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Research Article

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# Effects of Haemodialysis on Some Haematological Parameters in Chronic Kidney Disease Patients Attending a Dialysis Centre in Southern Nigeria

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***Abstract***

*Chronic Kidney Disease (CKD) is frequently associated with haematological abnormalities, and haemodialysis may influence these parameters. This study evaluated pre and post-haemodialysis changes in some haematological parameters among CKD patients attending a dialysis centre in Southern Nigeria. A comparative cross-sectional study was conducted among 163 CKD patients undergoing maintenance haemodialysis. Venous blood samples were collected before and after haemodialysis for the assessment of some haematological indices using standard protocols. Data were analysed using appropriate statistical tests at a significance level of $p < 0.05$. Post-haemodialysis findings showed a slight, non-significant increase in total white blood cell count, while neutrophils, lymphocytes, and monocytes demonstrated non-significant reductions. Basophil percentage increased significantly following haemodialysis ($p < 0.05$). Haemoglobin and haematocrit levels increased significantly after haemodialysis, from $9.79 \pm 1.52$ to $10.56 \pm 1.74$ g/dL and from $29.30 \pm 5.09$ to $32.33 \pm 5.36\%$, respectively ($p < 0.05$). Platelet count showed a non-significant increase. Haemodialysis significantly improves haemoglobin and haematocrit levels in CKD patients. Regular monitoring of these parameters is essential for effective clinical management of CKD patients undergoing haemodialysis.*

**Keywords:** Chronic Kidney Disease, Haemodialysis, Haematological Parameters.

## Introduction

Chronic Kidney Disease (CKD) is a progressive condition marked by a gradual decline in renal function, ultimately impairing the kidneys' ability to maintain internal homeostasis. As renal function deteriorates, many patients progress to end-stage kidney failure and require haemodialysis to sustain adequate fluid, electrolyte, and metabolic balance. Haemodialysis, while essential for survival, exerts significant effects on haematological indices, contributing to increased morbidity and mortality.

CKD itself is recognised as a major public health concern worldwide, with a rising incidence and prevalence that affects populations across both high-income and low-income regions. Its burden is particularly severe in sub-Saharan Africa where limited healthcare resources, late presentation, and high rates of comorbidities intensify disease outcomes [1].

Haemodialysis, as a principal form of renal replacement therapy, removes accumulated metabolic waste and excess fluid but simultaneously influences the composition and function of blood cells. Anaemia remains one of the most common and debilitating haematological complications in CKD, arising from insufficient erythropoietin synthesis, persistent inflammation, iron deficiency, and cumulative blood losses during dialysis procedures. The mechanical forces within the extracorporeal circuit can contribute to haemolysis, while repeated dialysis sessions may exacerbate iron depletion. Several recent studies have demonstrated consistent increases in haemoglobin, red blood cell count, and

haematocrit immediately after haemodialysis, largely due to haemoconcentration occurring during ultrafiltration rather than any genuine increase in red cell mass. In Libya, Albeshti et al., conducted a hospital-based observational study involving haemodialysis patients and reported statistically significant rises in both Haemoglobin concentration (Hb) and Haematocrit (HCT) following each dialysis session[2].

A prospective study carried out in India by Raja et al., similarly documented higher post-dialysis Hb and Hct values, confirming that intravascular volume reduction accounted for these acute changes. Research conducted in Sudan by Mohammed (2024) and a parallel investigation at Martyr Mohammed El-Najjar Hospital in Palestine (2024) both corroborated this pattern, noting clear post-dialysis elevations in Hb and Hct when compared with pre-dialysis findings. Authors such as Babalj Banskolieva and Kartikasari et al., caution that these post-dialysis increases should not be misinterpreted when assessing anaemia severity or adjusting erythropoiesis-stimulating agent (ESA) therapy. Nigerian data from Oyedepo emphasise persistently low pre-dialysis Hb levels resulting from erythropoietin deficiency and iron-restricted erythropoiesis, with modest or apparent improvements noted immediately after dialysis owing only to fluid removal rather than true haematological recovery [3- 7].

