ORIGINAL ARTICLE

Pattern of hormone receptors and human epidermal growth factor receptor 2 status in sub-Saharan breast cancer cases: Private practice experience

CC Nwafor, SO Keshinro[1]

Departments of Pathology, University of Uyo, Uyo, Akwa Ibom State, [1]Me Cure Healthcare Limited, Oshodi, Lagos State, Nigeria

Abstract

Introduction: Breast cancer is the most common cancer among women globally. With immunohistochemistry (IHC), breast cancer is classified into four groups based on IHC profile of estrogen receptor (ER)/progesterone receptor (PR) and human epidermal growth factor receptor 2 (HER2/neu) expression, positive (+) and/or negative (−). The IHC classification correlates well with intrinsic gene expression microarray categorization. ER-positive tumors may benefit from being treated with selective ER modulators and aromatase inhibitors, whereas patients with HER2/neu positive tumors have been shown to experience a significant survival advantage when treated with humanized monoclonal antibodies against HER2/neu.

Objective: To determine ER/PR, HER2/neu expression and their association with histological prognostic markers in female breast carcinomas seen in a private diagnostic laboratory based in Lagos.

Materials and Methods: Immunohistochemistry reports of breast cancer patients, which were diagnosed by histopathology section of a private diagnostic laboratory based in Lagos, Nigeria from August 2009 to August 2014.

Results: About 18.7% of breast cancers had IHC (ER, PR and HER2) done on them and were all females. The mean age of all subjects was 49.5 years (standard deviation, 13.2; range, 29–78 years). Most (95.8%) of the breast cancers were of invasive ductal carcinoma type, with 77.4% of them been >5 cm. IHC pattern was as follows:
ER/PR+, HER2− = 19 (39.6%), ER/PR−, HER2− (triple negative [TN]) = 14 (29.2%), ER/PR+, HER2+ = 9 (18.8%), ER/PR−, HER2+ = 6 (12.5%), corresponding to Lumina A, TN/basal-like, Lumina B and HER2 over expressed respectively.

Conclusion: Triple negative breast cancers are common in our environment and affect young females most and could be contributory to the poorer prognosis of breast cancer in our environment.

Key words: Breast cancer, human epidermal growth factor receptor 2/neu, immunohistochemistry, steroid receptors

Date of Acceptance: 05-Feb-2015

Introduction

Breast cancer is the most common cancer among women globally.[1] Breast cancer is a worldwide disease resulting in many deaths. Although breast cancer incidence is said to be lower in sub-Saharan African countries than in developed countries, African women are more likely than women in the developed world to be diagnosed at later stages of the disease and thus, are more likely to die from it.[2,3] This is due to the lack of awareness by women, accessibility to screening methods, and availability of African-based research findings that would influence decision making at the governmental level.[2,3] Some investigators have reported rising incidence in Nigeria.[4] Globally, over the last few decades there have been outstanding advances in breast cancer management leading to earlier detection of disease and the development of more effective treatments resulting in significant declines in breast cancer deaths

Address for correspondence:
Dr. CC Nwafor,
Department of Pathology, University of Uyo, Uyo, Nigeria.
E-mail: firstcocsin@yahoo.com

Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/1119-3077.156905

PMID: 25966732

and improved outcomes for women living with the disease, especially in developed countries.[5]

Major prognostic factors that are the strongest predictors of death from breast cancer are; invasive carcinoma versus *in situ* disease, distant metastases, lymph node metastases, tumor size and locally advanced disease.[6] A number of other factors are predictive of outcome; some of these also have direct therapies against particular molecular targets and includes; histologic subtype, histologic grade, estrogen receptor (ER) and progesterone receptor (PR), human epidermal growth factor receptor 2 (HER2/neu), lympho-vascular invasion, DNA content, gene expression profiling and response to neoadjuvant therapy.[6-8] Of all these prognostic and predictive factors, immunohistochemical (IHC) study of ER, PR and HER2/neu has been well studied in developed countries and very few African countries with some researchers venturing even into molecular and genetic classification of breast cancer.[9-15] With IHC, breast cancer is classified into four groups based on IHC profile of ER/PR and HER2/neu expression, positive (+) and/or negative (−). The groups are:[9-11,15]

- ER/PR+, HER2+ = ER+/PR+, HER2 + or ER−/PR+, HER2+ or ER+/PR−, HER2+
- ER/PR+, HER2− = ER+/PR+, HER2 − or ER−/PR+, HER2− or ER+/PR−, HER2−
- ER/PR−, HER2+ = ER−/PR−, HER2+
- ER/PR−, HER2− = ER−/PR−, HER2−.

