International Journal of Scientific Research and Modern Technology (IJSRMT) *ijsrmt.com*
Volume 5, Issue 5, 2026
DOI: https://doi.org/10.38124/ijsrmt.v5i5.1435

Evaluation of Insulin with Gold Standard Creatinine and eGFR as Markers for Kidney Failure Among Dialysis Patient in Nnewi North LGA, Anambra State

Collins Uchechukwu Obi[1]; 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 Ejike[8]; Odo Vincentmary Chukwuemeka[9]; Augustine Chiendu Ihim[10]

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

Publication Date: 2026/07/29

Abstract

This study evaluated the relationship between insulin, creatinine, and estimated glomerular filtration rate (eGFR) as biomarkers for kidney failure among dialysis patients in Nnewi North Local Government Area (LGA) of Anambra State, Nigeria. A cross-sectional design was employed, involving 45 patients on dialysis and 45 healthy controls aged 18-80 years. Anthropometric measurements, blood samples, and clinical data were collected, and biomarkers were analyzed using ELISA and Jaffe reaction methods. Results revealed significantly higher levels of creatinine (2.71 ± 0.88 mg/dL) and insulin (30.40 ± 35.82 uU/mL) in dialysis patients compared to controls (0.871 ± 0.24 mg/dL, 4.71 ± 6.46 uU/mL, and 1.07 ± 0.98 ng/mL, respectively), alongside significantly lower eGFR (27.15 ± 12.76 mL/min) in dialysis patients versus controls (118.84 ± 57.54 mL/min). No significant gender differences were observed among dialysis patients, but male controls exhibited higher insulin levels. Strong negative correlations were found between eGFR and creatinine in both groups, while insulin positively correlated with BMI in dialysis patients in controls. These findings underscore the metabolic and renal dysfunction in dialysis patients, highlighting the importance of monitoring these biomarkers for effective management of chronic kidney disease (CKD). The study recommends routine biomarker monitoring, management of insulin resistance, and region-specific research to improve CKD outcomes in Nnewi North LGA. Limitations include the cross-sectional design and sample size, suggesting the need for longitudinal studies with larger cohorts.

Obi, C. U., Obi , I. V., Ugwunna, O. C., Chigozie, O. F., Agbiogwu , I. N., Onuora, I. J., … Ihim, A. C. (2026). Evaluation of Insulin with Gold Standard Creatinine and eGFR as Markers for Kidney Failure Among Dialysis Patient in Nnewi North LGA, Anambra State. *International Journal of Scientific Research and Modern Technology, 5*(5), 103–112. https://doi.org/10.38124/ijsrmt.v5i5.1435

I. INTRODUCTION

The kidneys may be small, but they have a profound effect on our life. In other words, chronic kidney disease (CKD) is a silent killer, and early detection through biomarkers like Insulin, creatinine, and estimated Glomerular Filtration Rate (eGFR) is crucial for timely intervention and improved patient outcomes.

The increasing prevalence of chronic kidney disease (CKD) and its management through dialysis has become a significant public health issue worldwide, particularly in developing regions like Nnewi North Local Government Area (LGA) of Anambra State, Nigeria. CKD is often associated with metabolic disorders, including abnormalities in insulin levels (Chaudhary *et al*., 2018). Understanding these biochemical markers is essential for optimizing the management of patients undergoing dialysis.

Chronic kidney disease (CKD) is increasingly recognized as a major public health concern globally, with an estimated prevalence of 13.4% among adults (Hill *et al.*, 2016). This progressive condition, characterized by a gradual decline in kidney function, can lead to end-stage renal disease (ESRD), necessitating renal replacement therapy such as dialysis or transplantation (Levey *et al*., 2015). In Nigeria, the burden of CKD is particularly alarming, driven by rising rates of diabetes mellitus, hypertension, and inadequate healthcare resources (Nwankwo*et al*., 2020). Nnewi North LGA of Anambra State, with its densely populated urban and rural areas, faces a critical challenge in managing patients with CKD, many of whom are unaware of their condition until it has advanced significantly.

