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Hormone Receptor Status, Human Epidermal Growth Factor Receptor 2 Expression, and Demographic Patterns in Breast Cancer: A Descriptive Study

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Abstract

Introduction: Breast cancer is a significant public health concern globally, with varying incidence and mortality rates across different regions. Hormone receptor status, particularly that of estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor receptor 2 (HER2), play a crucial role in the prognosis and treatment of breast cancer. This research aims to provide a comprehensive understanding of hormone receptor status in breast cancer samples from Akure, Nigeria.
Methodology: This retrospective cross-sectional study evaluated the hormone receptor status of breast cancer samples from Akure, Nigeria. Data were obtained from medical records of histologically confirmed breast cancer specimens with complete immunohistochemistry reports at the University of Medical Science Teaching Hospital (UNIMEDTH), Akure, between January 2021 and December 2023. Data analysis employed descriptive statistics and inferential tests to explore associations between demographic and clinical variables. A p-value of less than 0.05 was deemed statistically significant.
Results: A total of 123 samples were analysed. The majority of patients (54.5%) were between 41 and 60 years of age. Receptor status analysis revealed that 51% of the patients were triple-negative, 26.8% were HER2-positive, 15.4% were estrogen receptor (ER)-positive, and 22% were progesterone receptor (PR)-positive. Additionally, 7.3% of the patients were ER- and PR-positive, 2.4% were PR- and HER2-positive, and ER-, PR-, and HER2-positive, respectively. The highest percentage of ER-positive cases (47.4%) and PR-positive cases (40.7%) appeared in the 41–50 years age group. HER2 overexpression in the samples was highest in the 41–50-year-old and 51–60-year-old age groups, with 27.3% each. Triple-negative breast cancer was most common, with 51% overall and 42.9% in patients aged 41--50 years.
Conclusion: Triple-negative breast cancer emerged as the most prevalent subtype, followed by HER2-positive cases, with the highest receptor-positive rates observed among premenopausal women. These findings underscore the importance of implementing targeted diagnostic and therapeutic strategies for this population.

Keywords: Breast cancer, Hormone receptor, Triple negative, Invasive ductal carcinoma

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Introduction

Breast cancer is a significant public health concern globally, with varying incidence and mortality rates across different regions.[1] The status of hormones, particularly estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor

receptor 2 (HER2), plays a crucial role in the prognosis and treatment of breast cancer. Determining these receptors in breast cancer specimens is essential for developing targeted therapies and improving patient outcomes.[1]

Hormone receptors are proteins found in and on breast cells that can attach to hormones circulating in the blood. The presence or absence of these receptors helps determine the most effective treatment options. Breast cancers that are hormone receptor positive (HR+) can be treated with hormone therapies that lower estrogen levels or block estrogen receptors. Conversely, hormone receptor-negative (HR-) breast cancers do not respond to hormone therapy and often require alternative treatments such as chemotherapy.[2]

Several studies have demonstrated that the distribution of hormone receptor status and HER2 status varies significantly across different populations, underscoring the importance of regional studies for understanding the local epidemiology of breast cancer. A study by Gonçalves et al. (2023) characterized hormone receptor and HER2 status in breast cancer via mass spectrometry imaging and reported significant variations in receptor status among different populations.[3] Another study by Brandão et al. (2020) discussed the impact of receptor status on the prognosis and treatment of HER2-positive early breast cancer, highlighting the heterogeneity of HER2-positive breast cancer across different populations.[4] Furthermore, a study published in the International Journal of Clinical Oncology (2022) systematically assessed the heterogeneity in the clinical outcomes of patients with HER2-positive breast cancer associated with hormone receptor status, further emphasizing the need for regional studies.[5]

In Nigeria, studies have examined the hormone receptor status of breast cancer specimens. Nwafor & Keshinro (2015) in Lagos reported that 18.7% of breast cancer patients underwent immunohistochemical analysis. Their results revealed that 39.6% were ER+/PR+, 29.2% were ER−/PR−/HER2− (triple-negative), 18.8% were ER+/PR+/HER2+, and 12.5% were HER2+ (HER2 overexpressed).[6] These findings highlight the predominance of triple-negative breast cancers in younger women. Another study in northeastern Nigeria by Minoza, Yawe, Mustapha, Na'aya, et al. (2016) reported that 36.8% of tumours were ER+, 34.2% were PR+, and 21.1% were HER2+. Interestingly, more than half of the breast cancer cases in their study were triple-negative (52.6%), which is associated with a poorer prognosis and limited treatment options.[7] They emphasized the high incidence of triple-negative breast cancer (TNBC) in Nigeria, especially among younger women, which contributes to poorer outcomes owing to limited treatment options.

