IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 14, Issue 5 Ver. III (May. 2015), PP 01-07
www.iosrjournals.org

An Initial Assessment of Breast Parenchymal Density in Kano

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Abstract:
Objective: *Breast density is currently recognized as an independent risk factor for the development of breast cancer and has also been identified to increase a woman's risk of developing a malignant neoplasm by four to six folds. We documented the mammographic pattern of breast density on screening mammograms in Kano and compared this with age in 111 women seen at Aminu Kano Teaching Hospital (AKTH).*
Materials and Methods: *This is a prospective review of women presenting for a free breast screening exercise. Biometric information and reports consisting of the ACR BI-RADS breast parenchymal density and findings were analyzed using statistical software.*
Results: *Mammograms of women ranging in age from 21 to 70 years with a mean age of 45.9 years, (SD OF 8.149) were reviewed. Predominantly fatty breast parenchymal density (BI-RADS 1) was the most common; seen in 39.64% (44) and BIRADS 4 the least recorded. Majority of women who attended were housewives referred from the out-patient department (OPD).*
Conclusion: *Most women attending the free screening had fatty replaced breast parenchymal density and a normal mammogram (BI-RADS 1) was the most frequent final assessment category. Housewives were more willing to avail themselves to this screening exercise.*
Keywords: *BI-RADS, Breast Parenchymal density, Mammography, Screening.*

I. Introduction

Mammography is now widely acknowledged as the imaging modality of choice to detect early breast cancer and its effect on reduction of mortality has been shown by many studies. It remains the most specific and sensitive method of detection of breast cancer at its earliest presentation[1, 2, 3.] Many risk factors have been identified and established for breast cancer, such as age, ethnicity, race, personal and family history of the disease, but mammographic breast density has been recognized as a strong marker for breast cancer risk and is shown to demonstrate a four to six fold higher risk in women with over 75% density (BI-RADS 4) as compared to those with a lower density (BI-RADS 1). Mammographically dense breast tissue also hinders visualization of lesions making early detection of cancers on screening mammograms difficult in some patients.[4- 6.]

Breast density is defined as a measure of the quantity of radiodense fibroglandular tissues in the breast while mammographic breast parenchymal density is defined as a measure in percentages of the radiodense area on a mammogram. On a mammographic image of the breast, epithelial and stromal tissues appear radiodense and the fat, which makes up the transitional zone, appears radiolucent[7 - 10]

Wolfe in 1976 became the first researcher to classify mammographic breast parenchymal density and suggest that it might be useful in determining a predisposition to carcinoma.[4, 6, 9-11] He categorized mammographic density on the basis of qualitative parenchymal patterns into N1 (predominantly fatty), P1 (Parenchymal thickening and ductal prominence, mainly in the retroareolar region with < a quarter of the breast involved), P2 (Ductal and fibroglandular prominence with > a quarter of the breast volume) and DY (extensive dysplasia) and described a linear relationship between progressively dense tissues and increasing risk for breast cancer with N1 pattern being associated with the lowest risk and DY pattern the highest. This was soon followed by Tabar's classification and much later by that of the American college of Radiology which established the Breast Imaging Reporting and Data System (ACR BI-RADS) to standardize mammographic reporting and included qualitative descriptors of mammographic density. The ACR BI-RADS is similar to and simplifies Wolfe classification even further into four (4) simple mammographic categories and is currently the most popular method used by radiologists to classify breast densities on mammograms[4, 6, 9, 10, 12,] These quantitative definitions added in 2003 by the ACR BI-RADS corresponds to the four patterns on Wolfe's classification where N1 is equivalent to BI-RADS 1 – predominantly fatty replaced and DY to BI-RADS 4 –extremely dense breast pattern[4].

We set out by this prospective study to document the breast parenchymal pattern of 111 women seen in Kano using the BI-RADS classification of mammographic breast density; as well as to initially assess pattern in Kano. We hope thereby, to determine the effect of breast density on lesion visualization; as well as to investigate the relationship between age and breast density in our environment.