Globally, especially in Nnewi North LGA of Nigeria, chronic kidney disease (CKD) is a major public health concern. The kidneys gradually lose their capacity to remove metabolic waste products from the blood in chronic kidney disease (CKD), which can result in end-stage renal disease (ESRD). Dialysis is required when end-stage renal disease (ESRD) develops since it replaces the kidney's vital functions artificially (KDIGO, 2020).Due to the increased incidence of diabetes, hypertension, and other illnesses that can harm the kidneys, chronic kidney disease (CKD) is becoming more widely acknowledged as a serious public health concern (Jassam*et al.*, 2023).

In Nnewi North LGA of Nigeria, the prevalence of CKD has been rising, In line with worldwide trends. This increase is largely attributed to the rising incidence of diabetes mellitus and hypertension, two primary risk factors for CKD (Akinmoladun *et al.*, 2022). Anambra State's status is consistent with the nationwide trend, as more patients need dialysis as their CKD advances to more severe stages. According to reports, CKD affects the majority of the adult population in Nnewi North LGA of Anambra State located in southeastern Nigeria, which puts great pressure on the healthcare system and highlights the need for more focused research and better management techniques (Chinonso *et al*., 2024). Despite this increase, there is a notable lack of detailed, region-specific research on the biochemical profiles of dialysis patients in Nnewi North LGA of Anambra State.

Effective management techniques are urgently needed since chronic kidney disease (CKD) is one of the leading causes of morbidity and mortality worldwide, according to the Global Burden of Disease Study (GBD, 2023). A growing number of patients in Nnewi North LGA of Anambra State, in southeast Nigeria, are receiving dialysis treatments; nevertheless, there is still a lack of information in this area about its biochemical markers.

Effective management of CKD involves monitoring various biochemical markers that can provide insights into kidney function and overall metabolic health. Among these markers, Insulin, creatinine, and estimated Glomerular Filtration Rate (eGFR) are particularly significant.

Dialysis is a life-sustaining treatment for patients with end-stage renal disease (ESRD),facilitating the removal of metabolic waste, excess electrolytes, and fluid from the bloodstream (Kass *et al.*, 2019). While effective, dialysis also presents numerous challenges, including the management of metabolic disorders such as insulin resistance, which is commonly observed in these patients. Insulin resistance in CKD is influenced by several factors, including inflammation, altered body composition, and the presence of uremic toxins that interfere with insulin signaling pathways (Meyer *et al.*, 2017). The coexistence of diabetes in dialysis patients complicates their management, as both conditions exacerbate each other's effects.

Additionally, the evaluation of kidney function typically involves measuring serum creatinine levels and calculating the estimated Glomerular Filtration Rate (eGFR) (Inker *et al.*, 2014). Elevated serum creatinine indicates impaired kidney function, while eGFR provides a more precise measure of renal health, adjusting for factors such as age, sex, and race (Levey *et al*., 2015). These markers are crucial for assessing the severity of CKD and guiding treatment decisions, including the initiation of dialysis.

Creatinine, a byproduct of muscle metabolism, is routinely measured to assess kidney function. Serum creatinine levels above normal are a basic diagnostic for the diagnosis and treatment of chronic kidney disease (CKD) since they indicate a decline in renal function (Garg *et al*., 2016). According to Matsushita *et al.* (2020), there is a well-established correlation between creatinine levels and renal function. However, there are other factors that can affect creatinine levels, including age, food, and muscle mass.

Serum creatinine levels alone cannot offer a complete evaluation of renal function; recent research highlights the necessity for other markers and techniques (Saran *et al*.,

2023). As creatinine levels are regularly checked in dialysis patients to guarantee proper dialysis and make necessary treatment adjustments as needed.

The estimated Glomerular Filtration Rate (eGFR) is a crucial parameter in evaluating kidney function. Serum creatinine levels are used in conjunction with age, sex, and race to compute it (KDIGO, 2020). Compared to serum creatinine alone, the eGFR offers a more precise picture of renal function, making it a crucial tool for staging CKD and tracking the course of the illness (Levey *et al*., 2020).

The accuracy of kidney function evaluations has increased due to recent developments in eGFR computation techniques, such as the CKD-EPI formula (Levey *et al.*, 2020). Determining the right amount of dialysis and treating CKD depend on accurate eGFR measurement. When it comes to optimizing patient outcomes, eGFR assists in customizing treatment programs and making the required modifications for dialysis patients.