The IHC classification correlates well with intrinsic gene expression microarray categorization: ER/PR+, HER2+ corresponds with Luminal B; ER/PR+, HER2− corresponds with Luminal A; ER/PR−, HER2+ corresponds with HER2 over-expressed or enriched and ER/PR−, HER2 − corresponds with triple-negative (TN)/basal-like tumors.[5,8]

The ER exists as two isoforms: ERα and ERβ, which are encoded by two different genes, located on chromosomes 6q25.1 and 14q22-24 respectively and they play critical roles in cell growth and differentiation.[16] Receptor level increases with age in some ethnic groups and is usually higher in white women than in black or Japanese women.[16] One of the most studied ER regulated genes is PR gene, which is located on chromosome 11q22-23 and mediates progesterone effects in the proper development of the mammary gland and breast cancer.[17] PR is also expressed as two isoforms PR-A and PR-B from a single gene. The dramatic increase in breast cancer incidence in women taking both estrogen and progesterone for hormone replacement therapy, compared with estrogen alone, emphasizes the importance of progesterone and the PR in breast cancer.[18] HER2/neu gene is located on chromosome 17q21 and encodes a 185 kDa transmembrane protein and is expressed at low levels in a variety of normal epithelia, including breast duct epithelium and is amplified and overexpressed in 20–30% of invasive breast cancers.[19-21]

With the development of tailored therapies targeting specific molecular markers, ER and HER2/neu have also become important predictive factors, as patients with ER-positive tumors may benefit from being treated with selective ER modulators and aromatase inhibitors, whereas patients with HER2/neu positive tumors have being shown to experience a significant survival advantage when treated with humanized monoclonal antibodies against HER2/neu.[22,23] Previous studies have shown that women with luminal A (ER/PR+, HER2−) tumors have better overall survival, breast cancer-specific survival and recurrence-free survival than women with other molecular phenotypes. Furthermore, women with luminal tumors, generally had better survival outcomes compared with those whose tumors were of HER2+ type or basal-like.[24,25]

Only very few centers are offering IHC investigations in Nigeria. The oncologists are dependent on the results of these IHC studies to plan treatment in any particular patient and a need was felt to determine the steroid hormone receptor and HER2/neu status and their association with some prognostic markers in breast cancer cases seen in one of the biggest private medical laboratories in Nigeria. This is the first breast IHC study from a private practice in Nigeria. The objective of this study was to determine steroid hormone receptor and HER2/neu expression and their association with histological prognostic markers in female breast carcinomas seen in Me Cure Healthcare Limited, a private diagnostic laboratory based in Lagos, Nigeria.

Materials and Methods

This retrospective study included IHC reports of all breast cancer patients, which were diagnosed by the histopathology section of Me Cure Health Limited (a large privately owned diagnostic establishment), from August 2009 to August 2013. This histopathology section renders services to many privately owned hospitals within Lagos State and few neighboring states. Data on patients were extracted from the establishment computer database and entered into an Excel sheet, and this included age, sex, and size of the tumor.