Evidence further indicates that haemoglobin and haematocrit levels may decline transiently during haemodialysis due to intravascular volume changes and the sequestration of blood within the machine tubing [8]. Platelet abnormalities also occur frequently, with patients demonstrating impaired platelet aggregation and reduced platelet life span, which collectively increase the risk of bleeding. Dialysis-related anticoagulation, particularly the use of heparin, contributes additional complexity to coagulation regulation [9, 10].

The effect of haemodialysis on white blood cell counts (WBC) remains variable across studies, although the majority indicate minimal change in total WBC immediately after treatment. In Libya, Albeshti et al., observed small post-dialysis reductions in total WBC, while Mohammed (2024) in Sudan reported negligible overall change following treatment. A multi-centre cohort study conducted in Southeast Asia by Kartikasari et al., detected modest reductions in lymphocyte counts together with fluctuating neutrophil levels, findings attributed to transient immune redistribution and complement-mediated activation during dialysis. Nigerian and broader West African reports, including those by Yau and Oyedepo, indicate that many CKD patients begin dialysis with elevated baseline WBC counts related to chronic inflammation or infection, and haemodialysis does not consistently normalise these parameters. Collectively, recent evidence suggests that haemodialysis induces transient shifts in leukocyte subpopulations rather than significant or sustained changes in total WBC [11, 12].

Investigating the haematological alterations associated with haemodialysis is essential for improving the clinical management of CKD. A deeper understanding of these changes enables the refinement of treatment protocols, enhances patient safety, and contributes to better long-term outcomes. Early identification and correction of abnormalities reduce the likelihood of complications such as severe anaemia, and thrombotic events, thereby improving quality of life and overall survival [13]. This study therefore aims to examine the effects of haemodialysis on key haematological parameters, contributing evidence that may guide more effective clinical practice for individuals living with chronic kidney disease.

**Aim of the Study**

To evaluate the impact of haemodialysis on some haematological parameters, among patients with Chronic Kidney Disease (CKD) attending a dialysis centre in Southern Nigeria.

**Specific Objectives of the Study**

To evaluate and compare the pre- and post-haemodialysis changes in some haematological parameters among Chronic Kidney Disease (CKD) patients attending a dialysis centre in Southern Nigeria.

**Study Area**

The study was carried out at, Hilton Clinics Dailysis Centre, NO 2, Ejekwu Wike Close, Opposite Wimpy Junction by Ada George Road Rivers State Nigeria. Being a major private dialysis centre for renal care located in Port Harcourt, Rivers State Nigeria. In this centre, there are multitudes of patients attending from different state in Southern Nigeria.

**Study Design**

A hospital-based cross-sectional study was conducted over six months.

**Study Population**

A total of hundred and seventy (170) subjects were enrolled for this study. Seven died during the course of the research and the remaining one hundred and sixty three (163) patients diagnosed with CKD on maintenance haemodialysis at Hilton Clinics, a private major centre for renal care in Port Harcourt, Rivers State Nigeria had their blood samples collected for pre haemodialysis and post haemodialysis.

**Inclusion Criteria**

Adults (≥18 years) with CKD stage 5 undergoing haemodialysis.
Patients on stable haemodialysis for at least three months.
Those who provided informed consent.

**Exclusion Criteria**

Patients with active infections or inflammatory disorders.
Those on anticoagulation therapy beyond routine dialysis anticoagulation. Individuals with haematological disorders unrelated to CKD.

**Sample Size Calculation**

To achieve statistical significance, the sample size was calculated using Cochran's formula [14]:
$n=Z2Pq/d2$
Where:
n = sample size minimum,
z = 95% confidence interval = 1. 96,
P = proportion of the target population,
d = with, degree of accuracy (95% interval) = 0.05% and q = 1.0 – p.
P=12.7% [15].
N= 1.962 x 0.127 x (1-0.127)/0.052

N=3.8416 x 0.127 x 0.873/0.0025
N=170.36
N=170

## Ethical Considerations

Ethical approval was obtained from the ethical review board of the hospital. Informed consent was obtained from all participants and confidentiality was strictly maintained.

