WOLFE'S MAMMOGRAPHIC BREAST PARENCHYMAL PATTERN: A STUDY IN NORTH CENTRAL NIGERIA

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Abstract
Different breast parenchymal patterns are noted among women as seen on mammography and these have been classified by various ways including the initial Wolfe's method and assist as indicators of the risk of breast cancer. This prospective research carried out between 2014 and 2016 was to assess the mammographic breast parenchymal patterns according to Wolfe's classification and determine their prevalence in our local Nigerian environment. Successive mammographs were evaluated to identify the Wolfe's parenchymal patterns and the results were recorded along with the age, indications, findings and BIRADS classification. Data were entered into a computer spread sheet and analyzed with the aid of Statistical Package for Social sciences (SPSS) version 15 and results were presented in tables and figures. A total of 162 females were studied. Their ages ranged between 31years and 86years with a median age of 45years. The mean age was 47.04 with a standard deviation of 9.15. Most females studied were above 50years (45, 27.8%) while the least number of the studied females were below 35years (12, 7.4%). Mammography was requested mostly for routine screening (36, 22.2%). Most mammograms evaluated were adjudged as normal (101, 62.3%). The Wolfe parenchymal pattern with highest frequency is the N1 pattern (111, 68.5%) while the pattern with the least frequency is P2 pattern (6, 3.7%). Highest abnormal mammographic findings were seen in those above 50years of age (19, 31.1%). The 36-40 years age group was observed with the highest frequency of the P2 and DY (dense) parenchymal patterns (2, 6.7% and 8, 26.7% respectively) The DY pattern was the predominant pattern associated with abnormal mammographic findings (18, 29.5%). Advocacy for provision of more functional mammography machines and public enlightenment on mammography should be vigorously pursued in our region as an important public health program.

Keywords: Mammography, Parenchymal Pattern, Wolfe's Classification, North Central Nigeria.

1 INTRODUCTION:

Breast tissues vary in their content of stroma, collagen, epithelium and fat, so the radiographic appearance of the breast differs among women owing to varying proportions of radiodense fibroglandular tissue and radiolucent adipose tissue "[1]". Mammographic density reflects the amounts of fibrogladular stroma and epithelium in the breast "[2]".

Involution (physiological atrophy of the fibroglandular tissue of the breast) with subsequent preponderance of fatty tissue occurs with advancing age. The process is not uniform throughout the breast and the timing of the changes varies with individuals. An acceleration of the process between ages 45 and 60 years appears to be superimposed on the gradual change that occurs from the beginning of the 4th decade up the 7th decade in females "[3]". "[4]" established an inverse relationship between mammographic density and age related involution. Other factors have also been advanced in the

disposition of the fibroglandular composition relative to the fatty portion of the parenchyma in different individuals "[1], [5]".
Wolfe "[6]" was the first to describe differences in breast parenchymal patterns and proposed the variations in mammographic patterns as indicators of the risk breast cancer. Wolfe's classification consists of four breast patterns: N1, P1, P2, and DY (arbitrarily assigned). In the N1 pattern the parenchyma is composed primarily of fat with small amounts of increased density. The ducts are not visible (Plate 1a)
The pattern P1 consists of a mainly fat parenchyma with prominent ducts in the sub-areolar and anterior portion occupying up to 25% of the volume of the breast. There may be a thin band of ducts extending into a quadrant (Plate 1b). In the P2 pattern the parenchyma is severely affected with a prominent duct pattern occupying more than 25% of the volume of breast (Plate 1c). The pattern DY consists of severely affected parenchyma appearing denser which sometimes hides an underlying prominent duct pattern (Plate 1d). The breast cancer risk associated with these patterns has been found to be low in patterns N1 and P1 and high in patterns P2 and DY "[2], [7]". In studies using the Wolfe classification criteria the prevalence of dense mammographic patterns (P2/DY) varies from 30 to 70% "[8]".
In this study, we examined the prevalence of mammographic breast parenchymal patterns in our local environment following the initial Wolfe's classification.