These breast specimens were received in 10% buffered formalin and processed with auto processors. Paraffin-embedded sections (at 2–3 μm) were routinely stained with hematoxylin and eosin stains. Histological features were classified using 2003 WHO classification of breast diseases and graded using the Nottingham modification of the Bloom–Richardson grading.[26,27] Representative paraffin embedded blocks were sent for IHC in our foreign partner laboratories, where IHC staining were performed using the Thermo Scientific Lab

Vision Autostainer 480S (clones ER-SP1; PR-SP2; Company: For steroid hormones) and (clone – SP3: Detection kit: Ultravision LP for HER2/neu). Data were analyzed using predictive analytical software, version 17 (IBM, SPSS Inc., Chicago, IL, USA). Comparisons of discrete data were done using Chi-square test, with levels of significance being set at $P \leq 0.05$. The research was approved by review board of the establishment.

Results

A total of 1205 breast specimens were received for histology during the period under the review. This formed 26% of 4,642 histology specimens received in the histopathology laboratory. Breast cancer lesions accounted for 257 cases (21.3% of all breast specimens). Forty-eight cases of breast cancer (18.7%) had IHC (ER, PR and HER2) done on them, and they were all females. The mean age of all subjects was 49.5 years (standard deviation [SD], 13.2; range, 29–78 years). Age group 40–49 years closely, followed by age group 30–39 years accounted for most cases [Table 1].

Table 1: Frequency of distribution of breast cancer patients by age groups

Age groups	Frequency (%)
20-29	1 (2.1)
30-39	11 (22.9)
40-49	14 (29.2)
50-59	8 (16.7)
60-69	9 (18.8)
70-79	5 (10.4)
Total	48 (100)

Table 2: Distribution of breast cancer by clinicopathological features

	Frequency	Percentage
Histological subtype		
IDC	46	95.8
Medullary carcinoma	1	2.1
Mucinous carcinoma	1	2.1
Total	48	100
Tumor grade	Available for 43	
Grade 1	17	38.1
Grade 2	12	28.6
Grade 3	14	33.3
Total	43	100
Tumor size	Available for 31	
<2 cm	1	3.2
2-5 cm	6	19.4
>5 cm	24	77.4

IDC=Invasive ductal carcinoma

Table 3: Expression of ER, PR and HER2 in cases

Marker	Frequency (%)	
	Positive	Negative
Cases 48		
ER	26 (54.2)	22 (45.8)
PR	24 (50)	24 (50.0)
HER2/neu	15 (31)	33 (68.8)

ER=Estrogen receptor; PR=Progesterone receptor; HER2/neu=Human epidermal growth factor receptor 2

Table 2 shows the baseline characteristics of subjects including tumor histologic subtype, tumor grade and tumor size. Most (95.8%) of the breast cancers were of invasive ductal carcinoma type. Grade 1 tumors (well-differentiated) were most (38.1%), while grade 3 tumors accounted for 33.3%. Together, grade 2 and 3 cases accounted for 61.9% of breast cancers. Of the 31 breast cancer tissues with documented sizes, 77.4% ($n = 24$) of were >5 cm in size.

Estrogen receptors was present in 26 (54.2%) cases, while PR was seen in 24 (50%) cases with HER2 present in 15 (31%) cases as shown Table 3.

Table 4 shows the pattern of distribution of the steroid receptors and HER2 based on IHC profile. ER/PR+, HER2− = 19 (39.6%), ER/PR−, HER2− (TN) = 14 (29.2%), ER/PR+, HER2+ = 9 (18.8%), ER/PR−, HER2+ = 6 (12.5%). There was significant statistical correlation ($P \leq 0.001$).

Table 5 shows the correlations of various clinicopathological features with the steroid hormone receptors and HER2. Histologic subtype of breast cancer showed no significant correlation with ER, PR and HER2 ($P \leq 0.05$). Grade 1 histologic breast cancers have significant statistical correlation ($P = 0.008$) while grade 2 and 3 cancers had no significant statistical correlation ($P = 0.157$ and 0.26 respectively).

