	135.85 ± 8.07	120.00-162.00
Potassium (mEq/L)	4.88 ± 0.78	3.20-7.10
Chloride (mEq/L)	104.16 ± 14.31	92.00-211.00
Proteins		
Total Protein (g/dL)	6.64 ± 0.85	3.70-8.20
Albumin (g/dL)	3.37 ± 0.62	1.70-4.90
Metabolic		
Random Blood Sugar (mg/dL)	192.21 ± 55.91	114.00-328.00
Lipid Profile		
Total Cholesterol (mg/dL)	181.15 ± 40.58	99.00-274.00
Triglycerides (mg/dL)	203.97 ± 84.75	87.00-354.00
LDL (mg/dL)	97.63 ± 29.24	43.00-165.00
HDL (mg/dL)	40.31 ± 10.16	12.00-75.00
Liver Function		
Total Bilirubin (mg/dL)	0.61 ± 0.23	0.14-1.10

ISSN (O): 2687-5365; ISSN (P): 2753-6556

SGOT (U/L)	41.91 ± 52.45	12.00-440.00
SGPT (U/L)	39.16 ± 33.29	12.00-275.00

Table 4: Adiponectin and Leptin Levels (n=68)

Parameter	Mean ± SD	Median	Range
Adiponectin (µg/mL)	18.76 ± 2.45	18.78	13.16-24.15
Leptin (ng/mL)	10.11 ± 2.37	10.01	4.62-14.45

Table 5a: Correlation and Association Analysis.

A. Correlation with eGFR	Correlation Coefficient (r)	p-value
Adiponectin	-0.806	<0.0001
Leptin	-0.867	<0.0001

Table 5b: Correlation and Association Analysis.

B. Association with CKD Stages	CKD Stage II/III (n=7)	CKD Stage IV (n=17)	CKD Stage V (n=44)	p-value
Adiponectin (µg/mL)				
Mean ± SD	14.45 ± 0.92	17.29 ± 1.04	20.01 ± 1.84	<0.0001
Leptin (ng/mL)				
Mean ± SD	5.79 ± 1.08	8.74 ± 1.25	11.32 ± 1.64	<0.0001

DISCUSSION

Chronic kidney disease (CKD) is a progressive disorder marked by declining renal function, often accompanied by metabolic, cardiovascular, and hormonal complications. Among the many metabolic markers, adipokines such as adiponectin and leptin play critical roles. Adiponectin generally exerts anti-inflammatory and insulin-sensitizing effects, while leptin is involved in energy regulation and inflammation. In CKD, however, adiponectin levels paradoxically rise—likely due to reduced renal clearance—while leptin levels increase and have been implicated in inflammation, malnutrition, and cardiovascular disease.

This study examined the levels of adiponectin and leptin across different stages of CKD (not on dialysis) and evaluated their relationship with eGFR. The average age of patients (49.56 ± 14.28 years) and their predominance in the 41–60 years age group align with previous findings.[12-14] Age is a key risk factor for CKD, and this demographic pattern supports the need for age-specific screening. Gender distribution revealed a male predominance (72.1%), which was slightly higher than other studies that reported male proportions ranging from 53% to 61%.[13,14] This could reflect gender differences in healthcare access or disease presentation.

Socioeconomic and environmental factors were evident in the occupational and residential distribution of the study population. The high proportion of business professionals and housewives, along with 73.5% urban residency, aligns with trends linking urbanization, sedentary lifestyle, and environmental pollutants to increased CKD risk. Comorbidities such as diabetes (39.7%), hypertension (30.9%), or both (29.4%) were highly prevalent, reinforcing their roles as major CKD risk factors.[14,15] Furthermore, these conditions are associated with altered adipokine profiles, as shown by studies linking elevated leptin to hypertensive heart disease and glucose dysregulation.[16,17]