Understanding the distribution of hormone receptor statuses in different regions is essential, as it can reveal variations in breast cancer profiles and guide more effective, targeted therapies. Currently, limited data exist on hormone receptor patterns in Akure and surrounding areas. Our research aims to provide a comprehensive understanding of hormone receptor status in Akure, Nigeria, thereby strengthening the need for tailored treatment approaches.

Materials and Methods

This study employed a retrospective cross-sectional design to evaluate hormone receptor status in breast cancer patients diagnosed at the Oncology Unit of the University of Medical Sciences Teaching Hospital (UNIMEDTH), Akure, Nigeria.

The sample included all breast cancer patients diagnosed between January 2021 and December 2023. The inclusion criterion was all histologically confirmed breast cancer cases. Patients without immunohistochemistry reports were excluded from the study. We reviewed the hospital records of eligible patients and extracted demographic data, histological diagnoses, and immunohistochemistry profiles (estrogen receptor ER, progesterone receptor PR, and human epidermal growth factor receptor 2 HER2). The histological diagnosis was categorized via the World Health Organization (WHO) 2016 classification. The immunohistochemical results were categorized as positive or negative for ER, PR, or HER2.

Data analysis was performed using SPSS 26.0 statistical software. Categorical variables such as histological diagnosis and distribution of hormone receptor status (ER, PR, HER2) were summarized using frequencies and percentages, the only quantitative variable, age was described as mean and standard deviation. The associations between hormone receptor status, age, and histological diagnosis were assessed using chi-square tests. Statistical significance was set at $p<0.05$.

Patient confidentiality was maintained by assigning

unique identifiers to each sample and ensuring that personal information was not disclosed. The study protocol was reviewed and approved by the ethical committee of the Hospitals Management Board, Akure.

Results

Demographics of the breast cancer specimens

A total of 347 histologically diagnosed breast cancer cases were identified during the study period; however, only 123 specimens were subjected to immunohistochemistry analysis and were included in our study. The other cases were excluded as immunohistochemistry was not done mainly due to patients' financial constraints. The age range of the patients was 24–90 years, with a mean age of 49.59 ± 12.11 years. The majority of patients (54.5%) fell within the 41–60-year age group, followed by the 61–80-year age group (35%). Patients aged 51--60 years accounted for 18.5% of the cases, whereas those aged 61--70 years accounted for 10.5%. The remaining cases were distributed among the younger (20--30 years) and older age groups (71--80 years and 81--90 years), with 2.4%, 6.5%, and 0.8% of cases, respectively.

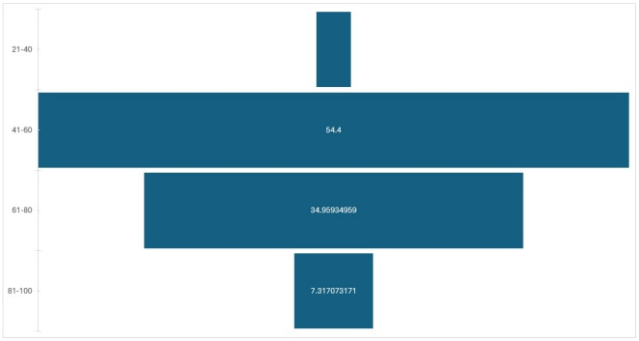

Figure 1- A horizontal funnel chart of Age range of patients with breast cancer

Hormone Receptor Status Distribution

The receptor status in the study indicates that most cases (51%) are triple-negative. This was followed by 26.8% of the patients being HER2/neu positive, 15.4% being estrogen receptor (ER)-positive, and 22% being progesterone receptor (PR)-positive. With respect to combinations of receptor status, 7% of cases are positive for both estrogen and progesterone receptors (ER/PR), 2.4% of cases are positive for all three receptors (ER/PR/HER2), and 2.4% of cases are positive for both progesterone and HER2 receptors (PR/HER2) (Figure I).

