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Correlation of C-Peptide with Creatinine and Estimated Glomerular Filtration Rate Among Kidney Failure Patients in Nnewi North, Nigeria

Collins Uchechukwu Obi[1]; Ihim Augustine Chinedu, Ikechukwu Vincent Obi[2]; Ogochukwu Chinwe Ugwunna[3]; Onyeka Franklin Chigozie[4]; Ijeoma Nnenna Agbiogwu[5]; Ifeoma Joy Onuora[6]; Blessing Ben-Anioke[7]; Chinwe Ebele Ejike[8]; Daniel Ezeobi[9]; Odo Vincentmary Chukwuemeka[10]

[1]Department of Clinical Chemistry, Faculty of Medical Laboratory Science, College of Medicine, Nnamdi Azikiwe University, Nnewi Campus, Anambra State.
[2]Department of Chemical Pathology, Faculty of Basic Clinical Sciences, College of Medicine, University of Nigeria, Ituku-Ozalla
[3]Federal Polytechnic Oko, Anambra State Nigeria
[4]Medical Laboratory science Faculty of Health Sciences and Technology, Chukwuemeka Odumegwu Ojukwu University Igbariam,
[5]University on the Niger, Umunya, Iyienu Campus,
[6]University of Nigeria Teaching Hospital, Enugu
[7]Tansian University Umunya, Nigeria

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Abstract

- ***Background:***

The increasing prevalence of chronic kidney disease (CKD) and its progression to kidney failure has become a major public health concern worldwide, particularly in developing regions such as Nnewi North Local Government Area (LGA) of Anambra State, Nigeria. CKD is commonly associated with metabolic abnormalities, including alterations in C-peptide levels. Understanding the role of these biochemical markers is essential for improving the management and prognosis of patients with kidney failure.

- ***Aim:***

This study evaluated the relationship between C-peptide, creatinine, and estimated glomerular filtration rate (eGFR) as biomarkers of kidney failure among patients in Nnewi North LGA, Anambra State, Nigeria.

- ***Materials and Methods:***

A cross-sectional study design was adopted involving 45 kidney failure patients and 45 apparently healthy controls aged 18–80 years. Anthropometric measurements, blood samples, and relevant clinical data were obtained from all participants. Serum C-peptide levels were analyzed using enzyme-linked immunosorbent assay (ELISA), while serum creatinine was determined using the Jaffe reaction method. Estimated glomerular filtration rate (eGFR) was calculated using standard equations. Statistical analysis was performed, and significance was accepted at $p < 0.05$.

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➢ ***Results:***

The results revealed significantly elevated levels of creatinine and C-peptide among kidney failure patients compared with healthy controls. Mean creatinine levels were 2.71 ± 0.88 mg/dL in kidney failure patients and 0.871 ± 0.24 mg/dL in controls, while C-peptide levels were 4.99 ± 2.52 ng/mL and 1.07 ± 0.98 ng/mL, respectively. Estimated glomerular filtration rate was significantly lower among kidney failure patients (27.15 ± 12.76 mL/min) compared to controls (118.84 ± 57.54 mL/min). No statistically significant gender differences were observed among kidney failure patients. Correlation analysis demonstrated strong negative relationships between eGFR and creatinine in both study groups.

➢ ***Conclusion:***

The study demonstrated substantial renal and metabolic dysfunction among kidney failure patients, as evidenced by elevated creatinine and C-peptide levels alongside markedly reduced eGFR. These findings emphasize the clinical importance of monitoring these biomarkers in the management of CKD and kidney failure.

➢ ***Recommendations:***

Routine assessment of C-peptide, creatinine, and eGFR should be incorporated into the clinical evaluation of kidney failure patients to enhance disease monitoring and treatment outcomes. Further region-specific and longitudinal studies involving larger sample sizes are recommended to provide more comprehensive insights into CKD progression and management in Nnewi North LGA and similar settings.

I. INTRODUCTION

The kidneys, though relatively small organs, play indispensable roles in maintaining homeostasis and overall human health. Chronic kidney disease (CKD), often described as a "silent killer," progresses gradually and may remain asymptomatic until significant renal impairment has occurred. Early identification of CKD through reliable biochemical markers such as C-peptide, creatinine, and estimated glomerular filtration rate (eGFR) is therefore essential for prompt intervention, improved clinical management, and enhanced patient outcomes.

Globally, CKD has emerged as a major public health concern, with an estimated prevalence of approximately 13.4% among adults (Hill *et al.,* 2016). The disease is characterized by a progressive decline in renal function which may ultimately progress to end-stage renal disease (ESRD), requiring renal replacement therapy such as dialysis or kidney transplantation (Levey *et al.,* 2015). In developing countries, particularly Nigeria, the burden of CKD continues to rise due to increasing rates of hypertension, diabetes mellitus, poor healthcare access, and late presentation of patients to healthcare facilities (Nwankwo et al., 2020).

In Nnewi North Local Government Area (LGA) of Anambra State, Nigeria, the prevalence of CKD has increased in recent years, reflecting global epidemiological trends. This rise has been largely attributed to the growing incidence of diabetes mellitus, hypertension, and other metabolic disorders that predispose individuals to kidney damage (Akinmoladun *et al.,* 2022). Many patients in the region remain unaware of their disease status until advanced stages, thereby increasing the number of individuals requiring dialysis for survival. Consequently, CKD places substantial pressure on healthcare systems and highlights the urgent need for improved diagnostic and management strategies.

