ClinicSearch

International Journal of Clinical and Medical Case Reports

Chinedu-Madu Jane U *

Open Access

Research Article

Assessment of Red Blood Cell Count and Red Cell Indices in Patients Diagnosed with Breast Cancer at Federal Teaching hospital, Owerri Nigeria

Chinedu-Madu Jane U [1]*, Onyenze Chimdiya A [2], and Aloy-Amadi Oluchi C [3]

[1] Department of Haematology, Federal University Otueke, Bayelsa State, Nigeria.

[2,3] Department of Medical Laboratory Science, Imo State University, Owerri, Nigeria.

***Corresponding Author**: Chinedu-Madu Jane U, Department of Haematology, Federal University Otueke, Bayelsa State, Nigeria.

Received Date: April 26, 2025; Accepted Date: May 03, 2025; Published Date: May 07, 2025.

Citation: Chinedu-Madu Jane U, Onyenze Chimdiya A, and Aloy-Amadi Oluchi C, (2025), Assessment of Red Blood Cell Count and Red Cell Indices in Patients Diagnosed with Breast Cancer at Federal Teaching hospital, Owerri Nigeria, *International Journal of clinical and Medical Case Reports*, 4(3); **Doi:**10.31579/2834-8664/070

Abstract:

Background: Breast cancer remains a major global public health issue, contributing significantly to morbidity and mortality among women. Hematological alterations, particularly in red blood cell (RBC) parameters, may provide insight into disease progression and treatment effects in affected individuals.

Objective: This study aimed to assess the red blood cell count and red cell indices in breast cancer patients attending the Federal Teaching Hospital, Owerri, and compare them with age-matched healthy controls.

Methods: A total of 40 participants were recruited, comprising 20 breast cancer patients aged 18–65 years and 20 apparently healthy, age-matched controls. Venous blood samples (5 mL) were collected aseptically into EDTA tubes and analyzed manually. RBC counts were determined using a hemocytometer, while red cell indices—mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width-coefficient of variation (RDW-CV), and red cell distribution width-standard deviation (RDW-SD)—were calculated using standard formulas. Statistical analysis was performed using IBM SPSS version 21.0, with results expressed as mean ± standard deviation. Student's t-test assessed differences between groups, and Pearson correlation evaluated relationships among variables. A p-value < 0.05 was considered statistically significant.

Results: Breast cancer patients exhibited significantly lower mean values of RBC count [(2.80±0.15)×10^{12}/L], MCV [(81.50±2.09) fL], MCHC [(329.45±12.58) g/L], and MCH [(29.05±1.23) pg] compared to controls [(4.53±0.45)×10^{12}/L], [(91.40±5.64) fL], [(342.50±14.09) g/L], and [(30.70±1.95) pg], respectively respectively (t=15.79, p=0.000; t=7.04, p=0.000; t=2.57, p=0.016; t=2.84, p=0.008). Conversely, RDW-CV [(23.20±1.96)%] and RDW-SD [(70.10±3.61) fL] were significantly elevated in breast cancer patients compared to controls [(13.70±1.16) % and (39.50±4.67) fL] (t=14.05, p=0.000; t=19.83, p = 0.000). Positive correlations were observed between RBC count and MCV (r = 0.90, p = 0.000), MCHC (r = 0.54, p = 0.002), and MCH (r = 0.57, p = 0.001). RBC count correlated negatively with RDW-CV (r = -0.91, p = 0.000) and RDW-SD (r = -0.95, p = 0.000).

Conclusion: Breast cancer is associated with significant alterations in erythrocyte parameters, including decreased RBC count, MCV, MCH, and MCHC, alongside elevated RDW-CV and RDW-SD. These hematological changes may reflect underlying tumor-induced inflammation, chemotherapy-related bone marrow suppression, or nutritional deficiencies. Monitoring these parameters may aid in evaluating disease progression and tailoring supportive management in breast cancer patients.

Keywords: red blood cell count; red cell indices; breast cancer

1.Introduction

Breast cancer is the most commonly diagnosed malignancy among women worldwide and a leading cause of cancer-related mortality, particularly in low- and middle-income countries where access to early diagnosis and comprehensive care remains limited (1). In Nigeria, breast cancer accounts for a significant proportion of female cancers, with rising incidence rates and considerable health system burden (2). Beyond its direct pathological impact, breast cancer and its treatment have systemic effects that may lead to alterations in hematological parameters, including those related to erythropoiesis and red blood cell morphology [3].