The highest percentage of ER-positive patients were in the 41–50 years age group (47.4%), followed by the 51–60 years age group (31.6%). Progesterone receptor (PR)-positive tumours were observed in 22% of the specimens. This percentage is greater than that of ER-positive tumours. The highest percentage of PR-positive patients were in the 41--50-year-old

Table 1: Demographic and immunophenotypic characteristics of breast cancers in Akure

Variable	Frequency (N)	Percent (%)
Age		
21-40	4	3.3
41-60	67	54.5
61-80	43	35.0
81-100	9	7.3
Immunohistochemistry Profile		
ER-PR+HER2-	12	9.8
ER+PR+HER2-	9	7.3
ER+PR-HER2-	6	4.9
ER-PR+HER2+	3	2.4
ER+PR+HER2+	3	2.4
ER+PR-HER2+	1	0.8
ER-PR-HER2+	26	21.1
ER-PR-HER-	63	51.2
ER Status		
Negative (NEG)	104	84.6
Positive (POS)	19	15.4
PR Status		
Negative (NEG)	96	78.0
Positive (POS)	27	22.0
HER2 Status		
Negative (NEG)	90	73.2
Equivocal	0	0
Over expression	33	26.8

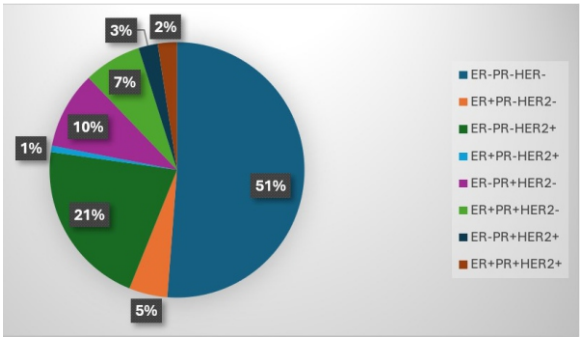

Figure I: Hormone receptor expression in patients with breast cancer

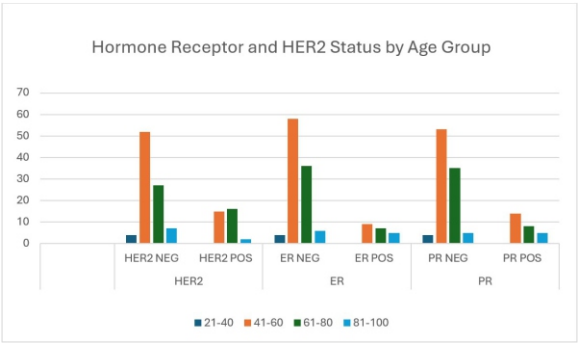

Figure II: Age distribution of patients with hormone receptor and HER2 status.

age group (40.7%), followed by the 51--60-year-old (18.5%), 31--40-year-old and 71--80-year-old (14.8%) groups (Figure II).

The highest percentage of HER2-positive tumours was in the 41–50-year and 51–60-year age groups (27.3%), followed by the 31–40-year age groups (24.2%). The highest percentage of TNBC patients were in the 41–50 years age group (42.9%), followed by the 31–40 years age group (22.2%) (Figure II).

The data highlight the prevalence of hormone receptor-positive breast cancers, particularly among those in their 40s and 50s, whereas triple-negative cases were more common in younger patients aged 31–50 years

Discussion

This analysis of 123 breast cancer samples from Akure, Nigeria, revealed that most patients (58.8%) were in the 41–60-year age group, with a mean age of 49.8 years, and the largest proportion of patients (40.3%) were in the 41–50-year age group. This finding is consistent with a study conducted in Lagos reporting that the majority of breast cancer patients were between 40 and 60 years old, with a mean age of 48.6 years.[8] Similarly, a study in northeastern Nigeria revealed that the highest incidence of breast cancer was among women aged 40--49 years, with a mean age of 46.5 years.[9] These findings suggest that breast cancer predominantly affects middle-aged women in Nigeria, which aligns with the results from Akure. Compared with international studies, breast cancer is most commonly diagnosed in women aged 50–69 years. In the United States, the median age at diagnosis is 62 years.[10] However, in Nigeria and sub-Saharan Africa, breast cancer tends to occur at a younger age.[11] This difference may be attributed to genetic, environmental, and lifestyle factors that vary between regions. Nigeria has a youthful population with a median age of 17.9 years. The life expectancy for women is 54.9 years. These demographics may contribute to a greater representation of breast cancer cases in younger age groups in our study.[12]

Breast cancer receptor expression varies across different populations. A meta-analysis focusing on five East African countries revealed significant variability in receptor-defined subtypes.[13] Our study highlights the significant prevalence of TNBC in Akure, accounting for 54.5% of cases, which aligns with findings from other Nigerian regions and global data on African populations. African studies reported a greater prevalence of hormone receptor-negative breast cancers than Western studies did. In fact, more than half of African women have hormone receptor-negative subtypes, which are typically associated with poor prognosis and limited therapeutic interventions.[14,15] HER2/neu-positive breast cancer was the second most common type of cancer in our study. While we found that 26.8% of the breast cancer samples were HER2/neu positive, Adedokun's study in Southwest Nigeria reported a significantly greater percentage, with 34.1% of the tumours being HER2 positive.[16] This discrepancy highlights regional differences and the importance of tailored HER2-targeted therapies in the treatment regimen for a significant proportion of patients who can be effectively treated.[17]