II. Materials And Methods

This prospective study was performed in Radiology department of Aminu Kano Teaching Hospital, Kano, Nigeria with reports and information from mammograms of patients who attended a free breast screening exercise conducted by the hospital in October, 2014 to commemorate the breast cancer awareness month. Women were randomly invited via radio announcements sponsored by the hospital; as well as referrals from relevant clinics in the hospital. All the mammographic examinations were performed by an experienced radiographer using a dedicated mammography unit (Mammograph T plus, TUR).

Verbal consent was sought from all the patients after the procedure was explained to them and before acquisition of mammograms. The procedure involved the use of conventional film-screen mammography to acquire images of the breast which consisted of 2 screening views per breast, a cranio-caudal view (CC) and a medio-lateral oblique view (MLO) for all the patients. Additional views were obtained when needed and as protocol in the department, all calcifications and small mammographic masses were spot magnified and all other masses seen were spot compressed. In Patients with large breasts, additional views done included 'anterior compression view' and extended cranio-caudal views. All the mammograms were reported blindly by 3 radiologists (senior radiology resident and 2 Consultant radiologists) whose practice was not limited to breast imaging. The consultant radiologists both have specialty training in breast imaging. Inter-observer variability was acknowledged (where discordance in findings existed, consensus was reached by adopting simple majority). Each report had information on the patient's mammographic breast density, reported according to BI-RADS and the findings on the mammogram stated as her final BI-RADS assessment category. Recommendations were made where necessary

Mammographic breast density was defined according to ACR's BI-RADS breast density classes 1-4 and each radiologist gave a qualitative description of mammographic density as follows: BI-RADS class 1 which is < 25% glandular or predominantly fatty; BI-RADS class 2 which is 25 – 50% glandular or scattered fibroglandular densities; BI-RADS class 3 which is 51 – 75% glandular or heterogeneously dense and BI-RADS class 4 which is > 75% dense tissues or extremely dense. The final BI-RADS assessment categories were 0, 1, 2, 3, 4, 5 and 6 and were defined as follows: BI-RADS category 0 –inconclusive study and required a review of prior mammograms or additional imaging in the form of additional mammographic views, Breast Ultrasound or MRI. All the patients seen for this screening exercise were baseline studies thus had no prior films, they either had additional mammographic views done or a breast ultrasound.

BI-RADS category 1: Normal mammogram with nothing to report.

BI-RADS category 2: Normal mammogram with benign finding to report. Examples of such benign findings are 'popcorn calcifications' of an involuting fibroadenoma, fat containing lesions such as oil cysts, lipomas and galactoceles, vascular calcifications, intramammary lymph nodes, implant or architectural distortion related to surgery.

BI-RADS category 3: Probably benign. Findings placed in this category have a less than 2% risk of malignancy and an initial short –interval follow up should be recommended.

BI-RADS category 4: suspicious abnormality- this category is reserved for findings that do not have the classical appearance of malignancy and is subdivided into 4A, 4B and 4C. A biopsy should be considered or recommended.

BI-RADS category 5: is highly suggestive of malignancy and lesions in this category have a high probability ($\geq$ 95%) of being cancer and appropriate action should be taken or biopsy is strongly recommended.

Finally BI-RADS category 6: is proven malignancy (biopsy has been done) and requires an appropriate action such as definitive therapy.

Data consisting of the findings and patients biometric information were analyzed using MINITAB statistical software.

III. Results

A total of 114 patients underwent free mammography at Radiology department, AKTH. Three (3) patients were excluded from the study for being males and having diagnostic mammograms and a total of 111 had screening mammograms. The median age of the women in the study was 45 years, with an age range of 21 – 70 years. In this screening population, all were baseline studies. 72% were above 40 years of age and fell in the age range of 41 – 70 years as represented in figure 1.

