

SMLS - 10(3) - 036

Comparative Evaluation of Inflammatory and Haematological Parameters in Erythropoietin-treated vs. Erythropoietin-naïve CKD Patients: Insight into Disease PathophysiologyOyeleke Kikelomo Olayemi¹, Adedeji Rashidat Adenike*¹, Jimoh Abiodun Abdulahi¹, Ibrahim Eleha Suleiman²Department of Medical Laboratory Science, Ladoko Akintola University of Technology, Ogbomosho, Oyo State, Nigeria¹, Chemical Pathology and Immunology Department, University of Ilorin Teaching Hospital, Ilorin, Kwara State Nigeria².

Author for Correspondence*: adedejirashidat4@gmail.com/ORCID: 0000-0009-9081-2351

<https://dx.doi.org/10.4314/sokjmls.v10i3.37>**Abstract**

Anaemia and persistent inflammation are key complications of chronic kidney disease (CKD), contributing to adverse clinical outcomes. While erythropoietin (EPO) therapy is central to anaemia management, its impact on inflammatory pathways in sub-Saharan African populations is underexplored. This study assessed the hematologic and anti-inflammatory effects of EPO in Nigerian CKD patients and identified predictors of poor outcomes. Eighty-nine CKD patients were stratified into EPO-treated (EPO ; $n = 53$) and EPO-naïve (EPO ; $n = 36$) groups. Haematologic indices were measured using an automated analyzer, and inflammatory markers [C-reactive protein (CRP), interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF- α)] quantified by enzyme-linked immunosorbent assay (ELISA). Statistical analyses (SPSS v26) included independent-sample t -tests, Pearson correlations, and multiple regression analysis, with significance at $p < 0.05$ were adopted. EPO patients had significantly higher haemoglobin and haematocrit (both $p = 0.001$) and lower CRP, IL-6, and TNF- α levels ($p < 0.001$). Severe anaemia occurred only in the EPO group. IL-6 was the strongest predictor of adverse outcomes ($\beta = 0.694$, $p < 0.001$). IL-6 correlated inversely with RBC count ($r = -0.445$, $p < 0.01$) and positively with other inflammatory markers. Hemoglobin correlated positively with RBC ($r = 0.513$, $p < 0.001$) and inversely with WBC count ($r = 0.443$, $p < 0.01$). EPO therapy improves anemia and reduces systemic inflammation in CKD, with IL-6 emerging as a critical prognostic

biomarker. These findings, from a sub-Saharan African cohort, support integrated management strategies combining EPO therapy with inflammation monitoring to optimize outcomes.

Keywords: Erythropoietin, CKD, Inflammation, TNF, Anaemia

Introduction

Chronic kidney disease (CKD) is one of the major and a growing global health burden. It affect approximately 10% of the world's population and contributes substantially to morbidity, mortality, and healthcare costs (Abd ElHafeez *et al.*, 2018). The increasing prevalence is attributed to the global rise in diabetes mellitus, hypertension, and obesity, as well as ongoing infectious diseases in low- and middle-income countries (Hill *et al.*, 2016). In sub-Saharan Africa, CKD often manifest at early stages in life and at advanced stages, reflecting late diagnosis, low awareness, limited health insurance coverage, and restricted access to nephrology services (Okwuonu *et al.*, 2017).

CKD is defined by a gradual decline in renal function, with anemia recognized as a prevalent and clinically important complication (Babitt and Lin, 2012; Abd ElHafeez *et al.*, 2018). The pathogenesis of anaemia in CKD is multifactorial, including failure of kidney to synthesis enough erythropoietin (EPO), iron dysregulation, a shorter lifespan for red blood cells, and prolonged systemic inflammation (Locatelli *et al.*, 2015). Elevated inflammatory mediators such as interleukin-6 (IL-6), tumor

necrosis factor-alpha (TNF- α), and C-reactive protein (CRP) are frequently discovered even at the early stage of the disease. Inflammation have been shown to suppress erythropoiesis, impair iron utilization, and reduce responsiveness to erythropoiesis-stimulating agents (ESAs) such as recombinant human EPO (Souma *et al.*, 2015; Provenzano *et al.*, 2021). However, the directionality of the inflammation anemia relationship remains incompletely understood.