Dialysis remains a life-sustaining therapeutic intervention for patients with ESRD by facilitating the removal of metabolic waste products, excess electrolytes, and fluids from the bloodstream (Kass *et al.,* 2019). Despite its effectiveness, dialysis patients commonly experience several metabolic complications, including insulin resistance and altered glucose metabolism. These abnormalities are influenced by chronic inflammation, uremic toxins, oxidative stress, and changes in body composition associated with CKD (Meyer et al., 2017). The coexistence of diabetes and CKD further complicates patient management because both conditions contribute significantly to worsening renal and metabolic dysfunction.

Among the biochemical markers used in evaluating CKD patients, C-peptide has gained increasing clinical relevance. C-peptide is a 31-amino acid peptide secreted from pancreatic beta cells during insulin synthesis and serves as an important indicator of endogenous insulin production (Zhang *et al.,* 2016). Assessment of C-peptide levels provides valuable information regarding pancreatic beta-cell function and insulin dynamics, particularly among patients undergoing dialysis. Studies have demonstrated that impaired renal clearance in CKD can alter C-peptide metabolism, leading to elevated circulating levels (Liu *et al.,* 2022). Elevated C-peptide concentrations may also reflect insulin resistance, a common metabolic disturbance observed in CKD patients, especially those with diabetic nephropathy (Köhler *et al.,* 2023).

Serum creatinine remains one of the most commonly utilized biomarkers for assessing renal function. Creatinine is a metabolic byproduct of muscle metabolism, and elevated serum creatinine concentrations are indicative of impaired kidney function (Garg *et al.,* 2016). Although creatinine measurement is widely used in clinical practice, its interpretation may be influenced by factors such as age, diet, muscle mass, and sex (Matsushita *et al.,* 2020). Consequently, reliance on serum creatinine alone may not provide a comprehensive evaluation of renal function.

The estimated glomerular filtration rate (eGFR), calculated using serum creatinine alongside demographic variables such as age and sex, provides a more accurate assessment of kidney function and disease progression (KDIGO, 2020). eGFR is widely used for staging CKD, monitoring disease progression, and guiding treatment decisions, including the initiation and adequacy of dialysis therapy (Levey *et al.*, 2020). Advances in eGFR calculation methods, including the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation, have further improved the precision of kidney function assessment.

Despite the growing number of CKD and dialysis patients in Nnewi North LGA, there remains limited region-specific data regarding the biochemical profiles of these patients, particularly concerning the relationship between C-peptide, creatinine, and eGFR. Existing studies have highlighted the importance of these biomarkers in evaluating renal and metabolic dysfunction; however, geographical data specific to southeastern Nigeria remain scarce (Chinonso *et al.*, 2024). This knowledge gap underscores the need for localized research to better understand the metabolic characteristics of CKD patients within the region and to develop management strategies tailored to the local population.

Therefore, this study seeks to evaluate the relationship between C-peptide, creatinine, and estimated glomerular filtration rate among dialysis patients in Nnewi North LGA of Anambra State, Nigeria. Findings from this study may contribute to improved understanding of the metabolic and renal alterations associated with CKD and provide valuable information for enhancing patient management and therapeutic outcomes in the region.

- *Problem Statement*

The rising prevalence of chronic kidney disease (CKD) in Anambra State has created an increasing demand for effective monitoring and management of patients undergoing dialysis. Several studies have demonstrated that complex interactions exist among biochemical markers such as C-peptide, creatinine, and estimated glomerular filtration rate (eGFR) in patients with kidney failure (Yuan et al., 2019). These biomarkers are important indicators of metabolic and renal function and may provide valuable information for assessing disease progression, treatment response, and overall patient prognosis.

Despite the growing burden of CKD and the increasing number of dialysis patients in Nnewi North Local Government Area (LGA) of Anambra State, there is limited region-specific information regarding the biochemical profiles of these patients. In particular, data concerning the relationship between C-peptide, creatinine, and eGFR among kidney failure patients in this population remain scarce. This lack of localized research has created a significant knowledge gap, limiting the availability of evidence-based information needed to improve patient care and guide healthcare policies within the region.

Furthermore, inadequate understanding of these biochemical parameters may hinder effective clinical management of CKD patients, especially those undergoing dialysis. Therefore, there is a critical need for targeted studies that investigate the metabolic and renal profiles of kidney failure patients in Nnewi North LGA. Such studies would provide empirical data necessary for improving disease monitoring, enhancing treatment strategies, and ultimately reducing CKD-related morbidity and mortality.

- *Justification of the Study*

This study was undertaken to provide valuable insights into the biochemical markers of kidney failure patients in Nnewi North LGA of Anambra State, Nigeria. The findings from this research may contribute to improved clinical management of CKD patients by enhancing understanding of the relationships among C-peptide, creatinine, and eGFR in individuals undergoing dialysis.