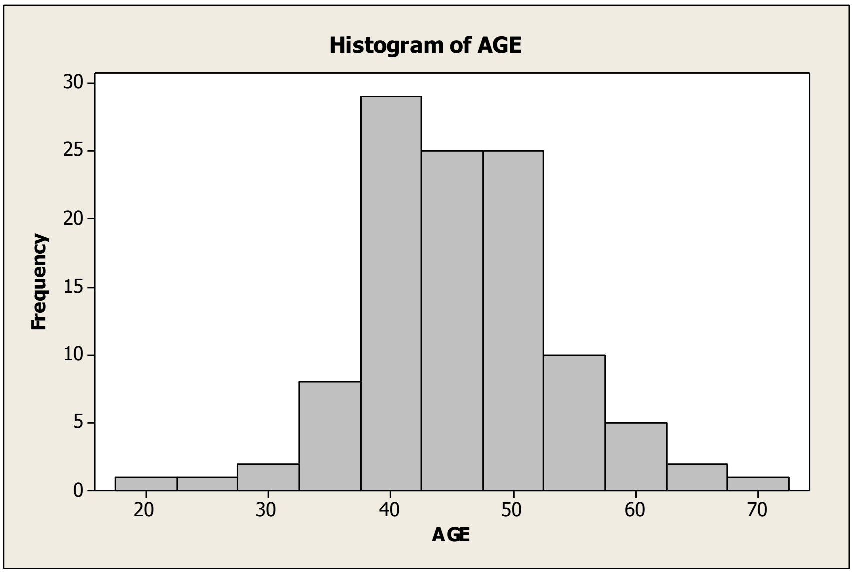

Figure 1: Histogram of Age distribution

Majority of women who attended the free screening exercise were housewives, with lowest attendees being business women (see table1). Out-patient department (OPD) had the highest number of referral while the lowest turnout came from the accident and emergency (A & E) unit; an unexpected source of patients for screening mammography with 1 referral (0.90%). Ten (9.01%) women were self referred as shown in table 2.

Table 1: Frequencies of Professions

PROFESSION	FREQUENCY	PERCENTAGE(%)
HOUSEWIVES	96	86.49
CIVIL SERVANTS	11	9.91
BUSINESS WOMEN	4	3.60
TOTAL	**111**	**100%**

Table 2: Distribution of Referrals.

REFERRALS	FREQUENCIES	PERCENTAGE(%)
A & E	1	0.90
OPD	98	88.29
SELF	10	9.01
SPECIALTY	2	1.80
TOTAL	**111**	**100%**

The mammographic breast pattern is shown in table 3 and shows BI-RADS 1 (fatty replaced) as the most frequent pattern seen in women from this screening exercise while BI-RADS 4 (extremely dense) was the least documented.

Table 3: Frequencies of Breast Parenchymal Densities

BREAST DENSITY (BI-RADS)	FREQUENCIES	(%)
BI-RADS 1 (Fatty replaced)	44	39.64
BI-RADS 2 (Scattered)	38	34.23
BI-RADS 3 (Heterogeneous)	18	16.22
BI-RADS 4 (Extremely dense)	11	9.91
TOTAL	**111**	**100**

Figure 2 shows age distribution of breast parenchymal density; with the highest percentage of breast parenchymal density been BI-RADS 1.