EPO therapy is a cornerstone of CKD-related anemia management, effectively improving hemoglobin levels and reducing transfusion dependence (Cantarelli *et al.*, 2019). Despite the therapeutic success of EPO therapy, 10-30% of patients exhibit EPO-hyporesponsiveness, often linked to persistent inflammation, infection, oxidative stress, hyperparathyroidism, micronutrient deficiencies, and inadequate dialysis (Provenzano *et al.*, 2021). EPO resistance is clinically important, as it is associated with poorer survival and heightened cardiovascular risk (Cunningham *et al.*, 2021). Understanding how inflammation interacts with anemia severity and treatment response is, therefore, essential for optimizing care.

In Nigeria and much of sub-Saharan Africa, indigenous data on this interaction are scarce. Local populations may have unique pathophysiological profiles due to nutritional deficits, high infectious disease burden, and genetic predispositions (Oluyonbo *et al.*, 2013). Moreover, most available studies do not distinguish between treatment-naïve CKD patients and those already on EPO therapy, limiting insight into the modifying effects of treatment on inflammatory and haematologic profiles.

This study addresses these gaps by comparing hemoglobin levels and inflammatory markers in three cohorts: EPO-treated CKD patients, CKD patients not yet initiated on EPO, and healthy controls. The objectives are to (i) clarify the relationship between inflammation and anemia severity, (ii) determine whether EPO therapy attenuates systemic inflammation in CKD, and (iii) explore whether persistent inflammation contributes to EPO-hyporesponsiveness in the

Nigerian context. Findings are expected to advance understanding of anemia pathophysiology in CKD, refine anemia management strategies, and inform locally relevant health policies for resource-limited settings.

Methodology

Study area

The samples was collected from consenting subjects attending the Bowen University Teaching Hospital (BUTH), Ogbomosho, Oyo State. A tertiary health center, located in the south-western region of Nigeria. The hospital provides quality health services to neighboring states like Osun, Kwara, Ekiti and Ondo states. BUTH has a bed space capacity of about four hundred and fifty (450) and an admission rate of about twelve thousand (12,000) patients per annum.

Study design

This study was a hospital-based, cross-sectional study carried out among consenting subjects. A structured questionnaire and retrieval of data from the participants' record were the approaches adopted to gather socio-demographic and clinical data. This study was carried out between October 2023 and July 2024.

Sample size calculation

Sample size was calculated using the Cochran formula (Charan and Biswas, 2013). According to the author, the formula for calculating sample size for a quantitative case control study is as shown below, the prevalence of CKD in Oyo State was 4.2% (Afolabi *et al.*, 2009). Therefore, using the formula below

$$\text{Sample size} = \frac{Z^2 P (1 - P)}{d^2}$$

Z = standard normal variation, at type 1 error ($p < 0.05$) it is 1.96

P = the prevalence rate of CKD in South-west Nigeria is 4.2% = 0.042.

d = degree of accuracy = 5% = 0.05

Using the above formula, the sample size was calculated to be 80.

Inclusion and exclusion criteria

All patients diagnosed with CKD within the study period who were 18 years and above and

consented to participate were recruited. Whether undergoing erythropoietin therapy due to anemia associated with CKD or not. Those with active infections, autoimmune diseases, malignancies, or any other chronic inflammatory disorders were excluded. Individuals who have received blood transfusions or iron therapy within the past three months are also excluded. Furthermore, patients with uncontrolled hypertension, severe cardiovascular disease, or those undergoing dialysis at the time of enrollment are not included. Pregnant or lactating women, as well as individuals with a history of hypersensitivity to erythropoiesis-stimulating agents, are also excluded.

Ethical clearance

Ethical approval was obtained from the ethical review committee of BUTH with reference number BUTH/PRS/569T/626. The research was carried out in line with the ethics governing the use of human samples and in accordance with Helsinki declaration. Ethical practices such as participant consent, confidentiality and safety laboratory practice was observed during the study.