Nnewi North LGA of Anambra State's growing dialysis patient population highlights the necessity for targeted studies on biochemical indicators in this patient population. Even though the number of dialysis facilities has increased, thorough information about the biochemical profiles of dialysis patients in the area is still lacking. Research specific to Anambra State is very important for comprehending the distinctive traits of the local patient population and developing management plans that would enhance patient outcomes.

According to recent research, there is no geographical information available regarding the relationship between dialysis patients' eGFR levels, creatinine, and Insulin levels (Chinonso*et al.*, 2024). This study attempts to fill the knowledge gap in Nnewi North LGA of Anambra State on these criteria and offer suggestions for improving the care of CKD patients.

Furthermore, assessment of the levels of creatinine, eGFR , Insulin in Nnewi North LGA of Anambra State dialysis patients could be used to the management of patient care. By better understanding these individuals' metabolic profiles, this study will help develop more effective strategies for treatment.

- *Problem Statement*

The increasing prevalence of CKD in Anambra State has highlighted the need for comprehensive monitoring of patients undergoing dialysis. Research indicates that there is a complex interplay between insulin levels, creatinine, and eGFR in dialysis patients. Understanding these relationships is vital for optimizing patient management and improving clinical outcomes (Yuan *et al.*, 2019). There was a noticeable lack of localized studies focusing on these biochemical parameters among dialysis patients in Nnewi North LGA of Anambra State. This gap in research highlighted the urgent need for targeted investigations that explore the metabolic profiles of this population, providing valuable data that can inform healthcare practices and policies.

However, the specific biochemical profiles, such as Insulin, creatinine, and eGFR levels, in this patient population are not well-documented. Understanding these parameters is critical for improving patient management and outcomes, this then remains the focus of this work.

- *Justification*

This study provided valuable insights into the biochemical markers of kidney failure patients in Nnewi North LGA of Anambra State, Nigeria. The findings informed clinical practices and improve patient management strategies, potentially leading to better health outcomes.

There is a scarcity of data on the association between Insulin, with and creatinine, and eGFR . However, none of this data is linked to Nigeria or any race in the country; so; this project aim to determine the levels of Insulin, creatinine, and eGFR levels in kidney failure patients, in the Nnewi-North, Anambra State. The outcomes of this study may provide empirical findings that may aid in the management of kidney failure as well as the developing of novel kidney failure -eradication tactics.

This research is also carried out to determine the Insulin, creatinine, and eGFR levels in kidney failure patients in the Nnewi-North, Anambra State part of Nigeria, estimate if age & gender predisposes prevalence of the disease, and to correlate if increases in creatinine, and eGFR have a relationship with serum Insulin concentration in kidney failure patients.

- *Aim and Objective of the Study*

The study sought to ascertain the relationship between Insulin with the Creatinine and eGFR in Dialysis Patients in Nnewi North LGA of Anambra State, Nigeria. The specific objectives of this study were: To estimate and assess the relationship in the results obtained from Insulin, Creatinine and eGFR among different study groups (Dialysis Patients and apparently healthy control individuals). To estimate and assess the levels obtained among different gender in the study area. To assess if there was any correlation in the Insulin, Creatinine and eGFR , and their anthropometric measurement.

- *Scope of Study*

The study examined the levels of serum Insulin, creatinine and eGFR among patients undergoing dialysis and apparently healthy individuals in Nnewi North of Anambra state, Nigeria. The study covers patients undergoing dialysis in Nnewi North of Anambra State who are in or out patients of participating hospital wards with kidney failure, but excludes other patients who are at the hospital for other reasons.

II. MATERIALS AND METHODS

➢ *Study Site*

This research was carried out in Nnewi North LGA, Anambra state, Nigeria. Nnewi North is a Local Government Area in Anambra State, south-central Nigeria. Nnewi is the only town in Nnewi North LGA. It has four villages (sub-towns) that make up the one-town local government, which includes; Otolo, Uruagu, Umudim and Nnewi-ichi. The LGA consists of several towns and villages.