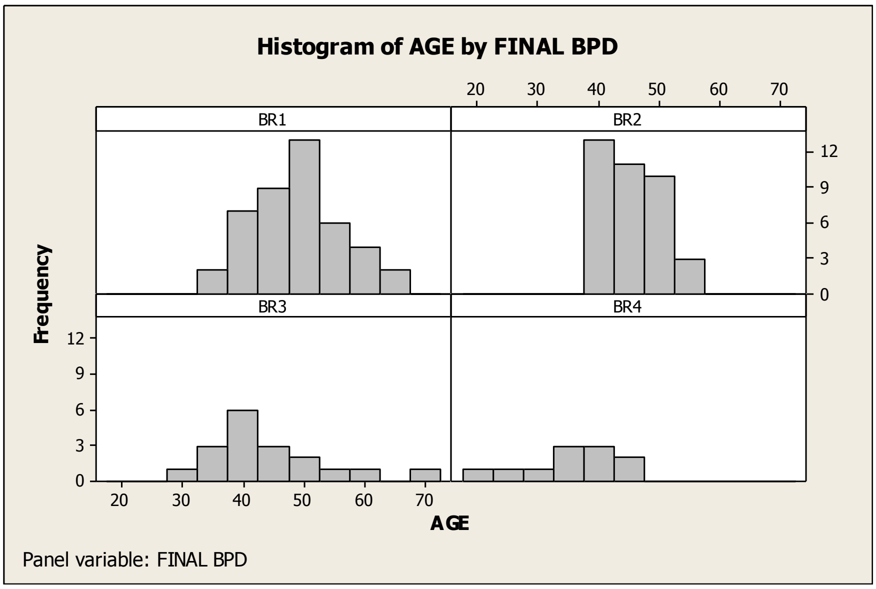

Figure 2: Age distribution by final BPD

The final BI-RADS assessment by age distribution is shown in figure 3. Thirty-seven (37) patients were in category 0 and needed further imaging in the form of additional mammographic and sonographic evaluation. These patients were called back but eight (8) failed to show up. BI-RADS 2 which signifies a normal mammogram but with findings to report was our most frequent final assessment category and BI-RADS 4 which suggests the presence of findings moderately suggestive of malignancy was our least with 4 patients in this category. The commonest benign findings within BI-RADS 2 recorded were intramammary lymph nodes (LN). Other findings seen in BI-RADS 2 are shown in table 4.

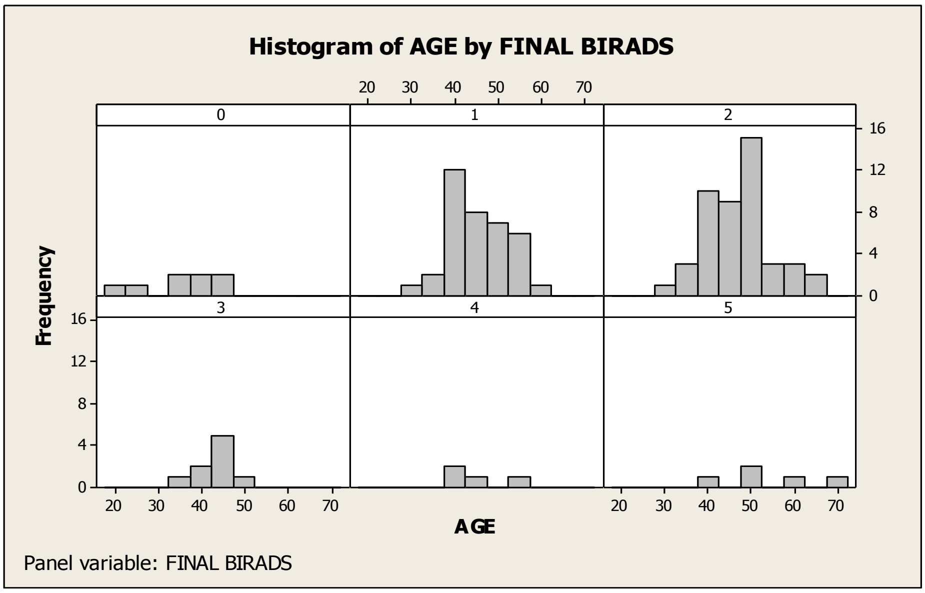

Figure 3: Age distribution by final BI-RADS assessment categories

Table 4: Distribution of BI-RADS 2 final assessment category

LESIONS	FREQUENCIES	%
Intramammary lymph nodes	14	37.84
Vascular calcifications	5	13.51
Other calcification	10	27.02
Focal asymmetry	2	5.41
Accessory breast tissue	3	8.11
Dilated ducts	2	5.41
Skin mole	1	2.70
Total	**37**	**100**

Table 5 below shows the final assessment categories in all the patients' initially classified as category 0. Eight patients remained category 0 as they failed to turn up for their additional imaging which involved additional mammographic views and breast ultrasound.