Statistical analysis

Statistical analysis was carried out using the IBM SPSS version 25 (SPSS Inc. Chicago, IL USA). Quantitative and qualitative variables were presented as mean \pm SEM and percentage respectively. P-values of < 0.05 were considered significant. Independent-sample t- test and Fisher's exact test was used for the comparison of data and inferential statistics. Correlation and regression analysis was used to evaluate the relationship between the haematological and inflammatory biomarkers.

Results

Demographic analysis of the participants

A total of 119 participants were included: 30 controls, 36 CKD patients not receiving erythropoietin (EPO⁻), and 53 CKD patients on EPO therapy (EPO⁺). Mean age was highest in the EPO⁺ group (57.34 ± 14.17 years) compared with EPO⁻ (51.37 ± 12.54 years) and controls (49.47 ± 12.54 years), with no significant differences in age or gender distribution. Underweight BMI (< 18.5 kg/m²) was most frequent in EPO⁺ patients (50.9%), followed by EPO⁻ (30.6%) and controls

(3.3%). Histories of diabetes and hypertension were more common in CKD groups than controls, though not statistically significant. Dialysis history was significantly higher in EPO⁺ (64.2%) and EPO⁻ (38.9%) groups compared with none in controls ($p = 0.029$).

Comparative analysis of haematological and inflammatory between the studied groups

Compared with EPO⁻ patients, EPO⁺ patients had significantly higher haemoglobin ($p = 0.001$), haematocrit ($p = 0.001$), and MCH ($p = 0.007$), but lower reticulocyte counts ($p = 0.015$). Inflammatory markers CRP, TNF, and IL-6 were markedly reduced in the EPO⁺ group (all $p = 0.001$), while other haematological and renal parameters showed no significant differences.

Impact of EPO therapy on hemoglobin and inflammatory markers

Analysis of categorical variables showed that low hemoglobin was less prevalent in EPO⁺ patients (67.9%) compared with EPO⁻ patients (91.7%), ($p = 0.008$). Elevated CRP, IL-6, and TNF levels were significantly less frequent in EPO⁺ patients (3.8%, 1.9%, and 3.8%, respectively) than in EPO⁻ patients (88.9%, 38.9%, and 47.2%, respectively; all $p = 0.006$).

The outcome of correlation and regression analysis

Correlation analysis revealed significant negative associations between haemoglobin and IL-6, TNF, and CRP (all $p < 0.001$), while strong positive correlations were observed among inflammatory markers ($p < 0.001$). Regression analysis confirmed IL-6 ($p = 0.019$) and CRP ($p = 0.004$) as significant negative predictors of haemoglobin, whereas TNF ($\beta = 0.584$, $p = 0.042$) was a positive predictor, explaining 39.1% of variance in haemoglobin levels (adjusted $R^2 = 0.365$, $p < 0.001$).

Area under the curve and

ROC curve analysis showed that CRP and hemoglobin had the most favorable discriminative profiles, demonstrating high sensitivity across a broad range of specificities. IL-6 and TNF showed lower sensitivity at higher specificity thresholds, indicating reduced predictive power compared with CRP.

Table 1: Demographic and clinical characteristics of the CKD participants

Characteristics	Control	EPO ⁻	EPO ⁺	p-value
Frequency (%)	30 (100)	36 (40.4)	53 (59.6)	
Age range	49.47±12.54	51.37±12.54	57.34±14.17	
Age (years)				
19 □ 30	05 (16.7)	3 (8.3)	02 (3.8)	0.426
31 □ 64	18 (60)	28 (77.8)	39 (73.6)	
= 65	07 (23.3)	05 (13.9)	12 (22.6)	
Sex				
Male	18 (60)	12 (33.3)	29 (54.7)	0.054
Female	12 (40)	24 (66.7)	24 (45.3)	
BMI (Kg/m ²)				
< 18.5	01 (3.3)	11 (30.6)	27 (50.9)	0.096
18.5 - 24.9	25 (83.3)	24 (66.7)	23 (43.4)	
25 – 29.9	04 (13.3)	1 (2.8)	03 (5.7)	
History of DM				
Positive	05 (16.7)	15 (41.7)	21 (39.6)	0.985
Negative	25 (83.3)	21 (58.3)	32 (60.4)	
History of HTN				
Positive	09 (30)	24 (66.7)	33 (62.3)	0.822
Negative	21 (70)	12 (33.3)	20 (37.7)	
History of dialysis				
Positive	0	14 (38.9)	34 (64.2)	0.029*
Negative	30 (100)	22 (61.1)	19 (35.8)	

Frequency (%), BMI = body mass index, CKD = chronic kidney disease, EPO = erythropoietin, DM = diabetes mellitus, HTN = hypertension.