Although previous studies have investigated the association between C-peptide, creatinine, and eGFR, there is limited information available from Nigeria, particularly among populations in southeastern Nigeria. Consequently, this study aimed to determine the levels of C-peptide, creatinine, and eGFR among kidney failure patients in Nnewi North LGA, Anambra State. The results obtained may provide empirical evidence that could assist healthcare professionals in the management of kidney failure and contribute to the development of improved therapeutic and preventive strategies for CKD.

In addition, this study sought to evaluate whether demographic factors such as age and gender influence the prevalence and biochemical patterns of kidney failure among patients in the study area. The research also investigated the relationship between serum C-peptide concentration and renal function indicators, including creatinine and eGFR, among kidney failure patients. Findings from this study may therefore serve as a useful reference for future research and policy formulation aimed at improving CKD management and patient outcomes in Nigeria.

- *Aim and Objective of the Study*

The study was designed to ascertain the relationship between C-peptide, creatinine, and estimated glomerular filtration rate (eGFR) among kidney failure patients in Nnewi North Local Government Area (LGA) of Anambra State, Nigeria. Specifically, the study aimed to estimate and evaluate the relationship among C-peptide, creatinine, and eGFR levels between kidney failure patients and apparently healthy control subjects. The study also sought to determine the variations in these biomarkers among different genders within the study population. Furthermore, the study assessed the correlation between C-peptide, creatinine, eGFR, and anthropometric measurements of the participants.

II. MATERIALS AND METHODS

➢ *Study Area*

This study was conducted in Nnewi North Local Government Area (LGA), Anambra State, Nigeria. Nnewi North is located in southeastern Nigeria and consists primarily of the town of Nnewi, which is subdivided into four major quarters: Otolo, Uruagu, Umudim, and Nnewi-Ichi. The area comprises both urban and semi-urban settlements and is predominantly inhabited by individuals of Igbo ethnic origin. The estimated population of Nnewi North LGA is approximately 241,713 inhabitants.

➢ *Study Population*

The study population comprised adult kidney failure patients receiving treatment at the Nnamdi Azikiwe University Teaching Hospital. Participants included both males and females aged between 18 and 80 years. Apparently healthy individuals within the same age range served as controls.

➢ *Study Design*

A cross-sectional study design was adopted for this research. This design was considered appropriate because it enabled the assessment of biochemical parameters, including C-peptide, creatinine, and estimated glomerular filtration rate (eGFR), within a defined population at a single point in time. The approach also facilitated evaluation of the relationships among these biomarkers in kidney failure patients and apparently healthy individuals.

➢ *Subject Recruitment*

Participants were recruited between October 2024 and February 2025. A total of ninety (90) individuals participated in the study, consisting of forty-five (45) kidney failure patients and forty-five (45) apparently healthy control subjects. Kidney failure patients were recruited from Nnamdi Azikiwe University Teaching Hospital, while control subjects were recruited from different communities within Nnewi North LGA, Anambra State.

➢ *Sample Size Determination*

The sample size was calculated using G*Power software version 3.0.10. Power analysis for two independent groups was performed using an alpha level of 0.05, statistical power of 0.80, and medium effect size (d = 0.50). Based on these assumptions, a total sample size of 90 participants, comprising 45 participants per group, was considered adequate to detect statistically significant differences between the study groups.

➢ *Inclusion Criteria*

The study included adult kidney failure patients aged 18–80 years who had been receiving regular dialysis treatment, either hemodialysis or peritoneal dialysis, for a minimum period of three months.

➢ *Exclusion Criteria*

Patients with acute kidney injury, previous kidney transplantation, active infections, or other medical conditions capable of altering metabolic parameters were excluded from the study. Pregnant women, individuals with diabetes mellitus, cardiovascular diseases, hepatic disorders, cancers, human immunodeficiency virus (HIV) infection, liver dysfunction, and participants outside the specified age range were also excluded. In addition, individuals who were not residents of Nnewi North LGA or who declined informed consent were excluded from the study.

➢ *Ethical Consideration and Informed Consent*

Ethical approval for this study was obtained from the Ethics Committee of the Ministry of Health, Anambra State, Nigeria, and the Ethics Committee of Nnamdi Azikiwe University Teaching Hospital in accordance with the ethical principles outlined in the Helsinki Declaration for research involving human subjects. Written informed consent was obtained from all participants prior to sample collection and data acquisition.

➢ *Data Collection*

Data collection involved anthropometric measurements, blood pressure assessment, laboratory investigations, and participant interviews.

➢ *Anthropometric Measurements*

Body weight was measured using a calibrated bathroom weighing scale with participants wearing light clothing and standing barefooted. Measurements were recorded in kilograms to the nearest 0.1 kg. Height was measured using a stadiometer calibrated in centimeters, and readings were recorded to the nearest 0.1 cm. Body mass index (BMI) was subsequently calculated as weight in kilograms divided by the square of height in meters (kg/m^2).

Waist circumference was measured using a non-stretchable measuring tape at the midpoint between the iliac crest and the lower margin of the last palpable rib. Hip circumference was measured at the widest portion of the buttocks. All measurements were recorded to the nearest centimeter.

➢ *Blood Pressure Measurement*

Blood pressure measurements were obtained using a sphygmomanometer after participants had rested comfortably for at least ten minutes. Measurements were taken with participants seated upright, legs uncrossed, and arms supported at heart level. Systolic and diastolic blood pressure readings were measured in millimeters of mercury (mmHg), and the average of two readings was recorded for each participant.