Discussion

Immunohistochemistry based classification of both ER/PR and HER2 status provides prognostic and therapeutic information not achievable from either alone.[9] The use of IHC in breast cancer has become an integral part of a complete and comprehensive histopathology report. In terms of prognosis and prediction of response to treatment, in addition to histological grade and tumor sub type, hormone markers ER/PR and HER2/neu has become the mainstay requirement for the oncologist.[13] In the developed world, assessment of hormonal receptors expression status is required to determine patient eligibility for hormonal therapy. However, in the developing countries clinicians administer hormonal therapy without any knowledge of their patient's receptors status.[28] ER and PR expression status is not routinely determined in the developing countries because of limited resources and the relatively high cost of testing.[2,28] In the index study cost was the

Table 4: Pattern of distribution of the steroid receptors and HER2 based on IHC profile

Major group	Components	Frequency (%)	Molecular type
ER/PR+, HER2−	ER+/PR+, HER2−; ER+/PR−, HER2−; ER−/ER+, HER2−	19 (39.6)	Lumina A
ER/PR+, HER2+	ER+/PR+, HER2+; ER−/PR+, HER2+; ER+/PR−, HER2+	9 (18.8)	Lumina B
ER/PR−, HER2−	ER−/PR−, HER2−	14 (29.2)	TN/basal like
ER/PR−, HER2+	ER−/PR−, HER2+	6 (12.5)	HER2 over expression

ER=Estrogen receptor; PR=Progesterone receptor; HER2=Human epidermal growth factor receptor 2; IHC=Immunohistochemistry; TN=Triple negative

Table 5: Baseline characteristics by tumor subtype

Parameter	ER/PR+, HER2− (*n*=19)	ER/PR+, HER2+ (*n*=9)	ER/PR−, HER2+ (*n*=6)	ER/PR−, HER2− (*n*=14)	*P*
Mean ages	50.8±12.4	47.4±13.5	56.7±14.2	45.9±13.4	>0.05
Cancer type (%)					
IDC	18 (94.7)	9 (100)	6 (100)	13 (92.9)	>0.05
Medullary	-	-	-	1 (7.1)	
Mucinous	1 (5.3)	-	-	-	
Histological grade					
Grade 1	6	3	4	4	>0.05
Grade 2	7	1	1	3	
Grade 3	5	4	0	5	
Tumor size					
<2 cm	-	-	-	1	>0.05
2-5 cm	2	1	1	2	
>5 cm	10	7	3	4	

ER=Estrogen receptor; PR=Progesterone receptor; HER2=Human epidermal growth factor receptor 2; IDC=Invasive ductal carcinoma

major limiting factor and reason why only 18.7% of breast cancers seen in our laboratory, had IHC carried out on them. The cost of IHC in our establishment is 3 times the cost of ordinary histology with hematoxylin and eosin, which costs roughly 50 dollars. Only very few centers in Nigeria perform IHC and it is not routinely done.

Fifty two point one percent of the cancer cases in this study were seen between age groups 30–49 years, with a mean age of 49.5 (SD, 13.15). This is similar to mean ages of 49.2 years, 48.1 years and 44.8 years reported in India, Pakistan, Nigeria/Senegal respectively, but less than mean age 55–58 years reported in Western Country like USA.[12,13,24,29] In this study, we did not find any significant association between the age of the patients and their tumor expression of ER, PR and HER2/neu. Primary breast carcinoma arising before 40 years of age are far more aggressive and likelier to metastasize and reduce patient's survival than arising in older patients, regardless of hormone receptor status.[30] Though the reason for this higher number of premenopausal breast cancer in Nigerians than postmenopausal breast cancers are uncertain, biological and genetic factors may be promoting to early carcinogenesis.[31] Also, the distribution/demography of the population is a major determinant.[31] Majority of the breast lesions (77.4%) were >5 cm in size, whereas previous reports from Senegal/Nigeria, Pakistan, India and USA reported rates of 39%, 25.7%, 13.9% and 4.7% respectively for breast cancer lesions >5 cm.[12,13,24,29] This calls for greater awareness for self-breast examination, clinical breast examination and establishment of national breast cancer screening programs, so as to enhance early detection since size of lesion at presentation is a very important prognostic factor.