Table 2: Comparison of hematological and inflammatory parameters between CKD patients with and without EPO therapy

Parameters	EPO ⁻ n = 36	EPO ⁺ n = 53	p-value
Red blood cells count (x 10 ¹² /L)	3.22 ± 0.57	3.46 ± 0.82	0.191
White blood cells count (x 10 ⁹ /L)	7.63 ± 3.16	6.46 ± 3.24	0.200
Reticulocytes (cells/μL)	2.65 ± 0.23	2.42 ± 0.43	0.015*
Haemoglobin (g/dL)	8.30 ± 1.02	9.60 ± 1.57	0.001*
Haematocrit (%)	24.91 ± 3.06	28.91 ± 4.72	0.001*
MCV (fL)	77.81 ± 4.79	78.79 ± 7.93	0.565
MCH (Pg)	26.17 ± 1.58	27.58 ± 2.08	0.007*
MCHC (g/dL)	33.83 ± 1.39	33.27 ± 1.89	0.214
RDW (%)	15.71 ± 1.92	16.09 ± 2.39	0.515
Platelet count (x 10 ⁹ /L)	170.9 ± 83.7	162.6 ± 83.3	0.706
Creatinine (mg/dL)	7.83 ± 4.88	8.63 ± 4.73	0.548
eGFR (mL/min/1.73)	20.98 ± 16.24	16.59 ± 13.19	0.523
CRP (ng/mL)	125.75 ± 52.65	21.19 ± 7.73	0.001*
TNF (ng/mL)	61.65 ± 34.63	13.80 ± 3.43	0.001*
IL-6 (ng/mL)	26.30 ± 16.7	8.96 ± 3.98	0.001*

The values are mean ± standard deviation, Independent-Sample T test was used to compare the means at p = 0.005, RDW = red cell distribution width, MCH = mean corpuscular hemoglobin, MCHC = mean corpuscular hemoglobin concentration, MCV = mean corpuscular volume, eGFR = estimated glomerular filtration rate, TNF = tissue necrosis factor, CRP = C-reactive protein, IL-6 = interleukin 6.

Table 3: The impact of EPO therapy on hemoglobin level and inflammatory parameters

Parameters	Status	EPO ⁻	EPO ⁺	p-value
Haemoglobin (g/dL)	Decreased	33 (91.7)	36 (67.9)	0.008*
	Normal	3 (8.3)	17 (32.1)	
CRP (ng/mL)	Elevated	32 (88.9)	2 (3.8)	0.000*
	Normal	4 (11.1)	51 (64.2)	
IL-6 (ng/mL)	Elevated	14 (38.9)	1 (1.9)	0.003*
	Normal	22 (61.1)	52 (98.1)	
TNF (ng/mL)	Elevated	17 (47.2)	2 (3.8)	0.006*
	Normal	19 (52.8)	51 (96.2)	

The values are finding (%). Fisher Exact Test was used to determine the significant of association between the variables at p = 0.05 (95% confidence level) 10th percentile was used to define reduced HBG level. On the other hand, the 75th percentile used for IL-6 and 90th percentile was adopted to determine elevated values in both TNF and CRP.