Red blood cells (RBCs) and red cell indices such as mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW) are vital components of the complete blood count (CBC) and serve as valuable indicators of hematopoietic activity and overall health status [4]. These parameters are often affected in cancer patients due to chronic inflammation, nutritional deficiencies, bone marrow suppression, and the effects of chemotherapy or radiotherapy [5,6].

Recent studies suggest that hematological changes in cancer patients, including anemia and anisocytosis (variations in RBC size), can provide insights into disease progression, prognosis, and response to treatment [7]. Elevated RDW values, in particular, have been associated with increased mortality and poor outcomes in several malignancies, including breast cancer [8]. Given the paucity of localized data, this study aimed to assess the red blood cell count and red cell indices in breast cancer patients attending the Federal Teaching Hospital, Owerri, Nigeria. It also sought to evaluate correlations among these parameters to better understand their clinical implications in the context of breast cancer.

2. Materials And Methods

2.1 Study Area

The study was conducted at the Federal Teaching Hospital, Owerri, Imo State, Nigeria.

2.2 Study Design

This was a cross-sectional study carried out between January and March 2024. Eligible participants who completed a structured questionnaire and provided written informed consent were recruited. The study population comprised 30 patients diagnosed with breast cancer. An equal number of age-matched individuals without breast cancer were selected as the control group**. Venous blood (5 mL)** was collected aseptically from each participant via venipuncture using sterile needles and syringes. The blood was transferred into EDTA tubes to prevent clotting, mixed gently, and transported to the laboratory for analysis. Red blood cell (RBC) count was determined manually using a hemocytometer, and red cell indices were calculated using standard formulas based on the RBC count and hemoglobin concentration. Data were analyzed using SPSS version 21.

2.3 Method of Recruitment

A total of 40 subjects (20 breast cancer patients and 20 controls) were recruited for the study. All participants were provided with informed consent forms. Those who signed the consent forms were enrolled in the study and asked to complete a structured questionnaire to collect relevant demographic and medical information.

2.4 Ethical Consideration

Ethical approval for the study was obtained from the Ethics Committee of the Federal Teaching Hospital, Owerri. Informed consent was obtained from all participants prior to inclusion in the study. Confidentiality and anonymity of participant data were maintained throughout the study.

2.5 Sample Collection

Five milliliters of venous blood was collected aseptically from the antecubital vein of each participant using sterile equipment. The blood was dispensed into properly labeled EDTA tubes, indicating the subject's name, sample number, and date of collection. The samples were then stored at 4°C until further analysis.

2.6 Laboratory Analysis

The collected blood samples were analyzed manually. Red blood cell count was performed using a hemocytometer chamber. Red cell indices—including mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC)—were calculated using established formulas based on the RBC count and hemoglobin concentration.

2.7 Statistical Analysis

All collected data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 21. Descriptive statistics were used to summarize the data, and results were presented as mean ± standard deviation. Comparative analysis between the patient and control groups was conducted using appropriate statistical tests, with significance set at $p < 0.05$

3.Results

Table 1 shows the mean values of RBC, MCV, MCHC and MCH in breast cancer patients versus controls.The mean values of RBC, MCV, MCHC and MCH were significantly lower in breast cancer patients $(2.80\pm0.15)x10^{12}/L$, (81.50±2.09)fL, (329.45±12.58)g/L and (29.05±1.23)pg, when compared to controls $(4.53\pm0.45)x10^{12}/L$, (91.40±5.64)fl, (342.50±14.09)g/L and (30.70±1.95)pg, respectively (t=15.79, p=0.000; t=7.04, p=0.000; t=2.57, p=0.016; t=2.84, p=0.008).

Parameter	Test (n=20)	Control (n=20)	t-value	p-value
RBC ($x10^{12}/L$)	2.80±0.15	4.53±0.45	15.79	0.000*
MCV (Fl)	81.50±2.09	91.40±5.64	7.04	0.000*
MCHC (g/L)	329.45±12.58	342.50±14.09	2.57	0.016*
MCH (pg)	29.05±1.23	30.70±1.95	2.84	0.008*

Table 1: Mean Values of RBC, MCV, MCHC and MCH in Breast Cancer Patients Versus Controls (Mean±SD)

KEY:
*: Significant p value
SD: Standard Deviation
RBC: Red Blood Cell
MCV: Mean Cell Volume
MCHC: Mean Corpuscular Haemoglobin Concentration
MCH: Mean Corpuscular Haemoglobin

Table 2 shows the mean values of RDW-CV and RDW-SD in breast cancer patients versus controls. The mean values of RDW-CV and RDW-SD were significantly higher in breast cancer patients (23.20±1.96) % and (70.10±3.61)fL, when compared to controls (13.70±1.16)% and (39.50±4.67) f L, respectively (t=14.05, p=0.000; t=19.83,p = 0.000).