Table 5: Effect of BPD on lesion detection.

S/NO	AGE (Years)	BPD	BIRADS (PRE-BUS)	BIRADS (POST-BUS)
1	42	4	0	-
2	37	4	0	-
3	25	4	0	-
4	43	4	0	-
5	21	4	0	-
6	45	3	0	-
7	39	4	0	-
8	36	4	0	-
9	50	3	0	2
10	40	3	0	3
11	50	3	0	2
12	50	2	0	3
13	47	2	0	3
14	62	1	0	1
15	38	2	0	5
16	46	3	0	4
17	41	1	0	1
18	52	2	0	2
19	65	1	0	2
20	45	4	0	3
21	42	1	0	2
22	42	2	0	4
23	45	2	0	2
24	34	3	0	3
25	45	2	0	3
26	52	1	0	5
27	42	3	0	3
28	42	3	0	4
29	39	4	0	1
30	45	3	0	1
31	32	4	0	1
32	60	3	0	5
33	36	4	0	1
34	70	3	0	5
35	53	3	0	4
36	45	2	0	3
37	46	1	0	3

IV. Discussion

Mammographic breast parenchymal density alone and in combination with many other variables have been studied for many years by several researchers in an attempt to investigate its relationship with the risk of developing breast cancer; and though the risk for breast cancer increases with age, breast parenchymal density decreases with advancing age, this clearly showing their inverse relationship. Breast parenchymal density has been proven to be one of the strongest breast cancer risk factors and an independent predictor of breast cancer risk [6, 7, 9, 10, 12, 13.]

We had a small sample size representing attendees of a free screening exercise which serves as an initial look at the pattern of mammographic breast density in women seen in Kano and gives us an idea of the group at a higher risk of developing breast cancer. Though we saw women between 21 – 70 years, most of them were in the 41 – 50 years age range with 72% above the age of 40 years. On the latter, Obajimi et al[6] made a similar observation, however, the sample size of their study was much higher and likely more representative of a normogram of mammographic breast density from southwestern Nigeria.

Housewives formed the majority of respondents to this free screening exercise while Civil servants were the second most frequent and Business women the least. This was not surprising as the radio was the medium used to invite women for the exercise and this medium is unavailable to the latter groups during working hours. The Out-patient department (OPD) which is the first port of call for most patients into the hospital had the highest number of referrals of 98 patients for this screening exercise and A & E the least with only 1.

Researchers have also estimated that women with highest mammographic breast densities (such as women with density in more than 60 -75% of their breasts) have consistently been found to have as much as a four to six fold increase in their risk of developing a breast cancer than their counterparts with little or no density[6, 9, 10, 13, 14.] Though breast density is by far one of the strongest known risk factors to developing breast cancer, the exact mechanism by which it increases a patient's risk is not known. It is second only to age and carrying a BRCA1 or BRCA2 mutation.