Table 4: Correlation analysis between haemoglobin level and inflammatory parameters in CKD Patients

Correlation		IL-6	TNF	CRP	HBG
IL-6	r		0.894	0.861	-0.681
	p	1	0.000**	0.000**	0.000**
TNF	r	0.894		0.882	-0.640
	p	0.000**	1	0.000**	0.000**
CRP	R	0.861	0.882		-0.688
	P	0.000**	0.000**	1	0.000**
HBG	R	-0.681	-0.640	-0.688	
	P	0.000**	0.000**	0.000**	1

TNF = Tissue necrosis factor, CRP = C-reactive protein, IL-6 = Interleukin 6, HBG = Haemoglobin level, r = Pearson coefficient, p = significant value

Table 5: Regression analysis of HBG and Inflammatory markers

Predictors	Beta	Standard error	T	p-value
IL-6	-0.625	0.042	-2.392	0.019
TNF	0.584	0.020	2.067	0.042
CRP	-0.564	0.007	-3.038	0.004

IL-6 = interleukin 6, TNF = tissue necrosis factor, CRP = C-reactive protein
 Model summary: $R^2 = 0.391$, Adjusted $R = 0.365$, F-statistic = 14.997, $P < 0.001$

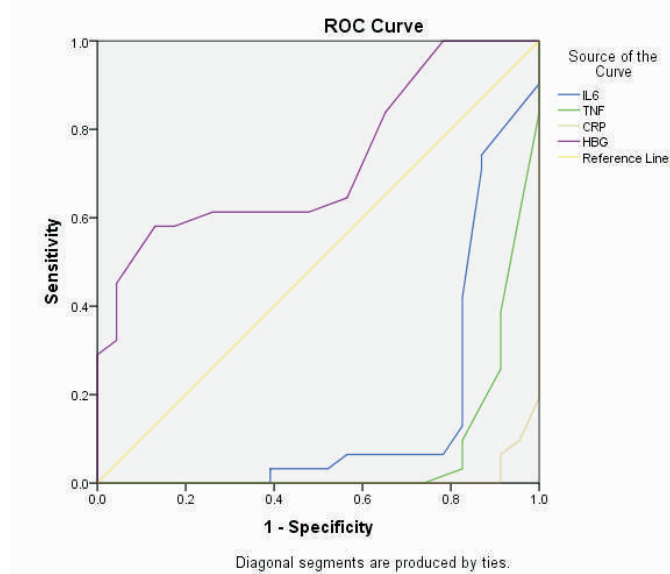


Figure 1: ROC among CKD patients in BUTH

Table 6: Area Under the Curve

Test Result Variable(s)	Area	Std. Error ^a	Asymptotic Sig. ^b	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
IL6	.156	.063	.000	.033	.280
TNF	.070	.039	.000	.000	.147
CRP	.010	.009	.000	.000	.027
HBG	.725	.069	.005	.590	.860

The test result variable(s): IL6, TNF, CRP, HBG has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

a. Under the nonparametric assumption

b. Null hypothesis: true area = 0.5

Discussion

This study evaluated the demographic, haematological, and inflammatory profiles of CKD patients stratified by erythropoietin (EPO) therapy, revealing both haematopoietic and immunomodulatory benefits of treatment. As shown in Table 1, although EPO participants tended to be older, age differences were not statistically significant. The higher representation of elderly patients in the EPO group likely reflects the greater burden of anaemia in advanced CKD, consistent with the known age-associated decline in renal function, diminished endogenous EPO production, chronic inflammation, and nutrient deficiencies that impair erythropoiesis (Moris *et al.*, 2017; Chukwuonye *et al.*, 2018). The observed near-significant male predominance among EPO participants may indicate gender-related differences in disease progression, treatment access, or anaemia severity, as previously suggested in related epidemiological studies (Moris *et al.*, 2017). Nutritional status, as reflected by BMI, showed a higher prevalence of underweight individuals in the EPO group, suggestive of the catabolic state of advanced CKD.

Haematological analysis (Table 2) confirmed that EPO therapy significantly improved haemoglobin and haematocrit levels, aligning with its established mechanism of action in correcting renal anaemia (Gupta *et al.*, 2023). Interestingly, despite higher RBC counts in EPO-treated patients, differences were not