2 METHODS:

Mammograms were conducted at the Mammography unit of the Radiology department of Jos University Teaching Hospital, North-Central Nigeria. The mammography examinations were routinely conducted during the first ten days of menstrual cycle and the women were accordingly booked where applicable following information on their last menstrual cycle. All booking and mammography were carried out by same female Radiographer staff experienced on mammography technique. Two standard views were taken for each breast, cranio-caudal (CC) view and medio-lateral oblique (MLO) view using a GE2005 Senographe DMR+ Mammography machine fitted with stereotactic component. These mammograms were prospectively assessed over a period of 3years between 2013 and 2016. Two Radiologists with at least 5 year experience in Mammography reporting were involved in assessing the mammographs using same mammography viewing box and the results were successively and carefully entered in a format including their age, the indications, Wolfe's pattern, findings, and BIRADS classification. The patients were grouped according to the following age brackets (in years): ≤35, 36-40, 41-45, 46-50, >50.

Successive mammograms of 162 women, comprising 648 images i.e. 2 CC and 2 MLO images for each woman were evaluated. Data was analyzed descriptively using Statistical Package for Social sciences. (SPSS) version 15 and results were presented in tables and figures.

3 RESULTS:

A total of 162 females were studied. Their ages ranged between 31years and 86years with a median age of 45years. The mean age was 47.04 with a standard deviation of 9.15. Most females studied were above 50years (45, 27.8%) while the least number of the studied females were below 35years (12, 7.4%) -Table 1. Mammography was requested mostly for routine screening (36, 22.2%) -Table 2. Most mammograms evaluated were adjudged as normal (101, 62.3%) -Table 3. The Wolfe parenchymal pattern with highest frequency is the N1 pattern (111, 68.5%) while the

pattern with the least frequency is P2 pattern (6, 3.7%) -Fig 1. Highest abnormal mammographic findings were seen in those above 50years of age (19, 31.1%). The 36-40 years age group was observed with the highest frequency of the P2 and DY (dense) parenchymal patterns (2, 6.7% and 8, 26.7% respectively) -Table 4. The DY pattern was the predominant pattern associated with abnormal mammographic findings (18, 29.5%) -Table 5.

4 DISCUSSION:

Following the initial work by Wolfe in 1976, a number of other mammographic image based classification of breast parenchymal patterns have been developed including the Boyd, BI-RADS and Tabar assessment methods. We undertook an assessment of mammograms of all the women which were conducted during the study period to enable us establish benchmark data specific to our environment based on Wolfe's proposal.
Females above 50years constituted the highest frequency of those that came for mammography examination from our findings (45; 27.8%). This is not unexpected as this age group includes those women who after the reproductive years tend to present in the clinics for routine mammography checks. Those below 35 years were the least to undergo the investigation during the study period (12; 7.5%). The reason for this is probably that ultrasonography, rather than mammography, should be the recommended imaging technique for womenin this age range with focal breast symptoms. Aside from cancers not being common in this group, mammograms in the younger reproductive years tend to yield dense breasts that is of no help to neither the patient nor the radiologist. This agrees with what is already known and identified in literature "[9]".

Most mammography requests were for routine screening (36; 22.6%). This is in consonance with the earlier discussed point of the 50 and above year olds being the ones that assess the mammography the most perhaps as a necessary component of their routine medical check up. Indeed it is evident that for some reasons, more women especially those in their reproductive years are still not conversant with mammography. In our local environment in a developing country, the only fuctional mammography machine during the period of the study was the index machine for this study. This machine actually served a subtantialpart of our region, Jos University Teaching Hospital being a referral tertiary hospital to quite a number of hospitals in Plateau State as well as other surrounding States in North Central region of Nigeria. It should be expected that there will be some traffic over the solitary machine. However, only 162 subjects were studied over a period of 3 years indicating the low level of awareness on issues of mammography. In mammography related studies done in other regions in Nigeria, "[10]" reported on a cohort of 300 women seen over a period of 3 years in the South West region while "[11]" described mammographic parenchymal densities in about 319 women seen over 4 years in the South East region. It is obvious that more work needs to be done in the area of public enlightenment on mammography and also in advocacy for more functional machines and trained man-power to service the populace. It is possible that those for whom mammography is needfully prescribed may have been discouraged from assessing it due to distance.
Most mammograms were assessed to be normal (101; 62.3%). This finding is not unexpected where most of the investigations were done for routine screening rather than for diagnostic purposes. Our research was carried out without the assistance of a computer-aided-detection (CAD) system. Though earlier authors allude to a positive effect in detective yield with a CAD "[12]" in mammography screening programmes, subsequent studies suggest that CAD is not so effective in its use in mammography interpretation "[13], [14]".