The estimated population of Nnewi North LGA is put at 241,713 inhabitants with the majority of the area's dwellers being members of the Igbo ethnic affiliation.

➢ *Subject*

The group of Nnewi North patients was recruited from Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State. Between October 2024 - February 2025, a cross-sectional study of forty-five (45) dialysis patients, aged 18 - 80 years and forty-five (45) apparently healthy individuals (control subjects), aged 18 - 80 years, that served as the control group of which was recruited from anywhere in Nnewi North of Anambra state.

➢ *Study Design*

This research will used a cross-sectional study design, which is suitable for assessing the prevalence of specific characteristics in a defined population at a single point in time (Creswell and Creswell, 2018). The cross-sectional design will allows the simultaneous evaluation of multiple parameters, including insulin, creatinine, and eGFR in Nnewi North of Anambra State, facilitating a comprehensive understanding of their interrelationships in dialysis patients.

➢ *Sample Size*

Sample size was calculated using G*Power software (version 3.0.10). Power analysis for two independent groups was conducted in G*Power to determine a sufficient sample size using an alpha of 0.05, a power of 0.80 and a medium effect size (d=0.50). Based on these assumptions, the calculated total sample size of 90 (45 per group) has 80% power to detect a difference of 0.50 (medium effect size) at significance level of 0.05.

➢ *Study Population*

The target population for this study consists of adult Nnewi North patients both male and female undergoing dialysis treatment within the age of 18 years to 80 years in NAUTH, Nnewi, Anambra State.

➢ *Inclusion Criteria*

This study includes Nnewi North dialysis patients (Adults) aged 18 years to 80 years, who are receiving regular dialysis (either hemodialysis or peritoneal dialysis) for at least three months. Those Patients diagnosed with diabetes or exhibiting insulin resistance and those who gave their consent were included in this study.

➢ *Exclusion Criteria*

This study excludes Patients with acute kidney injury or those who have undergone kidney transplantation, patients with active infections or other comorbidities that could confound metabolic parameters. Individuals outside the above age bracket, patients who are not from Nnewi North and those who did not give their informed consent, pregnant women with history of diabetes, cardiovascular disease, hepatic disorder, cancers, human immunodeficiency virus (HIV) infection and liver dysfunction will be excluded from the study.

➢ *Informed Consent*

Informed consent of the participants was sought and obtained prior to the study, according to the Helsinki declaration (General Assembly of the World Medical Association, 2014). This form is attached as Appendix III.

➢ *Ethical Approval*

The ethical approval for this research was obtained from the Ethics Committee of Ministry of Health, Anambra State of Nigeria and Nnamdi Azikiwe University Teaching Hospital (NAUTH) ethics committee in accordance with the Helsinki declaration by the World Medical Association (WMA) on the ethical principle for medical research involving human subjects (General Assembly of the World Medical Association, 2014). The ethical approval is attached as Appendix 1.

➢ *Data Collection*

Data collection was occurred through a combination of laboratory tests and patient interviews.

➢ *Anthropometric Measurements*

- Weight Measurements: The participants' weight was evaluated with a bathroom scale (Gulfex Medical and Scientific, England). The weight was measured in kilograms (kg) and recorded to the nearest 0.1kg. After nulling the scale to zero, each measurement was taken. Participants were measured while standing barefooted, wearing light clothing with pockets empty, headgear and excessive hair accessories removed, and their arms swinging naturally by their sides.
- Height Measurements: With the buttocks, upper back, or head touching the measuring surface of the rule, the participant's height was measured in meters using a height scale calibrated in centimeters (stadiometer), and the reading was taken to the nearest 0.1cm value.
- Body Mass Index (BMI): Each adult participant's BMI was calculated by dividing their weight in kilograms by the square of their height in meters (kg/m2) as a measure of generalized obesity.
- Blood Pressure Measurement:

➢ *Participants Preparation*

All apparel that concealed the cuff placement position was to be removed from the participants. The participants were sitting comfortably, with their legs uncrossed and their backs and arms supported so that the center of the upper arm cuff was at the level of the right atrium (the midpoint of the sternum). They were told to

stay as relaxed as possible and not to speak throughout the measurement.