statistically significant, possibly due to variability in iron status, inflammation, or comorbidities (Canterelli *et al.*, 2019). A notable finding was the significantly lower reticulocyte count in the EPO group, possibly reflecting suppression of endogenous erythropoietic drive once exogenous EPO achieves anemia correction (Wang *et al.*, 2020). The elevated MCH among EPO patients suggests improved hemoglobin content per erythrocyte, indicative of better iron utilization (Sangkhae and Nemeth, 2017). Other red cell indices remained unaffected, consistent with literature indicating that EPO mainly improves hemoglobin concentration without markedly altering red cell morphology (Fisher and Nemeth, 2017). Furthermore, a key observation from this study was the markedly lower inflammatory burden in EPO-treated patients (Table 2). CRP, IL-6, and TNF- α were significantly elevated in untreated patients, supporting the link between persistent inflammation, EPO resistance, and adverse CKD outcomes (Akhtar *et al.*, 2023). These results reinforce growing evidence that EPO may exert anti-inflammatory effects, potentially via downregulation of NF- κ B signaling and mitigation of oxidative stress (Fujiwara *et al.*, 2016; Lu *et al.*, 2020).

From Table 3, the outcome revealed that the proportion of patients with decreased hemoglobin was markedly higher in the untreated group compared to those receiving EPO (91.7% vs. 67.9%), while a

significantly greater percentage of treated patients achieved normal hemoglobin values ($p=0.008$). This agrees with the findings of Locatelli *et al.* (2004) and Maccougall (2001), who observed that recombinant human EPO effectively corrects anemia in CKD patients by enhancing erythropoiesis. Beyond hematopoietic correction, the sharp reduction in CRP levels (88.9% vs. 3.8%) and the significant decline in pro-inflammatory cytokines IL-6 and TNF among EPO-treated individuals reinforce evidence that EPO exerts anti-inflammatory actions. Panichi *et al.* (2001) reported similar decreases in CRP with EPO therapy, while Coletti *et al.* (2004) highlighted EPO's capacity to downregulate IL-6 and TNF expression through modulation of nuclear factor- κ B-mediated pathways. As revealed on table 4, the strong negative correlation between IL-6 and RBC count, and positive correlation between IL-6 and CRP, underscores IL-6's central role in inflammation-induced anaemia. Regression analyses (Table 5) identified IL-6, TNF- α , and diabetes mellitus as significant predictors of adverse clinical outcomes, while reduced eGFR and RBC count were inversely associated, highlighting the interplay between renal function, anaemia, and inflammation (Taal *et al.*, 2019).

Unexpectedly, ROC analysis (Figure 1) showed that IL-6, TNF- α , and CRP demonstrated poor discriminatory power in this CKD cohort, in contrast to higher AUC values (Table 6) reported in acute inflammatory conditions. This likely reflects the chronic, low-grade inflammatory state of CKD and overlapping biomarker elevations across groups (Mihai *et al.*, 2018). Haemoglobin, however, achieved acceptable discriminatory capacity, reinforcing its prognostic relevance in chronic disease contexts.

Conclusion

EPO therapy in CKD patients with anemia confers dual clinical benefits: effective haematopoietic correction and attenuation of systemic inflammation. Treated patients exhibited higher haemoglobin and haematocrit levels, alongside markedly lower inflammatory cytokines. IL-6 and TNF- α emerged as key predictors of adverse outcomes, emphasizing the pathogenic role of inflammation in CKD progression. These findings are clinically important, as anaemia and inflammation are synergistic drivers of adverse outcomes in CKD,

cardiovascular disease, and other chronic disorders. Thus, the observed improvements underscore the therapeutic significance of EPO not only in correcting anaemia but also in mitigating systemic inflammation.

While conventional inflammatory markers showed limited diagnostic utility in this cohort, haemoglobin demonstrated moderate prognostic value. These findings advocate for integrated anemia and inflammation management in CKD and highlight the need for biomarker validation in chronic inflammatory contexts.

Recommendations

1. **Therapeutic Integration:** EPO therapy should be routinely incorporated into the management of CKD-related anaemia, particularly in moderate-to-severe cases.
2. **Inflammation Monitoring:** Regular assessment of inflammatory markers (CRP, IL-6, TNF- α) is recommended to guide therapy and assess treatment efficacy.
3. **Adjunctive Strategies:** For EPO-resistant or persistently inflamed patients, adjunct anti-inflammatory interventions should be considered to optimize outcomes.

Author's contribution

- Oyeleke O.K.: Conceptualization, validation and editing of manuscript
- Adedeji R.A.: Hematological analysis, writing original manuscript
- Suleiman I.E.: Data curation, biochemical and statistical analysis.
- Jimoh A.A.: Provision of reagent and editing of manuscript.