Our study shows that the N1 pattern was the most common pattern in this environment with a prevalence of 68.5% (Fig 1). Two peaks are observed for this pattern in women above 40 years: the 41-45 and the >50 age groups (Table 4). DY pattern was the next most frequent pattern accounting for 17.9% of studied mammographic parenchyma, followed by the P1 pattern (5.6%) and N2 pattern (4.3%). The least common breast parenchymal pattern in our study is the P2 pattern constituting about 3.7% of the study population. The predominance of N1 pattern in our study could be attributed to the facts not only that most of the study subjects were above 50 years old but also to the higher level of parity in our local environment. Parous women are more likely to have fatty mammograms or the N1 pattern "[4]" and many studies indeed observed a shift from the denser DY pattern towards the N1 and P1 pattern in mammograms of women who are above 50 years old "[4], [15]". In our region of the country, reproduction is concluded by early-mid 4^{th} decade, having started relatively earlier than in the other regions. This probably explains the first peak of N1 pattern amongst the 41-45 age group. The studies in Lagos "[10]" and Enugu "[11]" showed a predominance of the 'fibrofatty' (49.7%) and fibroglandular pattern (50.5%) respectively. A strong correlation had been established between Wolfe, Boyd and BI-RADS based mammographic parenchymal pattern classifications by "[16]" such that N1 approximates to BIRADS I or fatty parenchyma, P1 to BIRADS II or scattered fibroglandular pattern, P2 to BIRADS III or heterogenously dense pattern, and DY to BIRADS IV or extremely dense pattern.

The finding of P2 parenchymal pattern as the least in our study is at variance with the study by "[8]" at Nijmegen, The Netherlands where P2 pattern was persistently seen with the highest frequency in those between 35 and 50 years, scoring as much as 53% in those between 35 and 39years old in the initial screening study. As already stated, dense (P2 and DY) patterns should expectedly be common in the pre-menopausal and reproductive age groups. Something similar is also noted in our study as the 35-40 year age grade has the highest number of these two patterns. However, there were more of DY pattern than P2 pattern all across the different ages and notwithstanding the preponderance of the post-menopausal age grade in this study, the P2 pattern is the least observed amongst the women less than 45 years in this study. Other factors may yet be contributory. While low body-mass-index (BMI) has been associated with non-dense breast tissue area, a high BMI and adiposity was associated with dense breast tissue "[17]" and these may play a moderating role. We did not set out to ascertain body-mass-index in this study and further studies on how this variable affects breast parenchymal pattern on mammography in our setting will be interesting.

The DY pattern was most associated with abnormal mammographic findings. We found the DY pattern cutting across the age groups but mostly in the 35-40years age group. In the study by "[11]" the few individuals with DY mammographic pattern were also noticed in similar age bracket. DY pattern has been associated with up to a 5 fold risk of developing cancer compared to N1pattern "[7], "[18]". Closer follow up mammography examinations is certainly necessary in this group of women.

5 CONCLUSION:

The commonest Wolfe's mammographic breast parenchymal pattern in our local environment is the N1 pattern with a prevalence of 68.5%. Further studies on a larger cohort should incorporate information on body mass index, hormonal therapy, age at first birth and parity as these may have effects, transient or prolonged, on the mammographic density. Advocacy for provision of more functional mammography machines and public enlightenment on mammography should be vigorously pursued in our region as an important public health program.

