Comparison Between BIRAD Scores and Histological Features in Diagnosis of Breast Neoplasia at Warith International Cancer Institution

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Abstract:
Introduction: Accurate evaluation and classification of breast lesions using the Breast Imaging-Reporting and Data System (BIRADS) are crucial for appropriate management and treatment planning of breast cancer. This study explores the relationship between BIRADS scores and histological features in the diagnosis of breast neoplasia at the Warith International Cancer Institution in Karbala, Iraq.
Methods: This descriptive study included 520 patients diagnosed with breast neoplasia with a pre-diagnostic malignancy probability (BI-RADS 3, 4, or 5) between June 2023 and June 2024. Based on the diagnostic imaging method, patients were classified into mammography and ultrasonography groups. Clinicopathological factors, including age, BI-RADS categories, and histological findings, were analyzed.
Results: Mammogram findings revealed that 63.65% of patients had benign results, while 20.77% had findings indicative of malignancy. Ultrasound findings showed that 71.35% of patients had benign results, and 11.35% had findings suggestive of malignancy. Histological analysis indicated that 23.85% of patients had malignant results, 68.07% had benign findings, and 2.31% showed suspicious results. Patients aged 50 years and above had a significantly higher likelihood of detecting malignant breast lesions through mammography compared to younger patients. At the same time, no significant association was found between age groups and ultrasound findings.
Conclusion: Mammography demonstrated high sensitivity and specificity in detecting breast neoplasia, although there were false positives and negatives. Ultrasound screening also effectively detected breast abnormalities, particularly in identifying lesions that required further evaluation. The study highlights the importance of age in influencing breast cancer detection through mammography, with older patients having a higher detection rate than younger patients.

Keywords: Breast Lesion, Comparison, Histopathological features, BIRADS Score

1. Introduction:

Breast cancer is the most common cancer in females in the world and one of the leading causes of death in women worldwide (1). Breast cancers usually are epithelial tumors of ductal or lobular origin (1). Most breast cancers present as palpable lumps, inflammatory lesions, nipple secretions, or mammographic abnormalities. Though radiology and cytology findings are reliable, a biopsy of the lump is to be done for a definitive diagnosis. Preoperative pathology diagnosis constitutes an essential part of the workup of breast lesions (2). Currently, the lifetime risk of developing breast cancer for women is 1 in 8. Notably, more than 40% of affected patients are over 65 years old, and this group accounts for nearly 60% of total breast cancer deaths (3,4). The estimated risk of developing breast cancer before the age of 49 is 1 in 53. This risk increases to 1 in 43 for women aged 50–59 and 1 in 23 for those aged 60–69. For women aged over 70, the risk is the highest, with a 1 in 15 chance of developing breast cancer (4,5). A combined diagnostic approach comprises clinical examination, radiology, FNAC, and biopsy in suspected cases of breast cancer, which improves the diagnostic efficiency of breast cancers and reduces morbidity and mortality. Mammography plays a pivotal role in breast cancer screening, with the Breast Imaging Reporting and Data System (BI-RADS) established by the American College of Radiology offering a standardized framework for interpreting radiological findings. Initially introduced in mammography in 1993, BI-RADS has undergone several revisions, with the current 5th edition encompassing seven categories (0 to 6). These categories provide a systematic approach to assessing the probability of malignancy before a breast cancer diagnosis is confirmed (6,7). BI-RADS categorizes findings into seven classes, ranging from 0 to 6. Categories 1 to 5 represent varying probabilities of malignancy. Specifically, BI-RADS 1 indicates a negative result (0% probability), BI-RADS 2 denotes a benign finding (0% probability), BI-RADS 3 suggests a probably benign abnormality (<2% probability), BI-RADS 4 signals a suspicious abnormality (2%–95% probability), and BI-RADS 5 indicates a high likelihood of malignancy (≥95% probability). The higher the BI-RADS category, the greater the probability of breast cancer (8). Despite BI-RADS' utility in predicting breast cancer probability, there is a lack of studies examining its correlation with tumor characteristics (9), prognosis, and patient survival. Thus, our study aims to comprehensively compare these two diagnostic approaches and their efficacy in assessing breast lesions. Thus, this study aims to compare these two diagnostic approaches and their effectiveness in evaluating breast lesions at the Warith International Cancer Institution in Karbala, Iraq.

2. Material &Methods:

In a descriptive study of 520 patients registered in Warith International Cancer Institution, in Karbala, Iraq, who were diagnosed with breast neoplasia with prediagnostic malignancy probability in radiological findings such as BI-RADS 3, 4, or 5 between 1 June 2023 and 1 June 2024, using mammography or ultrasonography in the routine preoperative diagnostic process. The clinicopathological factors included age, BI-RADS categories of mammography or ultrasonography, and histological findings. The exclusion criteria were as follows: BI-RADS 0, 1, 2, 6, or unknown in both mammography and ultrasonography; and unknown survival status. Depending on which diagnostic imaging method was used, the included patients were independently classified into the mammography and ultrasonography groups. Each group was further divided into BI-RADS 1-3 and 4-5 groups. Comparisons of the histological findings between the mammography and ultrasonography groups using the student t-test and chi-square test. In addition, the associations between each BI-RADS group and the other clinicopathological factors were compared using sensitivity analysis. All statistical analyses were performed using IBM SPSS Statistics ver. 22.0 (IBM Corp., Armonk, NY, USA), and P-values of <0.05 were considered to be statistically significant

