RESEARCH PAPER

Correlation of Serum Phosphorus Levels with Severity of Chronic Kidney Disease in a Tertiary Care Centre in Chengalpattu District.

Dr. Keerthana Prasitha M[1]*, Dr. Sujatha S[2], Dr. Poonguzhali R[3] , Dr. Kulothungan[4]

[1*,2,3,4]Department of General Medicine, Karpaga vinayaga institute of medical sciences and research centre, chengalpattu, Tamil Nadu

ORCID ID: 0009-0003-6233-8381[1*]

***Corresponding Author :** Dr. Keerthana Prasitha M
Email ID : drkeerthana812@gmail.com

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Introduction:

Chronic kidney disease (CKD) is now a major global public health problem, affecting more than 850 million people around the world and causing a lot of illness and death. By 2040, it is expected to be one of the top five causes of years of life lost.(1) Progressive loss of kidney function leads to various systemic complications, with disrupted mineral metabolism being a key factor. Hyperphosphatemia is an early and significant biochemical abnormality in chronic kidney disease (CKD), resulting from impaired phosphate excretion, secondary hyperparathyroidism, and changes in fibroblast growth factor 23 (FGF23) and Klotho signalling. (2)As kidney function deteriorates, serum phosphate levels rise, triggering vascular smooth muscle cell calcification and promoting arterial stiffness, left ventricular hypertrophy, and endothelial dysfunction .(3)

A substantial body of evidence demonstrates that elevated serum phosphorus serves as an independent risk factor for both cardiovascular disease and mortality in chronic kidney disease (CKD). In a substantial meta-analysis involving more than 327,000 patients, each 1 mg/dL elevation in serum phosphorus correlated with an 18% increased risk of all-cause mortality (Palmer et al., 2011). In a similar vein, data from the National Health and Nutrition Examination Survey (NHANES) covering 2001–2018 indicated that serum phosphorus levels ≥4.5 mg/dL were associated with a 28% rise in all-cause mortality and a 57% rise in cardiovascular mortality among non-dialysis CKD patients.(4) In the Fukushima CKD Cohort Study, patients in the highest quartile of serum phosphorus (≥3.7 mg/dL) demonstrated a 3.6-fold increased risk of renal disease progression relative to those with lower levels, thereby emphasising the prognostic significance of phosphate in CKD.(5)Beyond its direct effects on kidney function, hyperphosphatemia contributes to chronic kidney disease–mineral and bone disorder (CKD–MBD), a systemic condition characterized by disturbances in calcium, phosphate, parathyroid hormone, and vitamin D metabolism, which collectively heighten cardiovascular risk and mortality.(6) Experimental and clinical studies suggest that dietary phosphate restriction and phosphate binders may slow CKD progression and improve patient outcomes.(7)

Although these associations are extensively documented in Western and East Asian populations, there is a deficiency of data from low- and middle-income countries, including India. The Indian population with chronic kidney disease (CKD) exhibits unique demographic and clinical traits, such as an earlier onset of the disease, a greater prevalence of diabetes and hypertension, and varying patterns of dietary phosphorus intake. Earlier research in India has indicated a high prevalence of hyperphosphatemia in patients with advanced chronic kidney disease (CKD), yet there has been limited quantification of its association with estimated glomerular filtration rate (eGFR) or CKD stages.(8,9) Consequently, there exists an urgent necessity for region-specific investigations that evaluate the correlation between serum phosphorus levels and the severity of chronic kidney disease in non-dialysis patients.It is important to know how phosphorus levels and kidney function decline affect each other so that you can find and treat problems quickly. Detecting elevated phosphorus levels in chronic kidney disease (CKD) at an early stage could facilitate targeted dietary counselling, the utilisation of phosphate binders, and the optimisation of mineral metabolism, ultimately mitigating cardiovascular and renal complications.(10) Therefore, this study aims to evaluate the correlation between serum phosphorus levels and the severity of CKD in a tertiary care population in Chengalpattu district, Tamil Nadu, and to explore associated clinical and biochemical factors contributing to hyperphosphatemia in this cohort.