Conflict of Interest Statement:

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

- Abd ElHafeez, S., Bolignano, D., D'Arrigo, G., Dounousi, E., Tripepi, G., Zoccali, C. (2018) Prevalence and burden of chronic kidney disease among the general population and high-risk groups in Africa: a systematic review. *The British Medical Journal Open*;

- 8(1): e015069. DOI: 10.1136/bmjopen-2016-015069.
- Afolabi, M.O., Abioye-Kuteyi, E.A., Arogundade, F.A., Bello, I.S., Adewuya, A.O., and Ojo, O.E. (2009) Prevalence of chronic kidney disease in a Nigerian rural community: A community-based study. *African Journal of Medicine and Medical Sciences*; **38(3)**: 255-261.
- Akhtar M, Shahbaz T, Irfan, A. (2023) Association of erythropoiesis-stimulating agent (ESA) use with inflammation in chronic kidney disease: A cross-sectional study. *Clinical Kidney Journal*; **16(2)**: 305-312.
- Babitt JL, and Lin HY. (2012) Mechanisms of anemia in CKD. *Journal of the American Society of Nephrology*; **23(10)**: 1631-1634. DOI: 10.1681/ASN.2011111078.
- Cantarelli, C., Angeletti, A., Cravedi, P. (2019) Erythropoietin, a multifaceted protein with innate and adaptive immune modulatory activity. *American Journal of Transplant*; **19(9)**:2407-2414.doi:10.1111/ajt.15369.
- Charan, J., and Biswas, T. (2013) How to calculate sample size for different study designs in medical research. *Indian Journal of Psychological Medicine*; **35(2)**: 121-126. <https://doi.org/10.4103/0253-7176.116232>.
- Chukwuonye, I.J., Ogah, O.S., Anyabolu, E.N., Ohagwu, K.A., Nwabuko, O.C., Onwuchekwa, U., Chukwuonye, M.E., Obi, E.C., Oviasu, E. (2018) Prevalence of chronic kidney disease in Nigeria: systematic review of population-based studies. *International Journal of Nephrology and Renovascular Disease*; **11**: 165-172. <http://dx.doi.org/10.2147/IJNRD.S162230>.
- Coletti, D., Moresi, V., Adamo, S., Molinaro, M., Sassoon, D. (2004) Tumor necrosis factor alpha gene expression in regenerating soleus muscle of adult rat is inhibited by erythropoietin administration. *Journal of Physiology*; **555(2)**:507-519.
- Cunningham J, Danese MD, Lopez-Gomez JM. (2021) Novel strategies for anemia treatment in CKD. *Kidney International Reports*; **6(8)**: 2061-2071.
- Fisher, A.L. and Nemeth, E. (2017). Iron homeostasis during pregnancy. *American Journal of Nutrition*; **106**:1574S. doi: 10.3955/ajcn.117.155812.
- Fujiwara T, O'Geen H, Keles S. (2016) Transcriptional regulation of erythropoiesis. Cold Spring Harbor *Perspectives in Medicine*; **6(12)**: a026971. DOI:10.1101/cshperspect.a026971.
- Gupta, A., Mishra, P., Mahapatra, H.S., Abraham, A., Bhatia, D., Srivastava, R.N., Rajan, M.G.R., Ghosh, A., Rai, M., Banerjee, S., Sharma, S. (2023) Desidustat therapy for anaemia in chronic kidney disease: Evidence from phase 3 trials. *Kidney International Reports*; **8(1)**: 13-21. <https://doi.org/10.1016/j.ekir.2022.10.005>.
- Hill, N.R., Fatoba, S.T., Oke, J.L., Hirst, J.A., O'Callaghan, C.A., Lasserson, D.S., and Hobbs, F.D.R. (2016) Global prevalence of chronic kidney disease a systematic review and meta-analysis. *PLOS ONE*; **11(7)**: e0158765. DOI: 10.1371/journal.pone.0158765.
- Liu, T., Zhang, L., Joo, D., Sun, S.C. (2020) NF- κ B signaling in inflammation. *Signal Transduction Target Therapy*; **5(1)**:1-23. doi:10.1038/s41392-020-00407-3.
- Locatelli, F., Bárány, P., Covic, A., De Francisco, A., Del Vecchio, L., Goldsmith, D., Macdougall, I.C. (2017) Kidney disease: Improving global outcomes guidelines on anemia management in chronic kidney disease: A European Renal Best Practice position statement. *Nephrology Dialysis Transplantation*; **28(6)**:1346-1359. DOI: 10.1093/ndt/gft033.
- Macdougall IC. (2008) Novel erythropoiesis-stimulating agents: a new era in anemia management. *Clinical Journal of American Society for Nephrology*; **3(1)**:200-207.
- Mihai, S., Codrici, E., Popescu, I.D., Enciu, A., Albulescu, L., et al. (2018) Inflammation-related Mechanism in Chronic Kidney Disease Prediction, Progression, and Outcome. *Journal of Immunological Research*; **6**:2180373. Doi:10.1155/2018/2180373.
- Moris, C., De Jong, A., Wajcman, H., Fesler, P. (2017) Age-related thrombopoiesis dysfunction: Mechanisms and clinical implications. *Journal of Gerontology*:

- Biological Sciences*; **72(3)**: 312 - 324.
- Okwuonu, C.G., Chukwuonye, I.I., Adejumo, O.A., Agaba, E.I., Ojogwu, L.I. (2017) Prevalence of chronic kidney disease and its risk factors among adults in a semi-urban community of South-east Nigeria. *Niger Postgraduate Medical Journal*; **24(2)**:81-87. DOI: 10.4103/npmj.npmj_34_17.
- Oluyombo R., Ayodele O.E., Akinwusi O.O., Okunola A., Arogundade F.A., Sanusi A.A., Onayade A. (2013) A community study of the prevalence, risk factors and pattern of chronic kidney disease in Osun State, South West Nigeria. *West African Journal of Medicine*; **32(2)**:85-92.
- Panichi, V., Tetta, C., Migliori, M., De Pietro, S., Taccola, D., Sereni, A., Giovannini, L., Palla, R. (2001) Erythropoietin and interleukin-6 in haemodialysis patients. *Nephrology Dialysis and Transplant*; **16(11)**:2284-2289.
- Provenzano, R., Besarab, A., Sun, C.H., Diamond, S.A., Durham, J.H., *et al.* (2021): An oral hypoxia-inducible factor prolyl hydroxylase inhibitor for anaemia in chronic kidney disease. *Clinical Journal of the American Society of Nephrology*; **16(5)**: 748-758. <https://doi.org/10.2215/CJN.12441020>.
- Sangkhae, V. and Nemeth, E. (2017) Regulation of Iron Homeostatic Hormone Hepcidin. *Advanced Nutrition*; **8**: 126-136. Doi:10.3955/an.116.013961.
- Souma, T., Suzuki, N., Yamamoto, M. (2015) Renal erythropoietin-producing cells in health and disease. *Frontiers in Physiology*; **6**:167. doi: 10.3389/fphys.2015.00167.
- Taal, M.W., Chakraverty, B., Bardhan, R. (2019) The effects of erythropoietin on markers of inflammation in chronic kidney disease. *Kidney International*; **95(4)**: 920-930. <https://doi.org/10.1016/j.kint.2018.12.012>.
- Wang, Y., Yang, Y., Zhang, X. (2020) Effects of erythropoiesis-stimulating agents on inflammation and anemia in chronic kidney disease patients. *Kidney International*; **97(6)**: 1247-1255. <https://doi.org/10.1016/j.kint.2020.02.031>.

Citation: Oyeleke Kikelomo Olayemi, Adedeji Rashidat Adenike, Jimoh Abiodun Abdulahi, Ibrahim Eleha Suleiman. Comparative Evaluation of Inflammatory and Haematological Parameters in Erythropoietin-treated vs. Erythropoietin-naïve CKD Patients: Insight into Disease Pathophysiology. *Sokoto Journal of Medical Laboratory Science*; **10(3)**: 376 – 385. <https://dx.doi.org/10.4314/sokjmls.v10i3.37>

Copyright: This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.