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TABLE 1

Age distribution of respondents

Age group	Frequency	Percent
≤35	12	7.4
36-40	30	18.5
41-45	43	26.5
46-50	32	19.8
>50	45	27.8
Total	162	100.0

TABLE 2

Distribution of respondents according to indications

Indications	Frequency	Percent
Left breast mass	22	13.6
?Left breast lump	1	0.6
?Right breast lump	7	4.3
?Sclerosing adenosis	1	0.6
Post left mastectomy	1	0.6
Bilateral breast lump	4	2.5
Bilateral breast pain	15	9.3
Bilateral breast engorgement	2	1.2
Left ductal ectasia	1	0.6
Right ductal ectasia	2	1.2
Galactorrhoea	1	0.6
Right nipple discharge	1	0.6
Right breast pain	16	9.9
Left nipple discharge	2	1.2
Left breast pain	19	11.7
Left breast engorgement	4	2.5
Paget disease	1	0.6
Right breast mass	24	14.8
Right breast engorgement	2	1.2
Routine screening	36	22.2
Total	162	100.0

TABLE 3

Distribution of respondents according to findings

Findings	Frequency	Percent
Bilateral malignant masses	1	0.6
Bilateral intra-mammary lymph nodes	1	0.6
Bilateral macro-calcifications	1	0.6
Dense breasts	11	6.8
Left axillary lymph node	1	0.6
Left benign mass	16	9.9
Left benign mass + micro-calcification	1	0.6
Left malignant mass	1	0.6
Left intra-mammary lymph node	3	1.9
Lipoma	1	0.6
Macro-calcification	6	3.7
Normal	101	62.3
Right benign mass	7	4.3
Right benign mass + macro-calcification	1	0.6
Right benign mass + micro-calcification	4	2.5
Right benign mass + right axillary lymph node	1	0.6
Right malignant mass	3	1.9
Right intra-mammary lymph node	1	0.6
Right radial scar	1	0.6
Total	162	100.0

TABLE 4

Age distribution of respondents according to Wolfe pattern

Wolfe pattern	≤35	36-40	41-45	46-50	>50	Total
DY	1(8.3)	8(26.7)	7(16.3)	6(18.8)	7(15.6)	29(17.9)
N1	10(83.3)	19(63.3)	29(67.4)	25(78.1)	28(62.2)	111(68.5)
N2	0(0.0)	0(0.0)	4(9.3)	0(0.0)	3(6.7)	7(4.3)
P1	1(8.3)	1(3.3)	2(4.7)	0(0.0)	5(11.1)	9(5.6)
P2	0(0.0)	2(6.7)	1(2.3)	1(3.1)	2(4.4)	6(3.7)
Total	12(100.0)	30(100.0)	43(100.0)	32(100.0)	45(100.0)	162(100.0)