3. Results:

The study included 520 participants, with 208 (40.00%) falling into the age group of less than 50 years and 312 (60.00%) aged 50 or older. Mammogram findings according to the BI-RADS score revealed that

33 participants (6.35%) had negative results, while the majority, 331 (63.65%), had benign findings. Additionally, 48 participants (9.23%) showed suspicious results, and 108 (20.77%) had findings indicative of malignancy. Ultrasound findings categorized by the BI-RADS score showed that 26 participants (5.00%) had negative results, whereas 371 (71.35%) had benign findings. Moreover, 64 participants (12.30%) exhibited suspicious results, and 59 (11.35%) had findings suggestive of malignancy. Histological findings indicated that out of the 520 participants, 124 (23.85%) had malignant results, 354 (68.07%) had benign findings, 12 (2.31%) showed suspicious results, and 30 (5.77%) had normal findings, as shown in table (1)

Table (1): BIRADS (Mammogram, Ultrasound) results and Histological findings of examined breast neoplasia cases (n=520)		
Age group	n	%
< 50	208	40.00
≥ 50	312	60.00
Total	**520**	**100**
Mammogram findings of BIRADS Score		
Parameters	1-3 n, (%)	4-5 n, (%)
Negative	33 (6.35)	
Benign findings		331(63.65)
Suspicious		48 (9.23)
Malignancy finding		108 (20.77)
Total 520 (100%)		
Ultrasound findings Of BIRADS score		
Parameters	1-3 n, (%)	4-5 n, (%)
Negative	26 (5.00)	
Benign finding		371 (71.35)
Suspicious		64 (12.30)
Malignancy finding		59 (11.35)
Total 520 (100%)		
Histological findings		
Parameters	n	(%)
Malignant	124	23.85
Benign	354	68.07
Suspicious	12	2.31
Normal findings	30	5.77
Total	**520**	**100%**

Table (2) presents the results of screening by mammogram compared to histology findings, which serve as the standard test. Out of a total of 520 cases, 428 cases were identified as positive based on histological findings. Among these, 402 cases were also positive on mammogram screening, while 26 were negative. Similarly, 92 cases were identified as negative based on histological findings. Of these, 82 cases were also negative on mammogram screening, while ten were positive. These findings provide insights into the performance of mammogram screening compared to histology findings, assisting in evaluating its accuracy and effectiveness in detecting breast abnormalities. So, from this table, it is clear that the sensitivity of the mammogram was 94%, Specificity was 89%, Positive predictive value was 97%, Negative predictive value was 76%, and Accuracy was 93%.

Table (2): Results of screening by mammogram versus histology findings as a standard test.

Histological findings / Mammogram	positive	Negative	Total
Mammo (+)	402	10	412
Mammo (-)	26	82	108
Total	428	92	520

Table (3) illustrates the results of screening by ultrasound compared to histology findings, which serve as the standard test. Among the 520 cases, 350 were identified as positive based on histological findings. Of these, 339 cases were also positive on ultrasound screening, while 11 were negative on ultrasound screening. Moreover, 170 cases were identified as negative based on histological findings. Among these, 100 cases were also negative on ultrasound screening, while 70 were positive. These results provide insights into the performance of ultrasound screening compared to histology findings, aiding in assessing its accuracy and efficacy in detecting breast abnormalities. So, from this table, it is clear that the sensitivity of the ultrasonogram was 97%, the Specificity of the ultrasonogram was 41%, the Positive predictive value was 77%, the Negative predictive value was 86%, and the Accuracy was 97%.

Table (3): Results of screening by ultrasound versus histology findings as a standard test.

Histological findings / Ultrasonogram	Positive	Negative	Total
U/S (+)	339	100	439
U/S (-)	11	70	81
Total	350	170	520

Table (1) presents clinicopathological characteristics related to BIRADS categories in a sample of 263 patients, categorized by mammography and ultrasonography results, with separate columns for BIRADS categories 3-4 and 5. Among the patients who underwent mammography (n=228), 129 (56.58%) were classified under BIRADS categories 3-4, while 99 (43.42%) were classified under category 5. For ultrasonography (n=35), 23 patients (65.71%) fell into categories 3-4 and 12 patients (34.29%) into category 5. The mean age for patients classified under BIRADS categories 3-4 was (47.28) years for mammography and (34.39) years for ultrasonography. For category 5, the mean age was (52.77) years for mammography and (35.25) years for ultrasonography. The difference in age between categories 3-4 and 5 was statistically significant ($p<0.05$) for mammography and ultrasonography. The distribution of patients based on age groups (<50 and ≥50 years) showed a statistically significant association with BIRADS categories. For mammography, a higher proportion of patients aged ≥50 years were classified under category five compared to those aged <50 years ($p<0.05$). However, there was no significant difference in age distribution for ultrasonography between categories 3-4 and 5. Marital status did not significantly correlate with BIRADS categories for either mammography or ultrasonography ($p>0.05$). The histological results were significantly associated with BIRADS categories for both mammography and ultrasonography. A higher proportion of patients with positive histological results were classified under category 5, while a higher proportion of patients with negative histological results were classified under categories 3-4 ($p<0.05$). The distribution of histological types (IDC and DCIS) did not show a significant association with BIRADS categories for either mammography or ultrasonography ($p>0.05$). The table highlights substantial associations between age, histological results, and BIRADS categories, indicating their potential value in predicting breast cancer risk. However, marital status and histological type did not show significant associations with BIRADS categories in this sample related with ultrasonography.