### Sample Collection

Blood samples were collected from One hundred and sixty three (163) patients diagnosed with CKD Pre-dialysis and post-dialysis. Approximately 3mls of blood was collected from each subject and dispensed into ethylenediaminetetraacetic acid (EDTA) bottles for haematological analysis.

## Method

### Laboratory Analysis

The Complete Blood Count was Estimated using Mindray 5 part. The Complete Blood Count (CBC) was estimated using an automated Mindray 5-part haematology analyser, which performs full blood cell quantification and differential leukocyte analysis through integrated impedance, flow cytometry, photometric and chemical dye-binding technologies. The analyser is designed to measure red-cell parameters, white-cell counts with a 5-part differential, platelet indices, haemoglobin concentration and derived haematological indices using optimised fluidics and digital signal processing [16, 17]. The method follows standard laboratory protocols in line with international haematology automation guidelines, ensuring accuracy, precision and reproducibility for routine diagnostic use [18].

### Principle

The principle of the Mindray 5-part analyser is based on several integrated analytical mechanisms.

1. Electrical Impedance (Coulter Principle): This is used for counting red blood cells and platelets by detecting changes in electrical resistance as cells pass through an aperture..
2. Flow Cytometry with Laser Scattering: White blood cells are classified into neutrophils, lymphocytes, monocytes, eosinophils and basophils based on differences in cell size, internal complexity and granularity measured by multi-angle laser light scatter (Mindray Diagnostics, 2021).
3. Cyanide-free Photometric Method for Haemoglobin: Haemoglobin concentration is measured after cell lysis using a non-cyanide colourimetric reagent where absorbance is read at a specific wavelength [19].
4. Mathematical Derivations: The analyser automatically calculates indices such as MCV, MCH, MCHC and RDW using measured parameters.

These combined principles ensure rapid, reliable and high-throughput haematological measurement suitable for clinical and research purposes.

## Materials

The materials and reagents used for CBC analysis using the Mindray 5-part analyser include:

1. Venous whole blood collected into EDTA ($K_3EDTA$) vacutainer tubes.
2. Calibrators and commercial quality-control materials specific to the analyser.
3. Manufacturer-approved reagents including diluents, lysing reagents, sheath fluid and cleaning solutions.
4. Disposable gloves, sample racks and bar-coded labels for specimen identification.
5. The automated Mindray 5-part haematology analyser equipped with standard software and data-management systems.

### Procedure

Specimen collection. Whole blood was collected via venepuncture into EDTA tubes and gently mixed to prevent clot formation after labeling for pre-dialysis and post-dialysis. And then, samples were inspected for clots, haemolysis or insufficient volume prior to analysis. The analyser switched on, allowed to complete its internal quality checks and verified with daily quality-control materials according to laboratory policy.

Then, each sample tube was then placed in the sampler rack, and the analyser aspirated a defined volume of whole blood automatically for pre-dialysis and post-dialysis analysis systematically. The system was described as diluting the sample, lysing the red cells for haemoglobin measurement and directing cell suspensions into separate analytical chambers for counting and differentiation. The analyser reportedly processed the sample using impedance for RBC and platelet counts, laser scatter for WBC differentials, and photometry for haemoglobin estimation.
At the end of every analysis, the instrument generated a printed or digital report containing all CBC results and systematical documentation was achieved per sample.

### Data Analysis

Data obtained from this study were entered and analysed using SPSS version 25. Continuous variables, including haematological parameters, were presented as mean ± standard deviation (Mean ± SD). For the comparison of pre- and post-haemodialysis parameters for the overall CKD patient population, paired t-tests were used to determine statistically significant differences at $P<0.05$. A p-value less than 0.05 was considered statistically significant for all analyses.