Extensive mammographic density is commonly seen in women with breast cancer and some studies have shown that densities in more than 50% of the breast may account for a third of all breast cancers[14.] Also, another well known and documented fact regarding mammographically dense breast (BI-RADS 3 and 4,) is that it may limit the sensitivity of mammography as a screening tool for breast cancer by its ability to obscure lesions, making interpretation difficult and unreliable. So, we ask; if this could be the reason for the increased risk in patients with dense mammographic breasts? Mandelson et al[15]showed that the sensitivity of the mammogram of a woman is as high as 80% if she is predominantly fatty and decreased to as low as 30% if she is extremely dense (BI-RADS 4). Another study that examined patients with false negative mammograms and symptomatic cancers showed that 78% of the mammographically occult lesions were seen in patients with extremely dense or heterogeneously dense breast parenchyma. [4] These findings were in keeping with ours where we had 37 women with initial category 0 and 62.16% having a higher breast density (3 & 4) while 37.84% were BI-RADS 1 and 2. All the 8 patients who remained category 0 as they failed to return for their callbacks fell within the 62.16% of women with higher breast density.

The most frequently occurring breast parenchymal pattern we found was BI-RADS 1 (fatty replaced) accounting for 39.64% of the study group and the least common was BI-RADS 4 (extremely dense) with only 9.91%. Our findings were very similar to work done in Nigeria by Obajimi et al, Hamman et al and Bello et al[6, 16, 17] but, contrasted to many studies carried out on the Caucasian population where a significant number of women had dense mammograms,[4, 12] it has been shown that Caucasian women generally have a higher mammographic breast density when compared with their African or African American counterparts. Indeed breast density has been said to be genetically predetermined or hereditary.[6, 13]

The results showed a significant inverse relationship between breast parenchymal density and patient age with the younger patients generally showing a higher breast parenchymal pattern of BI-RADS 3 & 4 and the older patients were more of BI-RADS 1 & 2. These findings were similar to that seen in other parts of Nigeria as well as studies from other parts of Africa and the United States.[2, 4-10, 16, 17.] We noted that the minimum age of patient with BI-RADS 4 was 21 years compared to 33 years for BI-RADS 1. However, the oldest woman (70 years) in this study showed BI-RADS 3 parenchymal density instead of the expected BI-RADS 1 (i.e. completely fatty replaced). The reasons for her higher breast density at that age may be as a result of lower parity. Occasionally, we saw much older women with a heterogeneous breast density which was not explained by the use of hormonal replacement therapy (HRT); as this is rarely the case in this environment. Though it is well known and documented that breast parenchymal density decreases with age and that most postmenopausal women will be expected to have fatty replaced breast parenchymal patterns, some studies have shown that a significant proportion of postmenopausal women may have relatively dense breasts on their mammograms[4]. We recorded a number of older women with relatively dense breasts (BI-RADS 3 and 4).

The most frequent final assessment category in this study group was BI-RADS 2 with intramammary lymph nodes forming the highest finding and other calcifications (including lucent centered, rod-like and punctuate calcifications) being the next most frequent finding. BI-RADS 1 (normal mammograms) was the second most frequent final assessment category and BI-RADS 4 being the least final assessment category we documented.

We were unable to document the relationship between breast density and parity as this information was unavailable to us and we found no correlation between final assessment categories and age.

V. Conclusion

Research on breast parenchymal density patterns in Nigerian women is slowly gathering momentum. Mammographic parenchymal density and its importance as a risk factor for breast cancer as well as its limitations is something more researchers in Nigeria are becoming aware of. Today, the two most frequently used classifications are Wolfe's parenchymal pattern and the percentage of the breast with densities on a mammogram; both are combined in ACR BI-RADS classification which is now widely used. Fatty replaced breast parenchymal density been the most common pattern seen in our study as well as in other similar studies, will hopefully allow for earlier lesion detection and less missed mammographic lesions; and may explain our lower incidence of breast cancer when compared to that seen in Caucasian women.

VI. Recommendations

A larger sample size will be used in future studies to further verify these findings. Furthermore, many other biometric parameters such as parity, BMI, family history of breast cancer are worthy inclusions in future studies.

Acknowledgement

The authors wish to acknowledge and thank all the staff of Radiology department, AKTH for their contributions in one way or the other to the success of the screening exercise and to this paper. We particularly thank Dr. Anas Ismail and Dr. Musa Muhammed Bello for their assistance with analyzing this data.

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