Lumina A (39.6%, ER/PR+, HER2−) cases were the commonest type of breast cancers seen in this series and majority of them were seen in females aged 50 and above, though there was lack of significant association between histological subtypes and receptor status. The rate of 39.6% in the index study is higher than 29% reported from previous study in Nigeria/Senegal, similar to 37.2% reported in India and far less than 53.7%, 55.4% and 68.9% reported in South Africa, in America from African American women and white Americans, respectively.[9,10,13,14,29] The reason for this hormonal receptor difference between Western countries and the rest of the world is not clear. Several factors may contribute to these differences, including the age of breast cancer patients, stage at diagnosis, histopathologic methods, differential underlying risk-factor distributions, and ER positivity and ER negativity incidence rates and genetic heterogeneity across this vast continent.[14] Further research is needed to attempt to explain the reason, however environment may play a role since the results from African Americans and South African blacks equally showed a higher prevalence of Lumina A subtype. These hormone receptor positive tumors are usually associated with a better

prognosis when compared to HER2 overexpressed and TN subtypes.[9,11]

One well-defined subtype of breast cancer is characterized by the lack of ER, PR and HER2 expression/amplification and it's called TN tumors/basal-like cancers.[32] TN/basal-like cancers were the second most common type of cancer and accounted for 29.2% of cancers and 64.3% of them were seen in age groups 30–49 years and 78.6% of them had tumor grades 2 and 3. There was no statistical correlation between TN groups and their tumor grades or age distribution. The small sample size may have contributed. The rate of TN in the index study is similar to 27% and 32.5% reported in Nigeria/Senegal and India and slightly higher than 20.4% observed among blacks in South Africa, 21.2% observed among African Americans and far higher than 13.4% seen in Whites.[9,10,13,14,29] TN group of cancers generally has the worst overall and disease-free survival. They are known to have poor clinical, pathologic and molecular prognosis and more aggressive clinical course when compared to Lumina A subtype.[9,10] Other researchers have also shown that young black women were more likely than nonblack women to have ER negative or TN breast cancers.[10,14] This is in keeping with our findings.

Estrogen receptor/PR+, HER2+ (Lumina B), accounted for 18.8% of cancers seen. This rate is higher than findings from South Africa, India and USA (14.6%, 9.3% and 14.3% respectively) and may be a significant observation for future studies.[13,14,24]

HER2 enriched or over expressed (ER/PR−, HER2+) was seen in 12.5% of cases and 50% each occurred in fourth and sixth decade. The index rate is within the range of 4.9% and 15% reported in previous studies.[9,14,24,29] HER2/neu gene amplification occurs in 20–30% of breast cancers and it is associated with poor prognosis, lower response to hormone therapy and chemotherapy. HER2/neu positive breast cancer predicts response to anti-HER2/neu antibody.[33] HER2 amplified breast cancers have unique biological and clinical characteristics, which include increased sensitivity to certain cytotoxic agents such as doxorubin, propensity to metastasizes to the brain and viscera, higher proliferation rates and are associated with poorer patient prognosis. The poor outcome is dramatically improved with appropriate chemotherapy combined with the HER2 targeting drug trastuzumab.[34]

When interpreting the results of our study, it is important that we do so within the confines of its strengths and limitation. The major limitation was the small sample size.

In conclusion, the results of our study add to the growing literature that classifies invasive breast tumors into various IHC subtypes similar to that identified by gene expression profiling. The strength of this study lies in the fact that there are very few combined (ER/PR and HER2) IHC studies in our environment and this will serve as baseline for future studies. Breast carcinoma in the younger age group were mainly TN and IHC should be done on all breast cancers diagnosed histologically before commencing treatment as this would help reduce the morbidity and mortality associated with breast cancer chemotherapy.