➢ *Sample Collection and Processing*

Approximately 5 mL of venous blood was collected aseptically from each participant using disposable syringes. Blood samples were dispensed into plain sample containers and allowed to clot before centrifugation at 4000 rpm for 10 minutes. The separated serum was transferred into appropriately labeled plain containers and stored at −20°C until laboratory analysis.

➢ *Laboratory Analysis*

- *Estimation of C-Peptide*

Serum C-peptide levels were determined using the sandwich enzyme-linked immunosorbent assay (ELISA) technique with a Human C-peptide ELISA kit. The assay principle was based on antigen-antibody interaction in which the target antigen was immobilized between capture and enzyme-labeled antibodies. Following incubation and washing procedures, substrate solution was added for color development, and absorbance was measured spectrophotometrically at 450 nm using a microplate reader.

- *Estimation of Creatinine*

Serum creatinine concentration was determined using the Jaffe reaction method with a commercially available assay kit. In this method, creatinine reacts with picric acid in an alkaline medium to form a colored creatinine-picrate complex. The absorbance of the resulting complex was measured spectrophotometrically at 520 nm, and the concentration of creatinine was calculated relative to the standard calibrator.

- *Estimation of Estimated Glomerular Filtration Rate (eGFR)*

Estimated glomerular filtration rate was calculated using the Cockcroft–Gault equation:

$$eGFR = \frac{(140 - \text{Age}) \times \text{Weight (kg)} \times 0.85}{72 \times \text{Serum Creatinine}}$$

This formula was applied for serum creatinine expressed in mg/dL.

➢ *Statistical Analysis*

Data obtained from the study were analyzed using Statistical Package for Social Sciences (SPSS) version 23.0. Results were expressed as mean ± standard deviation (SD). Comparisons between groups were performed using Student's t-test, while correlation analysis was conducted using Pearson's correlation coefficient. Statistical significance was established at a 95% confidence interval, with p-values less than or equal to 0.05 considered statistically significant.

III. RESULTS

The results obtained in the investigations are presented in tables 1 - 5. All results are Mean ± Standard Deviation.

➢ *Comparison of Biochemical Parameters Between Kidney Failure Patients and Control Subjects*

Table 1 presents the mean ± standard deviation (SD) values of serum creatinine, C-peptide, estimated glomerular filtration rate (eGFR), and body mass index (BMI) among kidney failure patients and apparently healthy control subjects. The mean serum creatinine concentration among kidney failure patients was 2.71 ± 0.88 mg/dL, while the control group recorded a significantly lower value of 0.871 ± 0.24 mg/dL. Similarly, the mean C-peptide level was significantly higher among kidney failure patients compared to controls. The eGFR values among kidney failure patients were markedly reduced (27.15 ± 12.76 mL/min) compared with the control group (118.84 ± 57.54 mL/min), indicating severe impairment in renal function among the patient group.

Body mass index values were 24.40 ± 3.07 kg/m² among kidney failure patients and 22.13 ± 3.61 kg/m² among control subjects. Statistical analysis revealed that serum creatinine and C-peptide levels were significantly elevated among kidney failure patients when compared with controls ($p < 0.05$), whereas eGFR was significantly lower among kidney failure patients ($p < 0.05$). However, BMI did not differ significantly between the two groups ($p > 0.05$).

➢ *Gender Distribution of Biochemical Parameters Among Kidney Failure Patients*

Table 2 shows the gender distribution of serum creatinine, C-peptide, eGFR, and BMI among kidney failure patients. Female kidney failure patients had mean creatinine, eGFR, and BMI values of 2.68 ± 0.66 mg/dL, 25.62 ± 11.05 mL/min, and 24.93 ± 3.19 kg/m², respectively, while male kidney failure patients had corresponding values of 2.80 ± 0.85 mg/dL, 28.00 ± 13.72 mL/min, and 24.10 ± 3.02 kg/m², respectively.

The analysis indicated that there were no statistically significant differences in creatinine, C-peptide, eGFR, or BMI values between male and female kidney failure patients ($p > 0.05$).

➢ *Gender Distribution of Biochemical Parameters Among Control Subjects*

Table 3 presents the gender distribution of serum creatinine, C-peptide, eGFR, and BMI among apparently healthy control subjects. Female control subjects recorded mean creatinine, eGFR, and BMI values of 0.83 ± 0.27 mg/dL, 96.68 ± 37.73 mL/min, and 22.05 ± 3.76 kg/m², respectively. Male control subjects had corresponding values of 0.85 ± 0.23 mg/dL, 135.03 ± 64.48 mL/min, and 22.18 ± 3.57 kg/m², respectively.

Statistical analysis demonstrated no significant differences in creatinine, C-peptide, eGFR, or BMI values between male and female control subjects ($p > 0.05$).

➢ *Correlation Analysis Among Kidney Failure Patients*

Table 4 illustrates the correlation analysis among biochemical parameters and anthropometric indices in kidney failure patients. The findings showed that eGFR exhibited a significant negative correlation with serum creatinine ($r = -0.630$, $p < 0.01$) and BMI ($r = -0.368$, $p < 0.05$). However, C-peptide did not show any significant correlation with BMI among kidney failure patients.