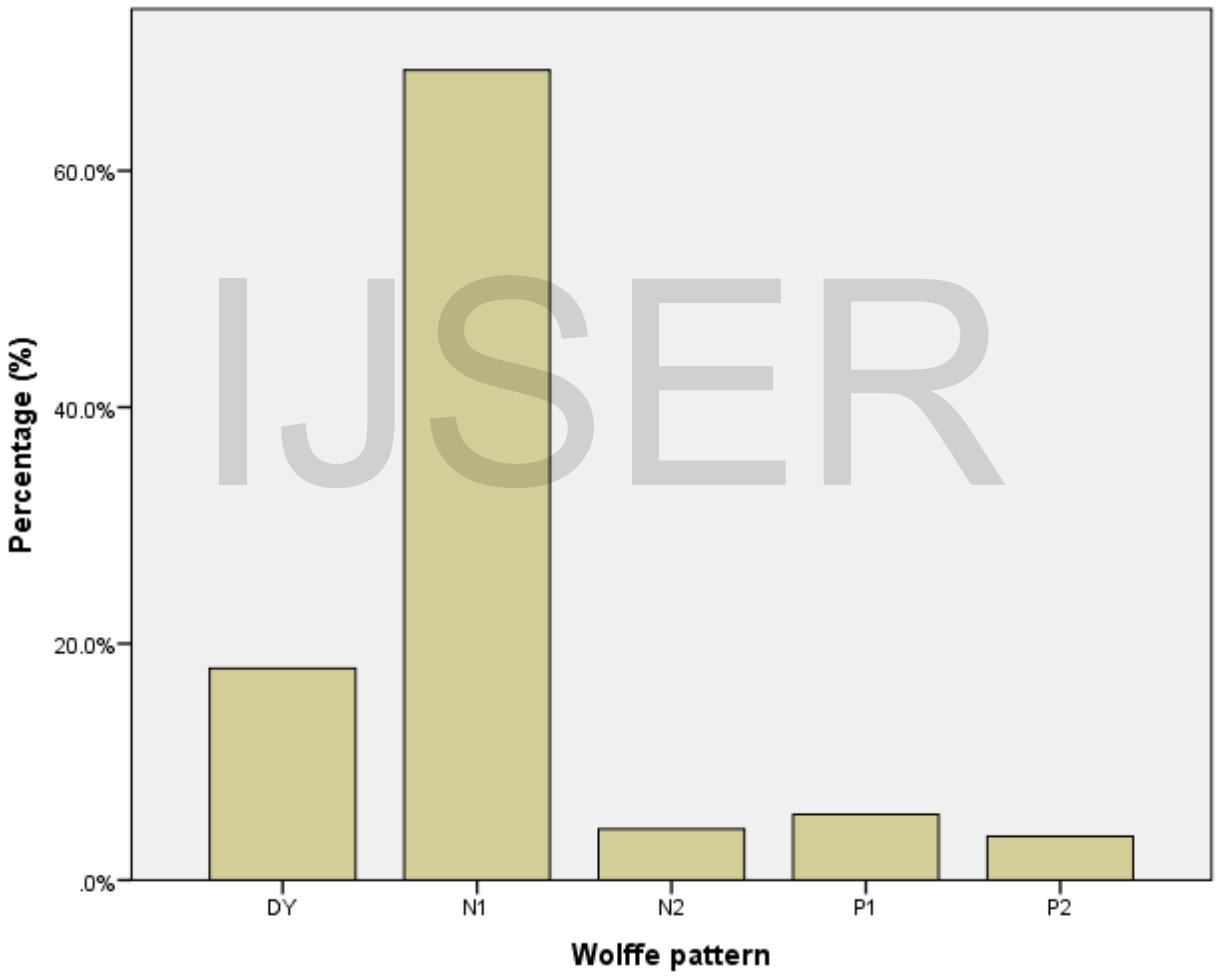

Fig 1: Bar chart showing the distribution of Wolfe pattern of study participants

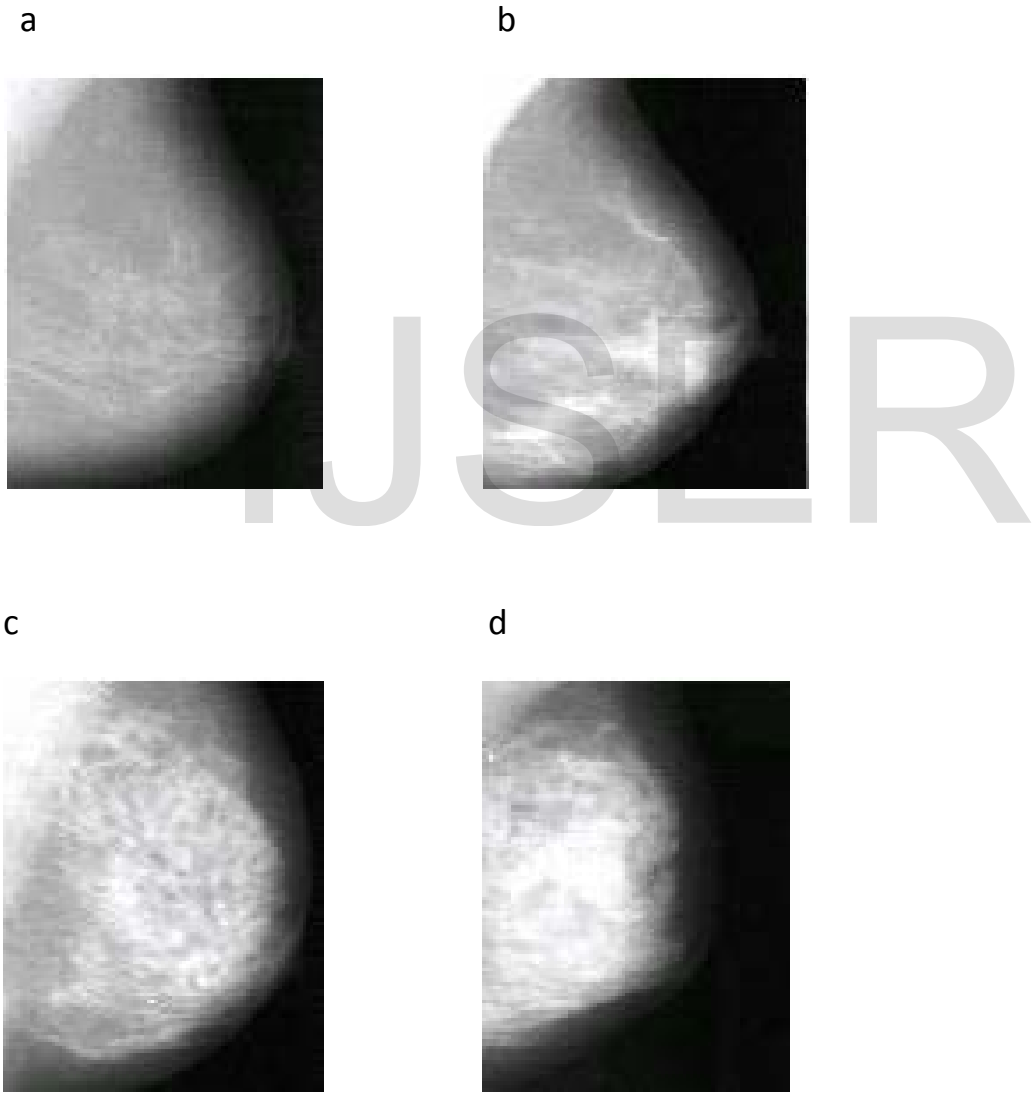

Plate 1: a-N1 pattern, b-P1 pattern, c-P2 pattern, d-DY pattern

TABLE 5

Wolfe pattern distribution of respondents according to findings

Findings	Wolfe's pattern (%)				
	DY	N1	N2	P1	P2
Bilateral malignant masses	1(3.4)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Bilateral intra mammary lymph nodes	1(3.4)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Bilateral macro-calcification	1(3.4)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Dense breast	11(37.9)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Left axillary lymph node	1(3.4)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Left benign mass	14(48.3)	2(1.8)	0(0.0)	0(0.0)	0(0.0)
Left benign mass + micro-calcification	0(0.0)	1(0.9)	0(0.0)	0(0.0)	0(0.0)
Left malignant mass	0(0.0)	1(0.9)	0(0.0)	0(0.0)	0(0.0)
Left intra-mammary lymph node	0(0.0)	3(2.7)	0(0.0)	0(0.0)	0(0.0)
Lipoma	0(0.0)	1(0.9)	0(0.0)	0(0.0)	0(0.0)
Macro-calcification	0(0.0)	6(5.4)	0(0.0)	0(0.0)	0(0.0)
Normal	0(0.0)	97(87.4)	4(57.1)	0(0.0)	0(0.0)
Right benign mass	0(0.0)	0(0.0)	3(42.9)	4(44.4)	0(0.0)
Right benign mass + macro-calcification	0(0.0)	0(0.0)	0(0.0)	1(11.1)	0(0.0)
Right benign mass + micro-calcification	0(0.0)	0(0.0)	0(0.0)	4(44.4)	0(0.0)
Right benign mass + right axillary lymph node	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(16.7)
Right malignant mass	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(50.0)
Right intra-mammary lymph node	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(16.7)
Right radial scar	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(16.7)
Total	29(100.0)	111(100.0)	7(100.0)	9(100.0)	6(100.0)