Methodology:

Study Setting

This was a cross-sectional observational study carried out in the Department of General Medicine and Nephrology at Karpaga Vinayaga Institute of Medical Sciences and Research Centre, located in Chengalpattu District, Tamil Nadu, India. The research was conducted over a duration of four months, spanning from December 2025 to March 2026. The Institutional Ethics Committee (SAC/IEC) approved the study, and all steps

*Author for Correspondence: drkeerthana812@gmail.com

were followed according to the Indian Council of Medical Research (ICMR) National Ethical Guidelines (2017).

Adult patients (≥18 years) diagnosed with chronic kidney disease (CKD) stages 3 to 5, as delineated by the Kidney Disease: Improving Global Outcomes (KDIGO) 2021 guidelines, were included. An estimated glomerular filtration rate (eGFR) of less than 60 mL/min/1.73 m² for at least three months was used to define CKD.

Patients were excluded if they were undergoing maintenance dialysis (haemodialysis or peritoneal dialysis), had acute kidney injury, a known parathyroid or malignant disease, severe hepatic dysfunction, or had commenced phosphate binders within the prior month.

Sampling Methods:

A consecutive sampling technique was employed to collect data from the hospital's Medical Record Department (MRD). Medical records of patients who attended the nephrology and general medicine outpatient departments were reviewed. The study covered a period of four months, during which 150 eligible patient records were included . A prestructured case record form was used to extract relevant patient data. To maintain confidentiality, all identifying information was removed before data analysis.

Data Collection:

We gathered demographic, clinical, and biochemical data, such as age, sex, comorbidities (like high blood pressure and diabetes), and serum phosphorus, calcium, creatinine, and parathyroid hormone (PTH) levels when they were available.

The colorimetric enzymatic method was used to measure serum phosphorus levels, and the Jaffe's kinetic assay was used to measure serum creatinine levels. We used the CKD Epidemiology Collaboration (CKD-EPI) equation to figure out the eGFR.

Variables:

The main independent variable was the amount of phosphorus in the serum (mg/dL).

The dependent variables included:

1. CKD severity, categorised based on KDIGO stages 3, 4, and 5.
2. The estimated glomerular filtration rate (eGFR) is a way to measure kidney function over time.
3.Age, diabetes mellitus, hypertension, calcium level, and PTH level were all possible confounding factors that were noted and taken into account in the analysis**.**

Operational Definitions:

- **CKD:** eGFR <60 mL/min/1.73 m² for ≥3 months.
- **Hyperphosphatemia:** serum phosphorus >4.5 mg/dL.
- **Calcium–phosphorus product:** calculated as Ca (mg/dL) × P (mg/dL).

Statistical Analysis

Data were entered into MS Excel and analysed using Jamovi (v.2.3.28) . Continuous variables were expressed as mean ± standard deviation (SD) and median and categorical variables were presented as frequencies and percentages. Comparisons of serum phosphorus level across CKD stages were performed using one-way ANOVA .The Spearman correlation coefficient (r) was used to assess the relationship between serum phosphorus and eGFR. Statistical significance was set at $p < 0.05$ (two-tailed).

Ethical Considerations

This study involved minimal risk to participants as all data were collected from routine medical records without additional procedures or costs. Patient confidentiality was strictly maintained through coded identifiers, and participation was voluntary, with the right to withdraw at any point without affecting standard care.