Parameter	Test (n=20)	Control (n=20)	t-value	p-value
RDW-CV (%)	23.20±1.96	13.70±1.16	14.05	0.000*
RDW-SD (FL)	70.10±3.61	39.50±4.67	19.83	0.000*

Table 2: Mean Values of RDW-CV and RDW-SD in Breast Cancer Patients Versus Controls (Mean±SD)

KEY:
*: Significant p value
SD: Standard Deviation
RDW-CV: Red Cell Distribution Width-Coefficient of Variance
RDW-SD: Red Cell Distribution Width- Standard Deviation

Table 3 shows the Pearson correlation of RBC with MCV, MCHC, MCH, RDW-CV and RDW-SD in breast cancer patients. There was a significant positive correlation of RBC with MCV (r=0.90, p=0.000), MCHC (r=0.54, p=0.002) and MCH (r=0.57, p=0.001) in breast cancer patients, and a significant negative correlation of RBC with RDW-CV (r=-0.91, p=0.000) and RDW-SD (r=-0.95, p=0.000) in breast cancer patients.

Dependent Variable	n	r	p-value
MCV	20	0.90	0.000*
MCHC	20	0.54	0.002*
MCH	20	0.57	0.001*
RDW-CV	20	-0.91	0.000*
RDW-SD	20	-0.95	0.000*

Table 3: Correlation of RBC with MCV, MCHC, MCH, RDW-CV and RDW-SD in Breast Cancer Patients.

KEY:
*: Significant p value
RBC: Red Blood Cell
MCV: Mean Cell Volume
MCHC: Mean Corpuscular Haemoglobin Concentration
MCH: Mean Corpuscular Haemoglobin
RDW-CV: Red Cell Distribution Width-Coefficient of Variance
RDW-SD: Red Cell Distribution Width- Standard Deviation

4. Discussion

This study revealed significant hematological alterations in breast cancer patients when compared to age-matched healthy controls. Specifically, breast cancer patients demonstrated significantly reduced red blood cell (RBC) count, mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), and mean corpuscular hemoglobin (MCH). Additionally, there was a marked increase in red cell distribution width-coefficient of variation (RDW-CV) and red cell distribution width-standard deviation (RDW-SD). These findings reflect underlying pathophysiological changes in erythropoiesis, potentially influenced by malignancy, treatment effects, and systemic inflammation. The reduction in RBC count observed in this study is consistent with reports by Akinbami et al. in Lagos, Nigeria, who found significantly lower RBC counts and hemoglobin levels in breast cancer patients undergoing chemotherapy compared to healthy controls [9]. This may be attributed to chemotherapy-induced bone marrow suppression and chronic inflammation, both of which compromise erythropoiesis. Similarly, studies by Grotto et al. and Bhat et al. also reported anemia as a common presentation in breast cancer patients, with reductions in erythrocyte indices related to disease burden and nutritional deficiencies [10,11]. The observed decrease in MCV, MCH, and MCHC supports findings from similar studies that indicated microcytic, hypochromic anemia in cancer patients. For example, research by Sirdah et al. found reduced MCHC and MCH levels in oncology patients due to iron-deficiency and anemia of chronic disease [12]. Iron sequestration mediated by inflammatory cytokines such as IL-6, and inadequate iron utilization for erythropoiesis are thought to be key mechanisms [13]. Furthermore, MCV reductions have been linked with long-standing chronic disease and chemotherapy-related cytotoxicity, as noted by Sharma et al. in their study on breast cancer patients in India [14].A notable finding in this study was the significantly elevated RDW-CV and RDW-SD in breast cancer patients. These indices indicate higher heterogeneity in RBC size (anisocytosis), which has been increasingly recognized as a marker of inflammation and poor prognosis in various cancers. Our results align with findings from Hu et al., who reported elevated RDW levels in several solid tumors and emphasized its predictive value in cancer outcomes [15]. Similarly, Montagnana et al. observed significantly increased RDW values in breast cancer patients, associating it with systemic inflammation and nutritional imbalance [16].The strong negative correlation between RBC and RDW-CV/RDW-SD found in this study suggests that worsening anemia is accompanied by greater anisocytosis, reflecting ineffective erythropoiesis. This is consistent with the findings of Lippi et al., who reported inverse relationships between RDW and red cell indices in inflammatory and neoplastic conditions [17].