- Measurement: Blood pressure (BP), systolic, and diastolic pressure readings were taken from the participant's left arm using a sphygmomanometer (Omron Medical, United Kingdom) after being seated for ten minutes. The reading was taken in the morning to the nearest mmHg. Each participant was allowed to rest in this position for 10 minutes before the blood pressure was taken. The cuff was tied around the participant's left arm, with the participant sitting comfortably on a chair with back support. The brachial artery was occluded and gradually deflated, and knockoff sounds detected(stethoscope) held over the artery. This sound was monitored attentively until it completely disappeared. The mercury level in the sphygmomanometer scale where the first clear tapping sound appeared corresponded to the systolic blood pressure. The mercury level in the sphygmomanometer where the sound disappeared corresponded to the diastolic blood pressure. The readings were taken in both arms, and the average was recorded as the participant's blood pressure. Two readings were taken for each participant each time, and the average of the two readings computed and used as the participants' blood pressure for the study.
- Waist and Hip Circumference: The waist circumference (WC) was measured with a stretch-resistant tape to detect abdominal obesity (HTS, China). The zero marks on the tape rule were used to calculate each participant's WC. The tape rule was wrapped around the participant at the midpoint between the top of the iliac crest and the lower edge of the last perceptible rib at the midaxillary line, tightly but not constrictively. After a few natural breaths, the reading was taken to the closest centimeter at the end of expiration (WHO, 2008). A stretch-resistant tape was also used to measure the circumference of the hips (HTS, China). The zero marks on the tape rule were used to measure each participant's hips. The tape rule was wrapped around the participant's hip snugly but not constrictively, and measurements were obtained to the nearest centimeter.

➢ *Laboratory Tests*

- *Collection of Samples*

Venous blood sample of five (5) mL was collected from each individual by venous puncture using disposable syringe and the blood was dispensed into a plain container and allowed to clot and retract then it was centrifuged at 4000rpm for 10minutes then the serum was extracted and dispensed into another plain container which was accurately labelled with a code specific to the individual and the samples was transported to the laboratory and stored at -20°C until testing.

- *Estimation of Insulin Level*

✓ Method of analysis: Estimation of insulin in the samples was carried out by sandwich ELISA Method using Human insulin ELISA Kit.
✓ Principle of the Assay: Sandwich ELISA

Sandwich ELISA works on the principle of antigen-antibody reaction where the target antigen is detected via anchoring between two antibodies, which recognize different epitopes. Sandwich ELISA starts from the immobilization of an antibody, called a capture antibody, on the microtiter plate. After blocking the plate surface to avoid non-specific adsorption of other proteins, the antigen in the sample is allowed to react with the immobilized capture antibody, and the antigen bound to the capture antibody is then sandwiched with an enzyme-labeled antibody for color development which is then read spectrophotometrically (Iles *et al.*, 2010).

- *Procedure of the Test*

All reagents were brought (microplate wells) to room temperature (18 - 25°C) before use. The concentrated solution was diluted i.e 1 volume of wash buffer concentration with 49 volume of distilled water. Pipetted standard of 50ml, serum samples and control were put into the desired number of coated wells, fixed on the holder. Enzymes conjugate (100ml) was added into the same coated wells. It was mixed efficiently and incubated at room temperature for 60minutes; the incubated mixture was removed and washed 5 times with diluted wash buffer. The wells were struck sharply into absorbent material (paper towel) to remove residual wash buffer. Substrate (A&B) was pipetted into all the wells, gently mixed for 5 seconds and incubated at room temperature for 20 minutes; the incubated mixture was removed and washed 5 times with diluted wash buffer. Stop solution was added into the same coated wells, gently mixed for 30 seconds and the absorbance was read at 450nm using the microplate reader within 30 minutes.

➢ *Estimation of Creatinine*

- Method of analysis: Jaffe Reaction Method, with kit assay system (Spinreact, 2019)
- Principle: Creatinine reacts with picric acid in an alkaline medium to form a red complex of creatine picrate whose absorbance is read Spectrophotometrically at 520nm wavelength. The color intensity produced is directly proportional to the concentration of creatinine in the sample.