Vital parameters and anthropometric measures in this population, including elevated systolic and diastolic blood pressure and normal BMI (22.36 ± 1.73), indicate subclinical cardiovascular stress, a common feature in CKD. Comparatively, previous studies linked higher BMI and fat mass with adverse renal outcomes.[18] Laboratory results showed typical CKD-related abnormalities—low hemoglobin (8.70 ± 1.50 g/dL), high creatinine (6.02 ± 2.76 mg/dL), and low eGFR (16.21 ± 10.32). These findings are consistent with prior studies and reflect the advanced CKD stages in most participants.[14,15]

Proteinuria, present in 86.8% of cases, reaffirmed its role as a marker of CKD severity. Studies have shown strong correlations between proteinuria and adiponectin levels, highlighting its link with ongoing kidney damage.[14,15] The adipokine levels in our study were markedly elevated: mean adiponectin was 18.76 ± 2.45 µg/mL and leptin 10.11 ± 2.36 ng/mL. These findings align with earlier studies suggesting reduced renal clearance and chronic inflammation as contributing factors.[14-17]

Notably, both adiponectin and leptin showed strong inverse correlations with eGFR—adiponectin ($r = -0.806$, $p = 0.0001$) and leptin ($r = -0.867$, $p = 0.0001$)—supporting their role as potential biomarkers of CKD progression [19-20]. Elevated adiponectin, while generally considered protective, may reflect compensatory mechanisms to inflammation and metabolic stress in CKD. Similarly, hyperleptinemia appears linked with energy imbalance and worsening renal outcomes.[15-17]

Adipokine levels also rose with CKD stage severity. Adiponectin increased from 14.45 µg/mL in early stages to 20.01 µg/mL in stage V; leptin rose from 5.79 ng/mL to 11.32 ng/mL. These trends were consistent with previous studies,[12,14,17,18] indicating that adipokines could serve as indicators of disease severity. The mechanisms likely include both impaired clearance and heightened production due to systemic inflammation and metabolic dysregulation.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

In summary, this study supports a significant association between adipokine levels and CKD severity. Elevated adiponectin and leptin levels correlated with declining eGFR and increasing disease stage, suggesting their potential as prognostic biomarkers in pre-dialysis CKD. Further research is needed to explore their therapeutic implications and potential in clinical practice.[19,20]

CONCLUSION

This study highlights a significant association between adiponectin and leptin levels with the severity of chronic kidney disease in pre-dialysis patients. The findings indicate that as CKD progresses, adiponectin and leptin levels increase, with a strong inverse correlation between these biomarkers and eGFR. Higher adiponectin and leptin levels were observed in patients with advanced CKD stages, suggesting their potential role in disease progression and metabolic dysregulation.

Furthermore, the high prevalence of comorbidities such as hypertension and diabetes mellitus among the study participants underscores the complex interplay between CKD and metabolic alterations. Given the significant correlation between these biomarkers and renal function, adiponectin and leptin may serve as potential indicators for monitoring CKD progression.

