ORIGINAL ARTICLE

Mammographic Parenchymal Patterns in Asymptomatic Women

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ABSTRACT

Background: Breast density has been found to be an independent risk factor for breast cancer. Mammographic breast parenchymal pattern or percent density is mainly a reflection of the proportion of glandular tissue to fatty tissue, and studies have shown that it works synergistically with other risk factors such as nulliparity in predicting breast cancer risk. This study analyses the various mammographic breast patterns and correlates this with some demographic variables and final Breast Imaging Reporting and Data System outcomes of asymptomatic women in our center.

Materials and Methods: This is a prospective descriptive study of mammographic breast pattern in 459 females who presented at the breast imaging suite of our institution. Mammography was performed after completion of an assisted administered questionnaire for demographic information. A GE Senographe DMR machine using two standard views (craniocaudal and mediolateral oblique) and additional views were used when necessary.

Results: A total of 459 women ranging in age from 34 to 80 years were included in the study, of which 46.6% were in the age range of 41 to 50 years. The scattered fibroglandular pattern was the most common pattern found (44%), and the homogeneous dense pattern was the least common (0.4%). A significant association with age and menopause status was found, while no association was found with age at the time of the woman's first delivery and family history of breast cancer.

Conclusion: This study demonstrates that there is a significant association between breast cancer and age and menopause status. However, no correlation was found with the age of women at their first delivery and family history of breast cancer.

Key words: Asymptomatic women, mammographic breast pattern, Nigeria

INTRODUCTION

Assessment of breast density pattern is an essential component of mammogram reporting as it conveys information on the sensitivity of mammography and the relative risk of breast cancer to the referring physician. Breast parenchymal pattern or breast density is consistently associated with an increased risk of breast cancer. This can be an independent risk factor or act synergistically with other breast cancer risk factors, such as nulliparity and hormone replacement therapy.[1,2] Mammographic density denotes the different percentage composition of the radiolucent fatty tissue and radiopaque glandular tissue with connective tissue present in a breast, and screening mammography is considered the most sensitive tool for detecting early breast cancer.[3] Mammographic breast density was first classified by Wolfe, with a view of its risk assessment in predisposition to breast cancer.[4] Subsequent classification of breast density was done by Boyd, with modification and standardization by the American College of Radiology (ACR) using Breast

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Imaging Reporting and Data System (BI-RADS), and revised in 2013.[5-7] Although quantitative methods are now available to calculate breast density pattern, qualitative methods are still in widespread use.[8-10] Using the ACR BI-RADS method, categorization of mammographic breast density can be done into BI-RADS 1–4. Of these, categorization in to BI-RADS 3 and 4 (i.e., higher mammographic density) have been reported to be associated with more aggressive tumors.[11] Therefore, categorization of breast density may help in estimating the risk of breast cancer among women as well as help initiate early interventions for breast cancer prevention among women at risk through hormone replacement therapy and lifestyle modifications.[12] The results of this research will provide data for a national database on breast cancer that will form the basis for a research-based, practical approach in reducing breast cancer mortality in Nigeria and, possibly, throughout the African continent.

MATERIALS AND METHODS

This is a prospective study of 459 women who attended the breast imaging unit of the Department of Radiology, University of Ilorin Teaching Hospital, Nigeria, between January 2009 and December 2013. After obtaining the informed written consent, participants were requested to complete a self-administered questionnaire, which would provide sociodemographic data; breast history including breast surgery; obstetrics and gynecologic history including menstrual history, parity and lactation; and data on use of contraceptives, menopausal status, hormone replacement therapy and family history of breast disease.

Mammography was performed with a GE Senographe DMR+ (GE Medical System, Germany) machine with two standard views, i.e., craniocaudal and mediolateral oblique views, and additional views such as exaggerated craniocaudal, spot magnification and spot compression views, when necessary.

In some women who had a strong family history of breast cancer and were aged <40 years, breast ultrasound was performed as the screening modality. In addition, breast ultrasound was used as an adjunct to mammography before a final BI-RADS impression was made in women with equivocal mammograms. This was obtained in cases of dense breasts to further characterize a nodule as cystic or solid as well as in cases of focal or global asymmetry to eliminate the possibility of an underlying lesion that was not visible in the mammography.

The breast ultrasound scan was performed using Aloka Prosound SSD-350+ (Aloka Co. Ltd., Tokyo, Japan) equipped with linear and curvilinear 7.5–10 MHz transducers, in longitudinal, transverse, radial and antiradial planes.

Inclusion criteria were women who had screening mammograms and breast ultrasounds and who had correctly completed the questionnaire. Exclusion criteria were women who had incomplete data and those that had diagnostic breast sonograms and mammographic study.