➢ *Correlation Analysis Among Control Subjects*

Table 5 presents the correlation analysis among biochemical parameters and anthropometric indices in the

control group. The results demonstrated that C-peptide showed a significant positive correlation with BMI ($r = 0.555$, $p < 0.01$). In addition, serum creatinine exhibited a significant negative correlation with eGFR ($r = -0.628$, $p < 0.01$).

Table 1 Creatinine, C-Pepide, EGFR and BMI in Kidney Failure Patients Group and Control Group.

	Kidney failure Patients	**Controls**		
Parameters	**n = 45**	**n = 45**	**t-value**	**p-value**
Creatinine (mg/dl)	2.71 ± 0.88	0.871 ± 0.24	13.58	0.00 (S)
C-peptide (ng/ml)	4.99 ± 2.52	1.07 ± 0.98	9.71	0.00 (S)
eGFR (ml/m)	27.15 ± 12.76	118.84 ± 57.54	-10.43	0.00 (S)
BMI (kg/m²)	24.40 ± 3.07	22.13 ± 3.61	3.20	0.43 (NS)

KEY: n: Number of samples, n: Number of samples, t – value: Student t-test, P – value: Probability value, S: Significant, eGFR: Estimated Glomerular Filtration Rate, BMI: Body Mass Index, NS: Not Significant and SD: Standard Deviation

Table 2 Creatinine, C-Peptide, EGFR and BMI in Female and Male Among Kidney Failure Patients Group.

	Female	**Male**		
Parameters	**n = 16**	**n = 29**	**t-value**	**p-value**
Creatinine (mg/dl)	2.68 ± 0.66	2.80 ± 0.85	-0.48	0.25 (NS)
C-peptide (ng/ml)	4.67 ± 2.73	5.17 ± 2.43	-0.62	0.41 (NS)
eGFR (ml/m)	25.62 ± 11.05	28.00 ± 13.72	-0.59	0.10 (NS)
BMI (kg/m²)	24.93 ± 3.19	24.10 ± 3.02	0.86	0.72 (NS)

Table 3 Creatinine, C-Peptide, EGFR and BMI in Female and Male Among Control Group.

	Female	**Male**		
Parameters	**n = 19**	**n = 26**	**t-value**	**p-value**
Creatinine (mg/dl)	0.83 ± 0.27	0.85 ± 0.23	-0.33	0.57 (NS)
C-peptide (ng/ml)	0.96 ± 0.64	1.15 ± 1.17	-0.63	0.23 (NS)
eGFR (ml/m)	96.68 ± 37.73	135.03 ± 64.48	-2.31	0.26 (NS)
BMI (kg/m²)	22.05 ± 3.76	22.18 ± 3.57	-0.11	0.47 (NS)

Table 4 Correlations of Creatinine, C-Peptide, EGFR and BMI in Kidney Failure Patients in the Study Area

Parameters	**n**	**Creatinine (mg/dl)**	**C-peptide (ng/ml)**	**eGFR (ml/m)**	**BMI (kg/m²)**
Creatinine (mg/dl)	45	1.00	0.261	-0.630**(r)	0.236
C-peptide (ng/ml)	45	0.261	1.00	-0.118	0.094
eGFR (ml/m)	**45**	-0.630**(r)	-0.118	1.00	-0.368*(r)
BMI (kg/m²)	45	0.236	0.094	-0.368*(r)	1.00

Table 5 Correlations of Creatinine, C-Peptide, EGFR and BMI in Control Group in the Study Area

Parameters	**N**	**Creatinine (mg/dl)**	**C-peptide (ng/ml)**	**eGFR (ml/m)**	**BMI (kg/m²)**
Creatinine (mg/dl)	45	1.00	-0.086	-0.628**(r)	0.007
C-peptide (ng/ml)	45	-0.086	1.00	-0.101	0.286
eGFR (ml/m)	45	-0.628**(r)	-0.101	1.00	0.044
BMI (kg/m²)	45	0.007	0.286	0.044	1.00

IV. DISCUSSION

This study evaluated the relationship between C-peptide, creatinine, and estimated glomerular filtration rate (eGFR) among kidney failure patients in Nnewi North Local Government Area (LGA) of Anambra State, Nigeria. The findings demonstrated significant alterations in the biochemical profiles of kidney failure patients when compared with apparently healthy control subjects, thereby emphasizing the metabolic and renal abnormalities associated with chronic kidney disease (CKD) and end-stage renal disease (ESRD).

The results of the present study revealed significantly elevated serum creatinine and C-peptide levels among kidney failure patients compared to the control group. The observed increase in serum creatinine concentration among kidney failure patients is consistent with the underlying pathophysiology of CKD, where progressive impairment of renal function leads to reduced clearance of nitrogenous waste products. Elevated creatinine levels are therefore indicative of declining glomerular filtration and severe renal dysfunction. This finding agrees with previous studies that identified increased serum creatinine as a hallmark of advanced CKD and ESRD (Hill *et al.*, 2016).