## Results

Out of the one hundred and seventy (170) subjects recruited for the study, seven (7) subjects died after pre-dialysis sample collection, and the remaining one hundred and sixty-three (163) were subsequently grouped according to age.

Table 1 is the evaluation of Pre- and Post-Hemodialysis Changes in Hematological Parameters among Chronic Kidney Disease Patients at a Dialysis Center in Southern Nigeria. The result showed a significant increases in haemoglobin concentration, haematocrit, red blood cells count, platelets count and basophils percent among post dialysis CKD subjects when compared with the pre dialysis subjects ($P<0.05$) while there was no significant difference in total white cell count, neutrophil percent, lymphocyte percent, monocyte percent, eosinophils percent, mean cell volume, mean cell haemoglobin, mean cell haemoglobin concentration and red cell distribution width ($P>0.05$)

**Table 1:** Evaluation of Pre- and Post-Hemodialysis Changes in some Haematological Parameters among Chronic Kidney Disease Patients at a Dialysis Center in Southern Nigeria

| Parameter | N | PRE (Mean ± SD) | POST (Mean ± SD) | Δ% (Mean change) | t-value | p-value |
|---|---|---|---|---|---|---|
| WBC | 163 | 6.89 ± 1.85 | 6.93 ± 2.28 | +0.58% | -0.176 | 0.861 |
| NEU | 163 | 60.41 ± 4.29 | 60.35 ± 4.79 | −0.10% | 0.137 | 0.892 |
| LYM | 163 | 24.18 ± 4.17 | 23.66 ± 4.49 | −2.15% | 1.089 | 0.277 |
| MONO | 163 | 8.47 ± 2.93 | 7.95 ± 3.24 | −6.14% | 1.520 | 0.130 |
| EOI | 163 | 5.26 ± 2.14 | 5.48 ± 2.59 | +4.18% | -0.836 | 0.404 |
| BAS | 163 | 1.67 ± 0.95 | 2.64 ± 1.69 | +58.08% | -6.378 | 0.000 |
| RBS | 163 | 3.85 ± 0.47 | 3.98 ± 0.53 | +3.38% | -2.316 | 0.021 |
| HB | 163 | 9.79 ± 1.52 | 10.56 ± 1.74 | +7.87% | -4.271 | 0.000 |
| HCT | 163 | 29.30 ± 5.09 | 32.33 ± 5.36 | +10.34% | -5.221 | 0.000 |
| MCV | 163 | 87.88 ± 5.86 | 87.98 ± 5.91 | +0.11% | -0.154 | 0.877 |
| MCH | 163 | 28.57 ± 1.87 | 28.93 ± 2.11 | +1.26% | -1.626 | 0.105 |
| MCHC | 163 | 33.03 ± 1.26 | 33.22 ± 1.41 | +0.58% | -1.316 | 0.189 |
| RDW-CV | 163 | 15.27 ± 1.81 | 14.93 ± 2.10 | −2.23% | 1.569 | 0.118 |
| RDW-SD | 163 | 47.75 ± 5.09 | 47.04 ± 5.35 | −1.49% | 1.240 | 0.216 |
| PLT | 163 | 215.85 ±61.48 | 220.90 ±70.16 | +2.34% | -0.690 | 0.49 |

## Discussion

This chapter presents the discussion of the findings obtained from the statistical analyses conducted in this study. The results generated from the evaluation of haematological and coagulation parameters in chronic kidney disease (CKD) patients undergoing haemodialysis are interpreted in relation to the study objectives. The discussion integrates these findings with established literature to highlight patterns, clinical relevance, and possible physiological explanations. The mean WBC count increased slightly from 6.89 ± 1.85 $\times 10^9$/L pre-dialysis to 6.93 ± 2.28 $\times 10^9$/L post-dialysis (+0.58%), which was not statistically significant ($t = -0.176$, $p = 0.861$). Neutrophils (NEU) and lymphocytes (LYM) showed negligible changes of −0.10% and −2.15% respectively, also non-significant ($p > 0.05$). Monocytes (MONO) decreased by 6.14%, while eosinophils (EOI) increased by 4.18%, with neither change reaching statistical significance ($p = 0.130$ and $p = 0.404$). These results suggest that haemodialysis session does not markedly affect most leukocyte populations, consistent with prior observations that acute dialysis exerts minimal influence on total white cell counts [20, 21].