References

1. Ferlay J, Shin HR, Bray F, Forman D, Mathers C, Parkin DM. Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. Int J Cancer 2010;127:2893-917.
2. Elgaili EM, Abuidris DO, Rahman M, Michalek AM, Mohammed SI. Breast cancer burden in central Sudan. Int J Womens Health 2010;2:77-82.
3. Allred DC, Wu Y, Mao S, Nagtegaal ID, Lee S, Perou CM, *et al.* Ductal carcinoma *in situ* and the emergence of diversity during breast cancer evolution. Clin Cancer Res 2008;14:370-8.
4. Adebamowo CA, Ogundiran TO, Adenipekun AA, Oyesegun RA, Campbell OB, Akang EE, *et al.* Waist-hip ratio and breast cancer risk in urbanized Nigerian women. Breast Cancer Res 2003;5:R18-24.
5. Ravdin PM, Cronin KA, Howlader N, Berg CD, Chlebowski RT, Feuer EJ, *et al.* The decrease in breast-cancer incidence in 2003 in the United States. N Engl J Med 2007;356:1670-4.
6. American Joint Committee on Cancer. AJCC Cancer Staging Manual. 6th ed. New York: Springer; 2002.
7. Harris L, Fritsche H, Mennel R, Norton L, Ravdin P, Taube S, *et al.* American Society of Clinical Oncology 2007 update of recommendations for the use of tumor markers in breast cancer. J Clin Oncol 2007;25:5287-312.
8. Mustac E, Zamolo G, Petkovic M, Dordevic G, Radic J, Grgurevic E, *et al.* Breast infiltrating ductal carcinoma: Analysis of hormone, HER-2 receptors and Ki-67 proliferation marker. Coll Antropol 2008;32:741-6.
9. Onitilo AA, Engel JM, Greenlee RT, Mukesh BN. Breast cancer subtypes based on ER/PR and Her2 expression: Comparison of clinicopathologic features and survival. Clin Med Res 2009;7:4-13.
10. Ihemelandu CU, Leffall LD Jr, Dewitty RL, Naab TJ, Mezghebe HM, Makambi KH, *et al.* Molecular breast cancer subtypes in premenopausal and postmenopausal African-American women: Age-specific prevalence and survival. J Surg Res 2007;143:109-18.
11. Puig-Vives M, Sánchez MJ, Sánchez-Cantalejo J, Torrella-Ramos A, Martos C, Ardanaz E, *et al.* Distribution and prognosis of molecular breast cancer subtypes defined by immunohistochemical biomarkers in a Spanish population-based study. Gynecol Oncol 2013;130:609-14.
12. Sharif MA, Mamoon N, Mushtaq S, Khadim MT, Jamal S. Steroid hormone receptor association with prognostic markers in breast carcinoma in Northern Pakistan. J Coll Physicians Surg Pak 2010;20:181-5.
13. Pawan N, Smita P, Dilip T, Shalu C. Study of ER (Estrogen Receptor), PR (Progesterone Receptor) and HER-2/NEU (Human Epidermal Growth Factor Receptor) expression by immunohistochemistry in breast carcinoma. Int J Biomed Adv Res 2014;05:275-8.
14. McCormack VA, Joffe M, van den Berg E, Broeze N, Silva Idos S, Romieu I, *et al.* Breast cancer receptor status and stage at diagnosis in over 1,200 consecutive public hospital patients in Soweto, South Africa: A case series. Breast Cancer Res 2013;15:R84.
15. Galukande M, Wabinga H, Mirembe F, Karamagi C, Asea A. Difference in Risk Factors for Breast Cancer by ER Status in an Indigenous African Population. ISRN Oncol 2013;2013:463594.
16. Skliris GP, Parkes AT, Limer JL, Burdall SE, Carder PJ, Speirs V. Evaluation of seven oestrogen receptor beta antibodies for immunohistochemistry, western blotting, and flow cytometry in human breast tissue. J Pathol 2002;197:155-62.
17. Conneely OM, Jericevic BM, Lydon JP. Progesterone receptors in mammary gland development and tumorigenesis. J Mammary Gland Biol Neoplasia 2003;8:205-14.
18. Rossouw JE, Anderson GL, Prentice RL, LaCroix AZ, Kooperberg C, Stefanick ML, *et al.* Risks and benefits of estrogen plus progestin in healthy postmenopausal women: Principal results from the Women's Health Initiative randomized controlled trial. JAMA 2002;288:321-33.
19. Naber SP, Tsutsumi Y, Yin S, Zolnay SA, Mobtaker H, Marks PJ, *et al.* Strategies for the analysis of oncogene overexpression. Studies of the neu oncogene in breast carcinoma. Am J Clin Pathol 1990;94:125-36.