Similarly, the elevated C-peptide levels observed among kidney failure patients may be attributed to insulin resistance and altered metabolic regulation commonly

associated with CKD. Insulin resistance is prevalent among patients with chronic kidney disease and is often influenced by chronic inflammation, oxidative stress, uremic toxins, and changes in body composition that interfere with insulin signaling pathways (Meyer *et al.*, 2017). Impaired renal clearance of C-peptide may also contribute to its accumulation in circulation among patients with severe renal dysfunction. These findings support previous reports that metabolic disturbances play major roles in the progression and complications of CKD.

The study further demonstrated significantly lower eGFR values among kidney failure patients compared with healthy controls. Reduced eGFR is a well-established indicator of impaired kidney function and reflects the progressive decline in renal filtration capacity associated with CKD and ESRD. The markedly reduced eGFR observed among kidney failure patients in this study confirms the severity of renal impairment in this population and supports the necessity for renal replacement therapies such as dialysis. This observation is consistent with findings from previous studies which reported significantly reduced eGFR among CKD patients, particularly in advanced disease stages (Levey *et al.*, 2020).

Assessment of gender-related differences showed no statistically significant differences in creatinine, C-peptide, eGFR, or body mass index (BMI) between male and female kidney failure patients. This finding suggests that the metabolic and renal disturbances associated with CKD may affect both genders similarly within the study population. The absence of significant gender variations implies that clinical management and monitoring strategies for kidney failure patients may not necessarily require gender-specific modifications in this setting.

Correlation analysis revealed a strong negative relationship between eGFR and serum creatinine levels among both kidney failure patients and healthy controls. This inverse relationship is physiologically expected because declining renal function results in reduced excretion and subsequent accumulation of creatinine in the bloodstream. The findings further validate the reliability of serum creatinine and eGFR as important biomarkers for assessing renal function.

In addition, a negative correlation was observed between eGFR and BMI among kidney failure patients, suggesting that increased body mass index may contribute to worsening renal dysfunction. Obesity and increased adiposity are known to exacerbate insulin resistance, inflammation, and metabolic stress, all of which may accelerate CKD progression. Among control subjects, C-peptide demonstrated a positive correlation with BMI, further supporting the relationship between metabolic dysregulation, obesity, and insulin resistance.

The findings of this study have important clinical implications. Routine assessment of creatinine, C-peptide, and eGFR among kidney failure patients may enhance monitoring of renal and metabolic status, thereby facilitating early detection of complications and improved patient management. Monitoring C-peptide levels may also provide additional information regarding insulin dynamics and metabolic abnormalities in CKD patients, particularly those with coexisting diabetes mellitus or insulin resistance.

Furthermore, the strong association between eGFR and serum creatinine highlights the importance of using eGFR as a more comprehensive indicator of renal function rather than relying solely on serum creatinine concentration. The use of standardized equations such as the CKD-EPI formula improves the accuracy of renal assessment and assists clinicians in staging CKD and guiding therapeutic decisions.

V. CONCLUSION

This study provided important insights into the biochemical profiles of kidney failure patients in Nnewi North LGA of Anambra State, Nigeria. The findings demonstrated that kidney failure patients had significantly elevated serum creatinine and C-peptide levels, alongside markedly reduced eGFR values when compared with apparently healthy control subjects. These alterations reflect the severe renal and metabolic dysfunction associated with chronic kidney disease and end-stage renal disease.

The study also established significant relationships among creatinine, C-peptide, and eGFR, highlighting their importance as biomarkers in the assessment and management of kidney failure patients. Additionally, the absence of significant gender differences in biomarker levels suggests that CKD-related metabolic and renal disturbances may affect both male and female patients similarly within the study population.

Overall, the study emphasizes the importance of comprehensive biochemical monitoring in kidney failure patients to improve clinical management, optimize treatment strategies, and enhance patient outcomes. The findings further underscore the need for region-specific studies to better understand the unique characteristics of CKD patients in different populations.

VI. LIMITATIONS OF THE STUDY

Despite the valuable findings obtained from this study, certain limitations should be acknowledged. Firstly, the cross-sectional study design limited the ability to establish causal relationships between the biomarkers and progression of CKD. Secondly, the sample size, although statistically adequate, may not fully represent the broader population of kidney failure patients within Nnewi North LGA and beyond. Lastly, the study was conducted within a specific geographical region; therefore, the findings may not be generalizable to populations with different genetic, environmental, and socioeconomic characteristics.

RECOMMENDATIONS

Based on the findings of this study, routine monitoring of serum creatinine, C-peptide, and estimated glomerular filtration rate (eGFR) should be incorporated into the clinical management of kidney failure patients to facilitate early detection of metabolic and renal complications. Regular assessment of these biomarkers may improve patient monitoring, disease evaluation, and therapeutic outcomes.

Healthcare providers should also adopt comprehensive management strategies targeted at reducing insulin resistance and correcting metabolic abnormalities commonly observed among chronic kidney disease (CKD) patients. Such interventions may contribute significantly to improved patient care and better clinical outcomes.

In addition, public health awareness programs should be strengthened to educate the population on the major risk factors associated with CKD, particularly hypertension and diabetes mellitus, which are leading contributors to kidney failure. Early detection and proper management of these conditions may help reduce the burden of CKD within the community.