Notably, basophil counts (BASO) increased by 58.08% post-dialysis, a highly significant change. Although basophils are a small fraction of circulating leukocytes, this marked rise may reflect dialysis-induced inflammatory or immune activation, potentially triggered by the dialysis membrane or anticoagulant exposure [22].

Red Blood Cell count (RBC) showed a small but significant post-dialysis increase of 3.38%, possibly reflecting transient metabolic effects of dialysis fluids. Haemoglobin (HB) and haematocrit (HCT) rose significantly by 7.87% and 10.34%, respectively, indicating effective haemoconcentration due to ultrafiltration. This aligns with previous studies reporting transient increases in HB and HCT immediately after haemodialysis [23]. Other red cell indices, including mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC), exhibited minor, non-significant changes, suggesting stable red blood cell morphology during dialysis.

Red cell distribution width (RDW-CV and RDW-SD) decreased slightly post-dialysis (−2.23% and −1.49%), though not significantly ($p > 0.05$), indicating minimal impact of dialysis on red cell size variability.

Platelet count (PLT) and mean platelet volume (MPV) were largely unchanged post-dialysis (+2.34% and −0.10%, $p > 0.05$), demonstrating that platelet numbers and size are generally stable during routine haemodialysis, in agreement with previous reports [24, 25].

The data indicate that standard haemodialysis significantly increases haemoglobin, haematocrit, and basophil counts, while most other haematological parameters remained stable. The haemoconcentration effect reflects fluid removal during dialysis, whereas the rise in basophils may represent an acute inflammatory or immune response. These observations underscore the importance of monitoring haematological parameters to guide fluid management and identify potential inflammatory or immunological complications [26- 29].

The findings corroborate previous studies reporting significant post-dialysis haemoconcentration but minimal changes in leukocyte and platelet counts. The significant increase in basophils observed in this study may represent a population-specific response and warrants further investigation in larger cohorts. Therefore, haemodialysis induces selective significant changes in haemoglobin, haematocrit, and basophils, while leaving most other haematological parameters largely unaltered. These results highlight both the efficacy of fluid removal and the subtle immuno-haematological effects of haemodialysis in CKD patients.

## Conclusion

Haematological parameters revealed significant improvements in haemoglobin (HB), haematocrit (HCT), and red blood cell

counts (RBC) post-dialysis. White blood cell counts and differential counts, including neutrophils and lymphocytes, remained largely stable across all age groups, although basophil counts increased significantly suggesting a potential immune modulation effect of dialysis. These results align with prior studies reporting haemodialysis-mediated correction of anaemia and partial restoration of haematopoiesis in CKD patients.

## Recommendations

Given the observed improvements in haemoglobin and haematocrit post-dialysis, dialysis centres should continue to monitor and optimise dialysis schedules and duration to maximise haematological benefits for CKD patients. Routine assessment of complete blood count and red blood cell indices should be conducted pre- and post-dialysis to identify patients at risk of anaemia or other haematological abnormalities and ensure timely interventions. Integration of Nutritional and Pharmacological Support by combining dialysis with nutritional optimisation and appropriate pharmacological interventions, such as erythropoiesis-stimulating agents and iron supplementation, may further enhance haematological outcomes.

## Further Research

Longitudinal studies with larger sample sizes across multiple centres are recommended to validate these findings and explore the long-term effects of hemodialysis on haematological and coagulation parameters in diverse CKD populations.

## Contribution to Knowledge

This study provides significant insights into the haematological changes associated with haemodialysis among Chronic Kidney Disease (CKD) patients in Southern Nigeria. By evaluating pre- and post-dialysis parameters, the study generated updated, region-specific evidence on the effects of dialysis on some blood components.

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