Mammographic density was categorized using the ACR BI-RADS method: BI-RADS 1 is <25% glandular reported as almost entirely fatty pattern (low density); BI-RADS 2 is 25–50% glandular reported as scattered fibroglandular pattern (average density); BI-RADS 3 is 51–75% glandular reported as heterogeneous dense pattern (high density) and BI-RADS 4 is >75% glandular reported as homogeneous dense (very high density). The final overall impression was also categorized using ACR BI-RADS 1–6 lexicon, which represents normal findings, benign findings, probably benign findings, suspicious findings, highly suspicious findings and known cancer, respectively. However, this study did not use the BI-RADS 6 category because only screening mammograms were analyzed. The mammographic pattern was further categorized into two groups: low risk (BI-RADS 1 and 2) and high risk (BI-RADS 3 and 4) to test associations with some selected variables and with the final BI-RADS 3–5.

Data were analyzed using SPSS version 21 (SPSS Inc., Chicago, IL, USA). Tables and figures were used to show descriptive frequency and univariate analysis (chi-square test) was used to test the association between breast density and the selected sociodemographic variables (including age, age at first child's birth, postmenopausal status and family history of breast cancer). Variables significant at 10% on the chi-square test were subjected to multivariate logistic regression models using the "enter" option as the selection algorithm to show predictors of BI-RADS 3 and 4 density pattern. Statistical tests were considered significant at $P < 0.05$ at a confidence level of 95%.

Ethical approval for this study was provided by the Ethics Committee at the University of Ilorin Teaching Hospital (Protocol No. IRC PIN/2008/02/0279), Ilorin, Nigeria.

RESULTS

A total of 459 women who met the inclusion criteria were included in this study. The youngest was aged

34 years and oldest was aged 80 years, with an age range of 46 years and a mean age of 51 ± 7.6 years. They were grouped into four categories: women aged <40, aged 40–49, aged 50–59 and aged ≥60 years. Women aged 40–49 years constituted the largest group (43.6%), closely followed by those aged 50–59 years (40.7%) and those aged ≥60 years constituted 16.8%. The <40 years age group constituted the lowest number of women. Breast parenchymal pattern analysis shows that most women had the scattered fibroglandular pattern (44%) and just two (0.4%) had the homogeneous dense pattern [Figure 1 and Table 1]. About 65% of the women aged >60 years had fatty replaced pattern, while 75% (three) aged <40 years had scattered fibroglandular. Classification of the breast parenchymal pattern into low-risk (BI-RADS 1 and 2) and high-risk pattern (BI-RADS 3 and 4) shows that the number of women in the low-risk group was higher (85%) than the high-risk group (15%). The age of women at birth of first child ranged from 15 to 47 years, with a median age of 26 years. For the postmenopausal women, the age of onset of the menopause ranged from 35 to 57 years, with a mean age of 47.97 and a median age of 49 years. A positive family history for breast cancer was elicited in 33 women (7.2%), while 426 (92.8%) had no known family history of breast cancer. The association of the breast parenchymal patterns with some sociodemographic factors is shown in Table 2. The mean age of women with mammographic patterns 1 and 2 (low risk) was found to be significantly higher than that of patterns 3 and 4 (high risk). The low-risk breast pattern was predominant in postmenopausal women, which shows a significant relationship between the age of women and their menopausal status. Age at the birth of first childbirth and positive family history of breast cancer showed no significant relationship. Multiple logistic regression was then used to test the odds ratios and confidence intervals of the significant variables age and postmenopausal status as independent predictors of BI-RADS 3 and 4 (high risk) breast patterns and this predicted 84.5% of women, as shown in Table 3. The final BI-RADS categories assigned to these women were analyzed [Table 4]. Benign findings (BI-RADS 2) were the most common findings (40.1%), while suspicious findings (BI-RADS 4) were seen in 0.7% and a case of highly suspicious findings (BI-RADS 5) constituted 0.2%. Tabulation of the final BI-RADS categories against low- and high-risk breast patterns is shown in Table 5. Suspicious and highly suspicious findings (BI-RADS 4 and 5) were observed in the low-risk breast parenchymal pattern, while 80% and 20% of the possible benign findings (BI-RADS 3) occurred in the low- and high-risk breast parenchymal patterns, respectively [Figure 2].