20. Gown AM. Current issues in ER and HER2 testing by IHC in breast cancer. Mod Pathol 2008;21 Suppl 2:S8-15.
21. Press MF, Slamon DJ, Flom KJ, Park J, Zhou JY, Bernstein L. Evaluation of HER-2/neu gene amplification and overexpression: Comparison of frequently used assay methods in a molecularly characterized cohort of breast cancer specimens. J Clin Oncol 2002;20:3095-105.
22. Goldhirsch A, Wood WC, Gelber RD, Coates AS, Thürlimann B, Senn HJ. Meeting highlights: Updated international expert consensus on the primary therapy of early breast cancer. J Clin Oncol 2003;21:3357-65.
23. Marty M, Cognetti F, Maraninchi D, Snyder R, Mauriac L, Tubiana-Hulin M, *et al.* Randomized phase II trial of the efficacy and safety of trastuzumab combined with docetaxel in patients with human epidermal growth factor receptor 2-positive metastatic breast cancer administered as first-line treatment: The M77001 study group. J Clin Oncol 2005;23:4265-74.
24. Dawood S, Hu R, Homes MD, Collins LC, Schnitt SJ, Connolly J, *et al.* Defining breast cancer prognosis based on molecular phenotypes: Results from a large cohort study. Breast Cancer Res Treat 2011;126:185-92.
25. Cheang MC, Voduc D, Bajdik C, Leung S, McKinney S, Chia SK, *et al.* Basal-like breast cancer defined by five biomarkers has superior prognostic value than triple-negative phenotype. Clin Cancer Res 2008;14:1368-76.
26. Devilee P, Tavassoli FA. World Health Organization: Tumours of the breast and female genital organs. Oxford, UK: Oxford University Press; 2003.
27. Rosai J. Breast. In: Rosai and Ackerman's Surgical Pathology. 9th ed. New Delhi India: CV Mosby Company; 2004. p. 1763-876.
28. Ugiagbe EE, Obaseki DE, Oluwasola AO, Olu-Eddo AN, Akhiwu WO. Frequency of distribution of oestrogen and progesterone receptors positivities in breast cancer cases in Benin-City, Nigeria. Niger Postgrad Med J 2012;19:19-24.
29. Huo D, Ikpatt F, Khramtsov A, Dangou JM, Nanda R, Dignam J, *et al.* Population differences in breast cancer: Survey in indigenous African women reveals over-representation of triple-negative breast cancer. J Clin Oncol 2009;27:4515-21.
30. Naeem M, Nasir A, Aman Z, Ahmad T, Samad A. Frequency of HER-2/neu receptor positivity and its association with other features of breast cancer. J Ayub Med Coll Abbottabad 2008;20:23-6.
31. Gukas ID, Jennings BA, Mandong BM, Manasseh AN, Harvey I, Leinster SJ. A comparison of the pattern of occurrence of breast cancer in Nigerian and British women. Breast 2006;15:90-5.
32. Nishimura R, Arima N. Is triple negative a prognostic factor in breast cancer? Breast Cancer 2008;15:303-8.
33. Huang HJ, Neven P, Drijkoningen M, Paridaens R, Wildiers H, Van Limbergen E, *et al.* Hormone receptors do not predict the HER2/neu status in all age groups of women with an operable breast cancer. Ann Oncol 2005;16:1755-61.
34. Gutierrez C, Schiff R. HER2: Biology, detection, and clinical implications. Arch Pathol Lab Med 2011;135:55-62.

How to cite this article: Nwafor CC, Keshinro SO. Pattern of hormone receptors and human epidermal growth factor receptor 2 status in sub-Saharan breast cancer cases: Private practice experience. Niger J Clin Pract 2015;18:553-8.

Source of Support: Nil, **Conflict of Interest:** None declared.