Estrogen receptor (ER)-positive breast cancer, another significant subtype, responds well to hormone therapies and can significantly improve patient outcomes. The percentage of ER-positive tumours was relatively low in the present study. Progesterone receptor (PR)-positive breast cancer, while less common in our patient cohorts, also responds to hormone therapies.[18] There were more PR-positive tumours than ER-positive tumours. We also found cases with dual ER/PR positivity (7%) and triple ER/PR/HER2-positive cases (2%), indicating the need for personalized treatment approaches that target multiple hormone receptors. A study conducted in Lagos by Adeniji et al. (2020) revealed that 43% of breast cancer cases were ER positive, 27.9% were PR positive, and 47.4% were triple negative.[19] Similarly, a study in northeastern Nigeria by Minoza et al. (2016) reported that 36.8% of tumours were ER positive, 34.2% were PR positive, and 52.6% were triple negative[20] Globally, the incidence of ER-positive breast cancer is relatively high, with studies reporting that approximately 70% of breast cancers are ER-positive.[21]

Triple-negative breast cancer (TNBC) exhibited the highest incidence among individuals aged 41–50 years (42.9%) in this study, which is consistent with findings from the Panoptic Overview of Triple-Negative Breast Cancer in Nigeria, which reported a significant prevalence in the same age group.[22] Globally, TNBC is recognized as the second most common breast cancer subtype, representing 13.1% of cases reported in a California study. This subtype is associated with several clinical and demographic factors, including younger age, African ancestry,

advanced stage at diagnosis, poorly differentiated histology, and lower socioeconomic status. Additionally, TNBC is often considered a surrogate for the basal-like molecular subtype, which shares similar genetic and pathological characteristics.[23]

The highest percentage of HER2-positive cases was observed in the 41–50- and 51–60-year age groups, followed by the 31–40-year age group. Studies have shown that approximately 19% of women aged 49 years or younger and 15% of women aged 50 years or older with early-stage breast cancer have HER2-positive tumours[24]. The ARETTA study revealed that HER2-positive breast cancer is aggressive and can lead to poor outcomes if not treated effectively. However, the study also highlighted the effectiveness of trastuzumab, a HER2-targeted therapy, in improving clinical responses among Nigerian women with HER2-positive breast cancer within these age groups.[17,25]

The findings from this study have several implications for breast cancer management in Akure, Nigeria. The relatively low percentage of hormone receptor-positive tumours suggests that fewer patients may benefit from hormone therapy targeting estrogen receptors. However, the significant percentage of HER2-positive tumours highlights the importance of HER2-targeted therapies. The high percentage of triple-negative breast cancer cases underscores the urgent need for novel therapeutic approaches and clinical trials to improve outcomes for these patients.

Conclusion

The hormone receptor status distribution of breast cancer samples from Akure revealed a low prevalence of hormone receptor-positive tumours and a high prevalence of triple-negative breast cancer. These findings are consistent with those of local studies in Nigeria. Therefore, we recommend enhancing access to local immunohistochemistry (IHC) testing in Akure, Nigeria, to facilitate faster and more accurate assessment of hormone receptor status, ultimately improving breast cancer management, which is crucial for effective treatment planning. Public health campaigns promoting early detection and routine screening should target women aged 41--60, the high-risk group identified in this study, as early diagnosis can significantly improve survival rates. Healthcare providers would benefit from specialized training in managing hormone receptor-positive patients and TNBC patients, keeping abreast of the latest treatment protocols and targeted therapies. Collaborations with international cancer research programs could introduce clinical trials for TNBC, providing access to novel therapies. Financial support or subsidies for HER2-targeted treatments, such as trastuzumab, could make these effective options more accessible to patients.

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Authors contributions: O.E.P and An.O.A. were responsible for the study's design and conceptualization, developed the methodology, performed the data analysis, contributed to interpretation and discussion, and drafted the original manuscript. At.O.A. and T.A.B participated in developing the methodology and data analysis. O.O.O. contributed to the methodology, data analysis, discussion and helped to draft the manuscript. All authors contributed to drafting the final manuscript.

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