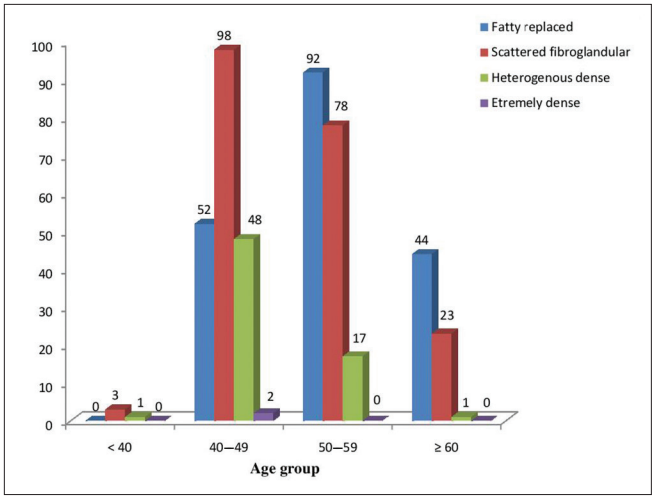

Figure 1: Breast mammographic pattern and age distribution

DISCUSSION

Breast cancer is the most common cause of cancer-related mortality among women worldwide. Screening programs and development of new technologies such as digital breast tomosynthesis, breast magnetic resonance imaging and breast ultrasound elastography help in the early detection of breast cancer. The assessment of breast density pattern is an essential component of diagnostic mammograms. However, this has been found to be the most undervalued and underutilized risk factor in studies investigating the causes of breast cancer.[13] In recent times, due to legislative developments in the United States, radiologists are required to provide data on breast density directly to patients because of the increased risk

Table 1: Breast mammographic pattern and age distribution

Mammographic pattern	Age group (years)				
	<40, *n* (%)	40–49, *n* (%)	50–59, *n* (%)	≥60, *n* (%)	Total, *n* (%)
Fatty replaced	0	52 (26.0)	92 (49.2)	44 (64.7)	188 (41.0)
Scattered fibroglandular	3 (75.0)	98 (49.0)	78 (41.7)	23 (33.8)	202 (44.0)
Heterogeneous dense	1 (25.0)	48 (24.0)	17 (9.0)	1 (1.5)	67 (14.6)
Extremely dense	0	2 (1.0)	0	0	2 (0.4)
Total	4 (100.0)	200 (100.0)	187 (100.0)	68 (100.0)	459 (100.0)

Table 2: Association between mammographic breast density pattern and selected sociodemographic and clinical variables

Variables (*n*)	Mammographic pattern			χ^2 or *t*	*P*
	1 and 2, *n* (%)	3 and 4, *n* (%)	Total, *n* (%)		
Age group (years)					
Mean ± SD	52.06 ± 7.65	46.12 ± 5.09		−6.208[t]	<0.001
<40	3 (0.8)	1 (1.4)	4 (0.9)	28.279[Y]	<0.001*
40–49	150 (38.5)	50 (72.5)	200 (43.6)		
50–59	170 (43.6)	17 (24.6)	187 (40.7)		
≥60	67 (17.2)	1 (1.4)	68 (14.8)		
Age at first delivery (years)					
Mean ± SD	25.45 ± 5.72	24.08 ± 9.02		−1.473[t]	0.141
<30	268 (82.5)	42 (79.2)	310 (82.0)	0.320	0.572
≥30	57 (17.5)	11 (20.8)	68 (18.0)		
Postmenopausal					
Yes	114 (29.2)	3 (4.3)	117 (25.5)	19.113	<0.001*
No	276 (70.8)	66 (95.7)	342 (74.5)		
Family history					
Yes	30 (7.7)	3 (4.3)	33 (7.2)	0.545[Y]	0.460
No	360 (92.3)	66 (95.7)	426 (92.8)		

[t]Independent samples *t*-test; [Y]Yates-corrected chi-square; *Statistically significant ($P < 0.05$). SD – Standard deviation

Table 3: Multiple logistic regression of breast density pattern of selected variables

Variable	OR	95% CI	*P*
Age group (years)	0.890	0.847–0.934	<0.001*
Postmenopausal	0.201	0.060–0.673	0.009*

*Statistically significant ($P < 0.05$); R^2:0.192; Predictive value:84.5%; χ^2 – 53.350; P<0.001. OR – Odds ratio; CI – Confidence interval

Table 4: Final BI-RADS category of women in the study

Final BI-RADS	Frequency (*n* = 459)	Percentage
Inconclusive study	16	3.5
Normal study	175	38.1
Benign findings	184	40.1
Probably benign	80	17.4
Suspicious lesion	3	0.7
Highly suggestive of malignancy	1	0.2