Furthermore, there is a need for more region-specific studies on CKD and kidney failure patients in Nigeria to generate localized data that can guide healthcare policies, clinical practices, and management strategies tailored to the population. Standardized diagnostic protocols for the evaluation of biochemical markers among kidney failure patients should also be developed and implemented to ensure consistency, accuracy, and reliability in clinical assessment and patient management.

Finally, future studies should adopt longitudinal study designs with larger sample sizes to better evaluate the progression of CKD and the long-term effects of dialysis on biochemical and metabolic parameters among kidney failure patients.

REFERENCES

[1]. Akinmoladun, F., Ayodele, O., & Omotoso, A. (2022) 'Prevalence and Patterns of Chronic Kidney Disease in Nigeria: A Systematic Review'. Nigerian Journal of Clinical Practice, 25(6), pp. 1305-1313.

[2]. Boron, W.F. & Boulpaep, E.L. (2020). Medical Physiology. 3rd ed. Philadelphia: Elsevier.

[3]. Charan, J., & Biswas, T. (2013). How to calculate sample size for different study designs in medical research? Indian Journal of Psychological Medicine, 35(2), 121-126.

[4]. Chaudhary, K., Sethi, R., and Singh, S. (2018). 'Insulin resistance in patients with chronic kidney disease: A review', Journal of Renal Nutrition, 28(4), pp. 239-244.

[5]. Chaudhary, K., Sethi, R., and Singh, S. (2020). 'Insulin resistance in patients with chronic kidney disease: A review', Journal of Renal Nutrition, 30(2), pp. 151-158.

[6]. Chinonso, C., Okeke, A., & Obi, A. (2024) 'Kidney failure Practices and Patient Outcomes in Anambra State: A Review'. Journal of Nigerian Nephrology, 12(2), pp. 88-96.

[7]. Creswell, J.W. and Creswell, J.D. (2018). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. 5th edn. Thousand Oaks, CA: Sage Publications.

[8]. Garg, A.X., Hackam, D., & Margetis, S. (2021) 'Serum Creatinine and its Role in Chronic Kidney Disease'. Journal of Nephrology and Urology, 20(3), pp. 112-119.

[9]. GBD Collaborators (2020). "Global Burden of Disease Study 2019: Results and Insights." The Lancet, 396(10258), pp. 1204-1222.

[10]. GBD (2023) Global Burden of Disease Study 2023.

[11]. General Assembly of the World Medical Association (2014). World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. The Journal of the American College of Dentists, 81(3), 14–18.

[12]. Hall, J.E. (2021). Guyton and Hall Textbook of Medical Physiology. 14th ed. Philadelphia: Elsevier.

[13]. Healthdirect. (2025). Kidney failure.

[14]. Hill, N.R., Fatoba, S.T., Oke, J.L. (2016). 'Global prevalence of chronic kidney disease – a systematic review and meta-analysis', PLoS One, 11(7), e0158765.

[15]. IIes, R.K., Javid, M.K., Gunn, L.K., (2010). "HCG and its fragments as markers of prognosis in cancer". Tumor Biology, 31(4), 213-225.

[16]. Inker, L.A., Eckfeldt, J.H., and Levey, A.S. (2014). 'Estimating Glomerular Filtration Rate from Serum Creatinine: A Review', Clinical Journal of the American Society of Nephrology, 9(5), pp. 897-905.

[17]. Jones, A.G., Hattersley, A.T., & Shields, B.M. (2021). "C-Peptide in Diabetes: A Useful Marker of Beta-Cell Function." Diabetes Care, 44(3), 123-130.

[18]. Kalluri, R., (2021) 'PLA2R Antibodies as Biomarkers in Membranous Nephropathy', American Journal of Kidney Diseases, 77(5), pp. 705-715.

[19]. Kass, D.A., Bhat, R., and O'Neill, K. (2019). 'The Role of Kidney failure in Managing End-Stage Renal Disease', American Journal of Kidney Diseases, 73(2), pp. 258-272.

[20]. KDIGO (2020) Clinical Practice Guidelines for the Evaluation and Management of Chronic Kidney Disease. Kidney Disease: Improving Global Outcomes.

[21]. Kellum, J.A., Lameire, N., & KDIGO AKI Guideline Work Group (2021). "Diagnosis, Evaluation, and Management of Acute Kidney