Furthermore, the positive correlation between RBC and MCV, MCH, and MCHC indicates that adequate red cell production is linked with more stable and normal red cell morphology. These correlations support the findings of Iqbal et al., who reported similar trends in breast cancer patients and proposed that red cell indices could serve as adjunct markers for disease monitoring [18].

Overall, our findings confirm that breast cancer induces significant alterations in erythrocyte parameters, likely due to a combination of direct tumor effects, nutritional compromise, systemic inflammation, and treatment-related myelosuppression. These hematological changes not only have diagnostic relevance but may also serve as potential markers for prognosis and treatment response in breast cancer patients.

References

1. Sung H, Ferlay J, Siegel RL, et al.(2021). Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide. *CA Cancer J Clin*. ;71(3):209–249.
2. Jedy-Agba E, Oga EA, Odutola M, et al.(2015). Developing national cancer registration in developing countries – case study of the Nigerian National System of Cancer Registries. *Front Public Health*;183:186.
3. Weiss G.(2009). Iron metabolism in the anemia of chronic disease. *Biochim Biophys Act*a;1790(7):682–693.
4. Bain BJ.(2015). Blood cells: a practical guide. 5th ed. Oxford: *Wiley-Blackwell*.

5. Harrison's Principles of Internal Medicine. 20th ed. McGraw-Hill Education; 2018.
6. Dale DC, Boxwala I.(2010). Hematopoietic growth factors in cancer patients. *Curr Opin Hematol*;17(3):177–183.
7. Jelkmann W.(2007). Erythropoietin after a century of research: younger than ever. *Eur J Haematol*;78(3):183–205.
8. Hu L, Li M, Ding Y, et al.(2017). Prognostic value of RDW in cancers: a systematic review and meta-analysis view and meta-analysis. *Oncotarget*;8(9):16027–16035.
9. Akinbami A, Ajibola S, Adegunsoye M, Adediran A. et al.(2014). Hematologic profile of breast cancer patients in Lagos, Nigeria. *Mol Clin Oncol*;2(6):1039–1042.
10. Grotto HZ, Zanichelli MA, Machado LA, Garcia CE.(2008). Hematologic changes in patients with breast cancer undergoing chemotherapy. *Rev Bras Hematol Hemoter;*30(4):296–300.
11. Bhat RA, Wani HA, Khan SM.(2016). Hematological profile in cancer patients undergoing chemotherapy: a prospective study. *Indian J Hematol Blood Transfus*.;32(1):120–126.
12. Sirdah M, Yaghi A, Yaghi A.(2021). Blood hemoglobin concentration of breast cancer patients in relation to disease progression and chemotherapy treatment. *Hematol Transfus Cell Ther*;43(2):167–173.
13. Weiss G, Goodnough LT.(2005). Anemia of chronic disease. *N Engl J Med*. ;352(10):1011–1023.
14. Sharma DC, Singh N, Gupta RK.(2015). Alterations in hematological profile in cancer patients during chemotherapy. J Pharm Sci Res;7(6):261–263.15.
15. Hu L, Li M, Ding Y, Pu L, Liu J, Xie J, et al.(2017). Prognostic value of RDW in cancers: a systematic review and meta-analysis. *Oncotarget.* 2017;8(9):16027–16035.
16. Montagnana M, Danese E, Lippi G.(2016). Red cell distribution width and cancer. Ann Transl Med;4(20):399.
17. Lippi G, Targher G, Montagnana M, Salvagno GL.(2009). Relation between red blood cell distribution width and inflammatory biomarkers in a large cohort of unselected outpatients. *Arch Pathol Lab Med*;133(4):628–632.
18. Iqbal MP.(2020). Clinical significance of red cell distribution width (RDW) in patients with breast cancer. Pak J Med Sci;36(7):1594–1598.