BI-RADS – Breast Imaging Reporting and Data System

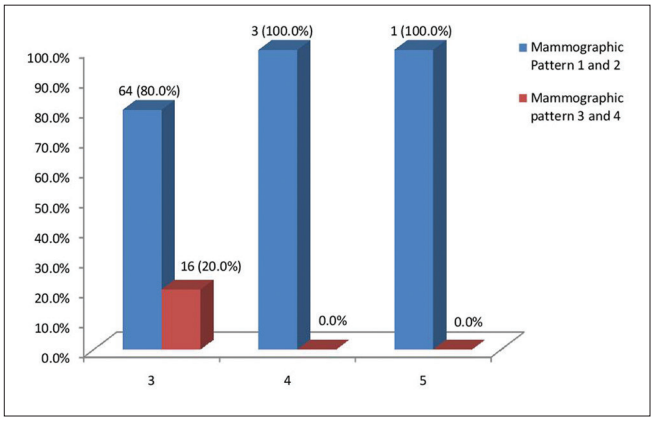

Figure 2: Breast density pattern in women with final Breast Imaging Reporting and Data System categories 3, 4 and 5

of breast cancer, which is four to six times greater among women with dense breast than those who do not have dense breasts.[5,14-16]

Mammography is well accepted as an effective screening tool for the early detection of breast cancer, especially in women aged ≥40 years. However, women with a strong history but aged <40 years could be screened using breast ultrasound. The need for increased awareness of screening and its merits is clearly demonstrated.[17] Women in their fifth and sixth decades of life constituted about 80% of this study population, which is in line with the findings of previous studies.[17-20]

The scattered fibroglandular pattern (BI-RADS 2) is the most common breast pattern in this study, which is similar to the findings of previous studies.[19-21] However, this was not the case in the study by Obajimi *et al*.[18]

Women with dense breasts (high risk), comprising the BI-RADS 3 (14.6%) and BI-RADS 4 (0.4%), were 15% of the cohort population in our study, which is relatively lower than that in other studies.[18,19,22,23] This is probably owing to the higher mean age in our study population.

Table 5: Final BI-RADS categories in the low- and high-risk mammographic density

Final BI-RADS	Mammographic pattern			χ^2	*P*
	1 and 2, *n* (%)	3 and 4, *n* (%)	Total, *n* (%)		
Inconclusive study	6 (1.5)	10 (14.5)	16 (3.5)	29.700[Y]	<0.001*
Normal study	157 (40.3)	18 (26.1)	175 (38.1)		
Benign findings	159 (40.8)	25 (36.2)	184 (40.1)		
Probably benign	64 (16.4)	16 (23.2)	80 (17.4)		
Suspicious lesion	3 (0.8)	0	3 (0.7)		
Highly suggestive of malignancy	1 (0.3)	0	1 (0.2)		

[Y]Yates-corrected chi-square; *Statistically significant ($P < 0.05$). BI-RADS – Breast Imaging Reporting and Data System

However, the percentage of women in this high-risk group in the present study was lower than a previous study from the same center, which analyzed both diagnostic and screening mammograms, as some breast pathologies increased the overall density of the breast on diagnostic mammograms study.[17,20] As cancers can easily be obscured by a dense breast, these groups of women are of concern because of the lower sensitivity to mammography as an imaging tool.[11,24]

Of the demographic variables tested with mammographic density, age and postmenopausal status showed a significant association, while age at the birth of the first child and a family history of breast cancer were not significantly associated. The ratio of women with a high dense pattern (BI-RADS 3 and 4) aged <50 years to those aged >50 years was 3:1. This shows that age has an inverse relationship and is an important predictor of density, as established by various reports.[24-27] However, some factors such as obesity could modify this because of the inverse relationship between body mass index and mammographic density.[27-29] There are conflicting reports, with some reporting an association between breast density pattern and menopausal status, while another demonstrated contrasting results.[2,18,30]

The majority of the findings in this study were normal and benign, which is in accordance with previously reported screen-based studies. The suspicious and highly suspicious lesions found were in the low-risk density pattern (BI-RADS 1 and 2). Seemingly paradoxical, other risk factors for breast cancer also come to the forefront here as three of these women had a low-risk breast pattern, although they were >50 years of age, with advancing age a known risk factor for breast cancer, especially in Caucasians.[31-33] There are emerging studies that show that the incidence age of breast cancer is lower in blacks than in their Caucasian counterpart.[34-36] This may explain the finding of a suspicious lesion in a 40-year-old woman in this study. The final BI-RADS 3 (suspicious for malignancy) and BI-RADS 4 (highly suspicious for malignancy) findings were confirmed by histology to be malignant lesions.

CONCLUSION

Breast density is an important but underestimated risk factor for breast cancer. Identification of women at high risk is important in instituting early preventive measures. Although our study comprised a low percentage of women with dense breasts, a significant association between breast density with age and postmenopausal status was found. This study further affirms the need for a more focused research on the peculiarities of breast cancer among black women.

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Conflicts of interest

There are no conflicts of interest.

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