➢ *Analytical Procedure*

The chemicals and photometer (Cuvette holder) were heated to 37°C. With distilled water, the instrument was blanked. Reagent 1 (500µL) and Reagent 2 (500µL) was pipetted into the cuvette, followed by 50 µL of Sample or calibrator in the same cuvette. After adding the sample, it was mixed and the absorbance (A1) was measured right away. The absorbance (A2) of calibrators and samples was measured immediately.

➢ *Calculation*

$$\text{Creatinine concentration (mg/dL)} = \frac{\mathbf{A}\ \text{Sample}}{\mathbf{A}\ \text{standard}} \times \text{Concentration of standard}$$

Where:

A Sample = Absorbance reading of test
A standard = Absorbance reading of standard

➢ *Reference Range*

- Male:0 – 1.3 mg/dl
- Female: 0 – 1.2 mg/dL (Spinreact, 2019).

➢ *Estimated Glomerular Filtration Rate*

The Cockroft and Gault formula for estimated Glomerular Filtration

- Rate (eGFR) is as follows:
- For plasma creatinine in mg/dL: eGFR = (140 – age) × mass (kg) × 0.85 / 72 × creatinine (The National Kidney Foundation, 2011).

➢ *Statistical Analysis*

The outcomes of this study were statistically evaluated using SPSS software version 23.0, which is a statistical tool for social sciences. The variables were given a mean and standard deviation. Student's t-test statistical method was employed for comparisons. Correlation coefficient was used to assess the association between two variables. The comparison was done at 95% confidence level, a p-value equal to or less than 0.05 ($p \leq 0.05$) were considered statistically significant.

III. RESULTS

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

Table 1 Creatinine, Insulin, eGFR and BMI in Dialysis Patients Group and Control Group.

	Dialysis 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)
Insulin (uU/ml)	30.40 ± 35.82	4.71 ± 6.46	4.73	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 one (1) discloses the mean ± SD of Creatinine (mg/dl), Insulin (uU/ml), eGFR (ml/m), and BMI of the dialysis patients group and the control group. From this table, the Creatinine (mg/dl), Insulin (uU/ml), eGFR (ml/m), and BMI (kg/m²) of the dialysis subjects were found to be 2.71 ± 0.88, 30.40 ± 35.82, 27.15 ± 12.76, and 24.40 ± 3.07, correspondingly. The control groups were found to be 0.871 ± 0.24, 4.71 ± 6.46, and 22.13 ± 3.61, correspondingly. The table also showed the Creatinine and Insulin of the dialysis subjects were significantly higher ($p<0.05$)., while eGFR was significantly lower in dialysis subjects ($p<0.05$)., but BMI showed no statistically significant difference ($p>0.05$) when compared to control subjects, according to this table.

Table 2 Creatinine, Insulin, eGFR and BMI in Female and Male Among Dialysis 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)
Insulin (uU/ml)	15.39 ± 23.19	38.69 ± 39.10	-2.17	0.14 (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 2: markers the sex distribution of the mean ± SD of Creatinine (mg/dl), Insulin (uU/ml), eGFR (ml/m), and BMI in female and male dialysis subjects. From this table, the Creatinine (mg/dl), Insulin (uU/ml), eGFR (ml/m), and BMI (kg/m²) of female dialysis subjects was found to be 2.68 ± 0.66, 15.39 ± 23.19, 25.62 ± 11.05, and 24.93 ± 3.19 respectively. Those of males were found to be 2.80 ± 0.85, 38.69 ± 39.10, 28.00 ± 13.72, and 24.10 ± 3.02 respectively. This table also showed the Creatinine, Insulin, eGFR and BMI of female dialysis subjects exhibited no statistically significant difference ($p>0.05$)., when compared to male dialysis subjects.