REFERENCES

1. KDIGO. KDIGO 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. Kidney Int Suppl. 2024;14(1):1–200.
2. Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. Kidney Int. 2024;105(4S): S117–S314.
3. de Boer IH, Khunti K, Sadusky T. Diabetes management in chronic kidney disease: a consensus report by the American Diabetes Association (ADA) and Kidney Disease: Improving Global Outcomes (KDIGO). Kidney Int. 2022;102:974–989
4. Centers for Disease Control and Prevention. Percentage of CKD stages 1–4 among US adults aged ≥18 years using NHANES 2017–March 2020 data based on the 2021 CKD-EPI equation. Atlanta, GA: CDC; 2023. Available from: https://nccd.cdc.gov/CKD/detail.aspx?Qnum=Q637
5. Anderson AH, Xie D, Wang X, Baudier RL, Orlandi P, Appel LJ et al. CRIC Study Investigators. Novel Risk Factors for Progression of Diabetic and Nondiabetic CKD: Findings From the Chronic Renal Insufficiency Cohort (CRIC) Study. Am J Kidney Dis. 2021 Jan;77(1):56-73.e1
6. Ikizler TA, Burrowes JD, Byham-Gray LD. KDOQI Clinical Practice Guideline for Nutrition in CKD: 2020 Update. Am J Kidney Dis. 2020;76(3 Suppl 1):S1-S107.
7. D'Elia L, Manfredi M, Perna L, et al. Circulating leptin levels predict the decline in renal function with age in a sample of adult men (The Olivetti Heart Study). Intern Emerg Med. 2019;14(4):507-13.
8. Golembiewska E, Safranow K, Ciechanowski K, Bober J, Bogacka A, Stepniewska J. Adipokines and parameters of peritoneal membrane transport in newly started peritoneal dialysis patients. Acta Biochim Pol. 2013;60(4):617-21.
9. Bi X, Loo YT, Henry CJ. Does circulating leptin play a role in energy expenditure? Nutrition. 2019;60:6-10.
10. Kollerits B, Fliser D, Heid IM, Ritz E, Kronenberg F, MMKD Study Group. Gender-specific association of adiponectin as a predictor of progression of chronic kidney disease: the Mild to Moderate Kidney Disease Study. Kidney Int. 2007;71(12):1279-86.
11. Devarajan P. The use of targeted biomarkers for chronic kidney disease. Adv Chronic Kidney Dis. 2010;17(6):469-79.
12. Lim CC, Teo BW, Tai ES, Lim SC, Chan CM, Sethi S et al. Elevated serum leptin, adiponectin and leptin to adiponectin ratio is associated with chronic kidney disease in Asian adults. PLoS One. 2015 Mar 20;10(3):e0122009.
13. Song SH, Oh TR, Choi HS, Kim CS, Ma SK, Oh KH et al. High serum adiponectin as a biomarker of renal dysfunction: Results from the KNOW-CKD study. Sci Rep. 2020 Mar 27;10(1):5598.
14. Kim JH, Han JM, Kim H, Lee KB, Chung W, Kim YS et al; KNOW-CKD Study Group. Low serum adiponectin level is associated with better physical health-related quality of life in chronic kidney disease. Sci Rep. 2021 May 25;11(1):10928.
15. Park YC, Lee S, Kim YS, Park JM, Han K, Lee H et al. Serum leptin level and incidence of CKD: a longitudinal study of adult enrolled in the Korean genome and epidemiology study(KoGES). BMC Nephrol. 2022 May 26;23(1):197.
16. Abi N, Xu X, Yang Z, Ma T, Dong J. Association of Serum Adipokines and Resting Energy Expenditure in Patients With Chronic Kidney Disease. Front Nutr. 2022 Mar 15;9:828341.
17. Ofori EK, Adekena CN, Boima V, Asare-Anane H, Yorke E, Nyarko ENY et al. Serum leptin levels in patients with chronic kidney disease and hypertensive heart disease: An observational cross-sectional study. Health Sci Rep. 2023 Jan 19;6(1):e1053.
18. Park HS, Park SH, Seong Y, Kim HJ, Choi HY, Rhee Y et al. Adiponectin-to-leptin ratio and incident chronic kidney disease: Sex and body composition-dependent association. J Cachexia Sarcopenia Muscle. 2024 Aug;15(4):1298-1308.
19. Hwang SY, Jeong S, Choi S, Kim DH, Kim SR, Lee G et al. Association of Air Pollutants with Incident Chronic Kidney Disease in a Nationally Representative Cohort of Korean Adults. Int J Environ Res Public Health. 2021 Apr 4;18(7):3775.
20. Ziolkowski SL, Long J, Baker JF, Chertow GM, Leonard MB. Chronic Kidney Disease and the Adiposity Paradox: Valid or Confounded? J Ren Nutr. 2019 Nov;29(6):521-528.

ISSN (O): 2687-5365; ISSN (P): 2753-6556