Results:

Table 1: Baseline Demographic Characteristics of the Study Participants

Variable	Category	n	Percentage
Age (years)	20–40	16	10.70%
	41–60	80	53.30%
	60–90	54	36.00%
Sex	Female	61	40.70%
	Male	89	59.30%

Table 2: Distribution of Major Comorbidities Among the Study Population

Co- morbidity	n	Percentage
Diabetes	78	52.00%
Hypertension	120	80.00%

Table 3: Classification of Participants According to CKD Stages

CKD_Stage	n	Percentage
3	48	32.00%
4	54	36.00%
5	48	32.00%

Table 4: Prevalence of Hyperphosphatemia in the Study Population

Hyperphosphatemia	n	Percentage
Yes	73	48.70%
No	77	51.30%

Table 5: Descriptive Statistics of Key Biochemical Parameters

Variable	Mean	Median	SD
eGFR	25.785	25.83	13.479
Serum Phosphorus	4.626	4.363	1.346
Serum Calcium	8.605	8.627	0.754

Table 6: Correlation Between eGFR and Serum Phosphorus Levels

Variables Compared	Spearman's rho (ρ)	p-value
eGFR vs Serum Phosphorus	−0.667	< 0.001

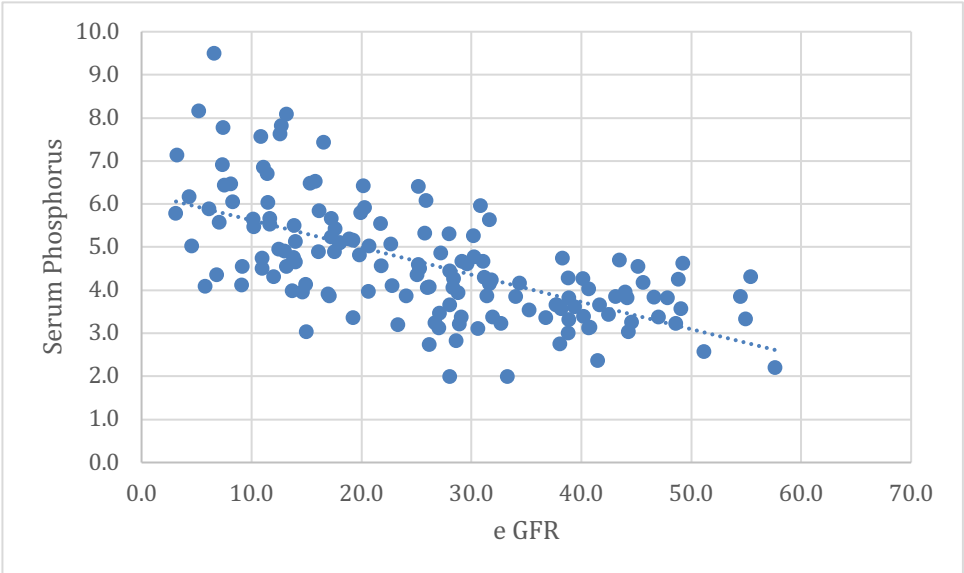

Figure 1: Scatter Plot Depicting the Correlation Between eGFR and Serum Phosphorus

Table 7:Comparision of phosphorus level across different CKD stages:

CKD Stage	N	Mean ± SD	p-value

Stage 3	48	3.59 ± 0.64	
Stage 4	54	4.51 ± 0.95	**< 0.001**
Stage 5	48	5.79 ± 1.35	

The compiled tables give a full picture of the study population's demographic, clinical, biochemical, and correlational traits. Table 1 shows the basic demographics, which show that most of the participants were men between the ages of 41 and 60. Table 2 shows the burden of major comorbidities, showing that diabetes and hypertension are very common in this group. Table 3 shows the severity distribution of renal dysfunction by dividing participants into CKD Stages 3, 4, and 5. This shows that moderate to severe kidney disease is evenly spread across the three stages.Table 4 provides more information about the biochemical profile by showing the percentage of people with and without hyperphosphatemia. This shows how common it is among CKD patients. Table 5 provides descriptive statistics for key laboratory parameters—eGFR, serum phosphorus, and serum calcium—offering insight into central tendencies and variability within the study population. Finally, Table 6 presents the results of a Spearman correlation analysis, revealing a strong, statistically significant inverse association between declining eGFR and rising serum phosphorus levels. Figure 1 illustrates this correlation via a scatter plot, corroborating the negative trend discerned in the statistical analysis.

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