Table 3 Creatinine, Insulin, 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)
Insulin (uU/ml)	3.05 ± 1.71	5.93 ± 8.23	-1.49	0.01 (S)
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 3: signposts the sex distribution of the mean ± SD of Creatinine (mg/dl), Insulin (uU/ml), eGFR (ml/m), and BMI in female and male control subjects. From this table, the Creatinine (mg/dl), Insulin (uU/ml), eGFR (ml/m), and BMI (kg/m²) of female control subjects were found to be 0.83 ± 0.27, 3.05 ± 1.71, 96.68 ± 37.73, and 22.05 ± 3.76 respectively. The male control subjects were found to be 0.85 ± 0.23, 5.93 ± 8.23, 135.03 ± 64.48, and 22.18 ± 3.57 respectively. The Insulin of the control subjects were significantly lower ($p<0.05$)., but Creatinine, eGFR BMI showed no statistically significant difference ($p>0.05$) when compared to male control subjects, according to this table.

Table 4 Correlations of Creatinine, Insulin, eGFR and BMI In Dialysis Patients in the Study Area

Parameters	**n**	**Creatinine (mg/dl)**	**Insulin (uU/ml)**	**eGFR (ml/m)**	**BMI (kg/m²)**
Creatinine (mg/dl)	45	1.00	0.099	-0.630**$^{(r)}$	0.236
Insulin (uU/ml)	45	0.099	1.00	0.033	0.348*$^{(r)}$
eGFR (ml/m)	**45**	-0.630**$^{(r)}$	-0.033	1.00	-0.368*$^{(r)}$
BMI (kg/m²)	45	0.236	0.348*$^{(r)}$	-0.368*$^{(r)}$	1.00

Table 4: displays the eGFR correlations with Creatinine & BMI, and Insulin correlation with BMI in dialysis subjects in the study area. It also discloses that Insulin positively correlates with BMI (0.348*$^{(r)}$) while eGFR correlate negatively with Creatinine (-0.630**$^{(r)}$) and BMI (-0.368*$^{(r)}$).

Table 5 Correlations of Creatinine, Insulin, eGFR And BMI in Control Group in the Study Area

Parameters	**n**	**Creatinine (mg/dl)**	**Insulin (uU/ml)**	**eGFR (ml/m)**	**BMI (kg/m²)**
Creatinine (mg/dl)	45	1.00	0.066	-0.628**$^{(r)}$	0.007
Insulin (uU/ml)	45	0.066	1.00	0.093	0.302*$^{(r)}$
eGFR (ml/m)	45	-0.628**$^{(r)}$	-0.093	1.00	0.044
BMI (kg/m²)	45	0.007	0.302*$^{(r)}$	0.044	1.00

Table 5: points out the Insulin correlations with BIM, and Creatinine correlation with eGFR in control group in the study area. It also discloses that Insulin positively correlates with BMI (0.302*$^{(r)}$) while Creatinine correlate negatively with eGFR (-0.628**$^{(r)}$).

IV. DISCUSSION

The study aimed to evaluate the relationship between insulin, creatinine, and estimated glomerular filtration rate (eGFR) among dialysis patients in Nnewi North Local Government Area (LGA) of Anambra State, Nigeria. The findings revealed significant differences in the levels of these biomarkers between dialysis patients and healthy controls, highlighting the metabolic and renal dysfunction associated with chronic kidney disease (CKD) and end-stage renal disease (ESRD). The discussion is structured around the key findings, their implications, and how they align with or diverge from existing literature.

According to the findings of this study, comparison of Biomarkers Between Dialysis Patients and Controls; The results showed that dialysis patients had significantly higher levels of creatinine and insulin compared to the control group, as shown in Table 1. This is consistent with the pathophysiology of chronic kidney disease, where impaired kidney function leads to reduced clearance of metabolic waste products, including creatinine, and altered insulin metabolism. Elevated creatinine levels in dialysis patients are a direct reflection of reduced glomerular filtration rate (GFR), which is a hallmark of chronic kidney disease. The elevated insulin levels in dialysis patients may be attributed to insulin resistance, a common complication in chronic kidney disease patients, particularly those with diabetes or metabolic syndrome. Insulin resistance in chronic kidney disease is often driven by factors such as chronic inflammation, uremic toxins, and altered body composition, which interfere with insulin signaling pathways (Meyer *et al*., 2017).

The significantly lower eGFR in dialysis patients further confirms the severity of renal dysfunction in this population. The eGFR is a critical marker for assessing kidney function, and its reduction in dialysis patients aligns with the progression of chronic kidney disease (CKD) and end-stage renal disease (ESRD), necessitating renal replacement therapy such as dialysis (Levey *et al.*, 2020). The findings are consistent with global trends,

where CKD patients exhibit elevated creatinine and reduced eGFR , particularly in advanced stages of the disease (Hill *et al.,* 2016).