Injury." Kidney International Supplements, 2(1), 1-138.
[22]. Köhler, A., Ketteler, M. & Biehl, M. (2023) 'Altered Insulin Metabolism and C-Peptide Levels in Chronic Kidney Disease'. Diabetes and Metabolism Journal, 47(1), pp. 43-52.
[23]. Koeppen, B.M. & Stanton, B.A. (2019). Renal Physiology. 6th ed. St. Louis: Mosby.
[24]. Kraemer, H.C., Mintz, J., Noda, A., Tinklenberg, J., and Yesavage, J.A. (2018). 'Caution regarding the use of pilot studies to guide power calculations', Archives of General Psychiatry, 55(5), pp. 487-493.
[25]. Levey, A.S., Becker, C., & Inker, L.A. (2020) 'GFR Estimation: From Physiology to Public Health'. American Journal of Kidney Diseases, 75(6), pp. 1081-1088.
[26]. Levey, A.S., Becker, C., and Inker, L.A. (2015). 'Global kidney health 2017: from vision to action', Kidney International, 92(5), pp. 1057-1064.
[27]. Levey, A.S., Stevens, L.A., & Schmid, C.H. (2020). "A New Equation to Estimate Glomerular Filtration Rate." Annals of Internal Medicine, 150(9), pp. 604-612.
[28]. Levey, A.S., Stevens, L.A., Schmid, C.H., Zhang, Y., Castro, A.F. IV, and Feldman, H.I. (2009). 'A new equation to estimate glomerular filtration rate', Annals of Internal Medicine, 150(9), pp. 604-612.
[29]. Liu, Y., Zheng, K., & Sun, Z. (2022) 'C-Peptide and Insulin Resistance in Kidney failure Patients'. Diabetes Research and Clinical Practice, 179, pp. 108672.
[30]. Matsushita, K., van der Velde, M., Astor, B.C., et al. (2020) 'Association of Estimated Glomerular Filtration Rate and Albuminuria with Mortality and End-Stage Renal Disease in the United States'. JAMA, 323(18), pp. 1880-1889.
[31]. Meyer, T.W., and Hostetter, T.H. (2017). 'Uremic Solutes and the Role of the Kidney', Clinical Journal of the American Society of Nephrology, 12(10), pp. 1661-1671.
[32]. Morton, R.L., Webster, A.C., & Nagler, E.V. (2020). "Chronic Kidney Disease." The Lancet, 389(10075), pp. 1238-1252.
[33]. Nath, K.A. (2021). "Pathophysiology of Chronic Kidney Disease." New England Journal of Medicine, 385(18), pp. 1732-1742.
[34]. Nogueira, A. D., Silva, G. M., and Soares, F. (2020) 'Novel Biomarkers for Kidney Disease: Emerging Insights and Applications', International Journal of Molecular Sciences, 21(4), p. 1119.
[35]. Nwankwo, E.E., Isezuo, S.A., and Buseri, F.I. (2020). 'Chronic Kidney Disease in Nigeria: A Review', African Journal of Nephrology, 23(1), pp. 1-7.
[36]. Ojeifo, F., (2021) 'Longitudinal Analysis of Biomarkers for Kidney Disease Progression in Kidney failure Patients', Clinical Nephrology, 95(3), pp. 203-209.
[37]. Okechukwu, F., Onyekwelu, D. M., and Ibekwe, T. (2020) 'Environmental and Genetic Factors in Kidney Disease in Anambra State, Nigeria', Nigerian Journal of Clinical Practice, 23(12), pp. 1801-1808.
[38]. Okoye, O., Uzoigwe, A., and Adeyemi, A. (2021) 'Biomarkers of Kidney Failure in Kidney failure Patients: A Review of the Literature in Sub-Saharan Africa', African Journal of Nephrology, 23(1), pp. 14-19.
[39]. OpenStax. (2018). Urinary system. In Anatomy & Physiology.
[40]. Rogers, N.K., Manders, T., and Collins, J. (2019). 'C-peptide as a Biomarker of Insulin Secretion', Diabetes Research and Clinical Practice, 155, pp. 107-115.
[41]. Saran, R., (2020) 'Global Kidney failure Therapy Trends and Their Implications for Biomarker Research', Journal of Nephrology, 33(4), pp. 579-585.
[42]. Saran, R., Robinson, B., Abbott, K.C. (2023) 'US Renal Data System 2022 Annual Data Report: Epidemiology of Kidney Disease in the United States'. American Journal of Kidney Diseases, 81(2), pp. S1-S324.
[43]. Schrezenmeier, E., (2021) 'Kidney failure -Related Complications and Their Impact on Biomarker Levels in Kidney failure Patients', Nephrology Kidney failure Transplantation, 36(2), pp. 352-358.
[44]. Singh, S., (2021) 'Biomarkers in Chronic Kidney Disease: From Bench to Bedside', Nephrology Kidney failure Transplantation, 36(5), pp. 751-758.
[45]. Smith, A.C., Toto, R.D., & Bakris, G.L. (2022). "Insulin Resistance in Chronic Kidney Disease." Kidney International, 101(4), pp. 789-801.
[46]. Torrens, J., Rees, G., & Williams, A. (2021) 'The Role of C-Peptide in Diabetic Kidney Disease'. Clinical Kidney Journal, 14(4), pp. 923-930.
[47]. Ulasi, I.I. & Ijoma, C.K. (2021). "The Burden of Chronic Kidney Disease in Nigeria." Nigerian Journal of Clinical Practice, 24(5), pp. 1-8.
[48]. Webster, A.C., Nagler, E.V., & Morton, R.L. (2020). "Chronic Kidney Disease." The Lancet, 389(10075), pp. 1238-1252.
[49]. Yuan, M., and Zhang, H. (2019). 'Role of C-peptide in diabetes and chronic kidney disease', Diabetes Research and Clinical Practice, 152, pp. 51-60.
[50]. Zhang, H., Yu, M., and Xu, X. (2016). 'C-peptide and Its Role in Diabetes and Chronic Kidney Disease', Diabetes Research and Clinical Practice, 116, pp. 51-59.