The study also explored gender differences in biomarker levels among dialysis patients and controls. Interestingly, no significant differences were observed in creatinine, insulin, eGFR , or BMI between male and female dialysis patients, as shown in table 2 and 3. This suggests that the metabolic and renal dysfunction associated with CKD and dialysis is not significantly influenced by gender in this population. However, in the control group, insulin levels were significantly higher in males compared to females, which may reflect differences in insulin resistance or metabolic profiles between genders in the general population. This finding aligns with studies that have reported higher insulin resistance in males compared to females, particularly in populations with higher rates of obesity or metabolic syndrome (Smith *et al.*, 2022).

Correlations Between Biomarkers as presented in table 4 and 5, this study found significant correlations between certain biomarkers in both dialysis patients and controls. In dialysis patients, insulin levels positively correlated with BMI, indicating that higher body mass index (BMI) is associated with increased insulin resistance. This is consistent with the well-established relationship between obesity, insulin resistance, and metabolic dysfunction in CKD patients (Köhler *et al.,* 2023). Additionally, eGFR showed a strong negative correlation with creatinine, which is expected given that reduced kidney function leads to elevated serum creatinine levels. The negative correlation between eGFR and BMI in dialysis patients suggests that higher BMI may exacerbate renal dysfunction, possibly due to increased metabolic demands and insulin resistance.

In the control group, insulin levels positively correlated with BMI, further supporting the link between insulin resistance and metabolic health. The negative correlation between creatinine and eGFR in controls is consistent with the physiological relationship between these markers, where reduced kidney function leads to elevated creatinine levels.

The findings of this study have several clinical implications. Firstly, the elevated levels of creatinine and insulin in dialysis patients underscore the importance of monitoring these biomarkers in CKD management. Insulin resistance and hyperinsulinemia are common in dialysis patients and can exacerbate metabolic imbalances, making diabetes management more challenging.

Secondly, the strong correlation between eGFR and creatinine highlights the importance of using eGFR as a more accurate measure of kidney function compared to serum creatinine alone. The CKD-EPI formula, used in this study, provides a more precise estimation of GFR and is crucial for staging CKD and guiding treatment decisions (Levey *et al*., 2020).

Finally, the lack of significant gender differences in biomarker levels among dialysis patients suggests that CKD management strategies can be applied uniformly across genders. However, the higher insulin levels in male controls indicate that gender-specific approaches may be necessary for managing metabolic health in the general population.

V. CONCLUSION

This study provides valuable insights into the biochemical profiles of dialysis patients in Nnewi North LGA of Anambra State, Nigeria. The findings confirm that dialysis patients exhibit significantly elevated levels of creatinine and insulin, along with reduced eGFR , compared to healthy controls. These biomarkers are critical for assessing kidney function and metabolic health in chronic kidney disease (CKD) patients. This study also highlights the importance of monitoring insulin resistance levels in dialysis patients, as these factors can significantly impact metabolic management and overall patient outcomes.

The lack of significant gender differences in biomarker levels among dialysis patients suggests that chronic kidney disease (CKD) management strategies can be applied uniformly across genders. However, the higher insulin levels in male controls indicate that gender-specific approaches may be necessary for managing metabolic health in the general population.

Overall, this study underscores the need for comprehensive monitoring of biochemical markers in dialysis patients to optimize treatment strategies and improve clinical outcomes. The findings also highlight the importance of region-specific research to better understand the unique characteristics of chronic kidney disease (CKD) patients in different populations.

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) ‘Dialysis 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 Dialysis 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 Dialysis 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 Dialysis 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 Dialysis 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 Dialysis 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) 'Dialysis-Related Complications and Their Impact on Biomarker Levels in Dialysis Patients', Nephrology Dialysis Transplantation, 36(2), pp. 352-358.
[44]. Singh, S., (2021) 'Biomarkers in Chronic Kidney Disease: From Bench to Bedside', Nephrology Dialysis 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.