Table (1) clinicopathological characteristics related to BIRADs categories, n= (263)

Clinicopathological factors	Mammography n= (228)		P-value	Ultrasonography n= (35)		P-value
	BIRADs 3-4 n, (%)	BIRADs 5 n, (%)		BIRADs 3-4 n, (%)	BIRADs 5 n, (%)	
Patients	129 (56. 58)	99 (43.42)		23 (65.71)	12 (34.29)	
Age (years)	47.28±7.49	52.77±9.54		34.39±3.64	35.25±4.99	
< 50 ≥50	94 (41.22) 35 (15.35)	40 (17.54) 59 (25.88)	<0.00001	21 (60.00) 2 (5.71)	8 (22.86) 4 (11.43)	0.7359
Marital status: Married: Single:	112 (49.12) 17 (7.45)	89 (39.03) 10 (4.39)	0.4759	19 (65.71) 4 (11.43)	10 (28.57) 2 (5.71)	0.771
Histological results Positive: Negative:	4 (1.75) 125 (54.82)	94 (41.23) 5 (2.19)	<0.00001	2 (5.71) 18 (51.43)	12 (34.28) 3 (8.57)	0.00004
Histological type: IDC: DCIS:	53 (23.24) 10 (4.39)	110 (48.24) 55 (24.12)	<0.0090	15 (45.71) 8 (22.85)	7 (20.00) 5 (14.28)	0.6890

Table (2) presents the odds ratios (OR) and corresponding 95% confidence intervals (CI) for clinicopathological factors associated with BI-RADS categories, categorized by mammography and ultrasonography results. For mammography, the odds ratio of being categorized under BI-RADS categories 3-4 compared to category 5 was 3.96 (95% CI: 2.26-6.92) for patients <50 years compared to those aged ≥50. This difference was statistically significant (p<0.00001). However, there was no significant association for ultrasonography between age and BI-RADS categories, with an odds ratio of 0.76 (95% CI: 0.15-3.68). For mammography and ultrasonography, marital status did not significantly correlate with BI-RADS categories. The odds ratio for being categorized under BI-RADS categories 3-4 compared to category 5 for single individuals compared to married individuals was 0.74 (95% CI: 0.32-1.96) for mammography and 1.33 (95% CI: 0.19-9.31) for ultrasonography. Positive histological results were significantly associated with being categorized under BI-RADS categories 3-4 compared to category 5 for mammography and ultrasonography. The odds ratio was 0.0017 (95% CI: 0.0004-0.006) for mammography and 0.03 (95% CI: 0.0043-0.21) for ultrasonography, indicating significantly lower odds of being in category 5 for patients with positive histological results compared to negative ones (p<0.00001 for both). The histological type did not significantly correlate with BI-RADS categories for either mammography or ultrasonography. The odds ratio for being categorized under BI-RADS categories 3-4 compared to category 5 for IDC compared to DCIS was 0.73 (95% CI: 0.37-1.45) for mammography and 1.07 (95% CI: 0.25-4.49) for ultrasonography. Overall, age and histological results were significant predictors of BI-RADS categories, with younger age and positive histological results associated with higher odds of being categorized under BI-RADS categories 3-4 compared to category 5. In this analysis, marital status and histological type did not show significant associations with BI-RADS categories related to ultrasonography.

Table (2) Analysis of clinicopathological factors associated with BI-RADS categories, n= (263)

Clinicopathological factors	Mammography n= (228)	P-value	Ultrasonography n= (35)	P-value
	OR (95% CI)		OR (95%CI)	
Age (year) < 50 ≥50	3.96 (2.26-6.92)	<0.00001	0.76 (0.15 - 3.68)	0.7359
Marital status: Married: Single:	0.74 (0.32 – 1.96)	0.4759	1.33 (0.19 – 9.31)	0.771
Histological results Positive: Negative:	0.0017 (0.0004 – 0.006)	<0.00001	0.03 (0.0043 – 0.21)	0.00004
Histological type: IDC: DCIS:	0.73 (0.37-1.45)	<0.0090	1.07 (0.25 – 4.49)	0.6890

4. Discussion:

Studies are still few in Iraq that have investigated the comparison between radiological investigations such as ultrasound and mammography with tissue diagnosis through biopsy. So, this study aligns with this trend. Additionally, the age range of patients diagnosed with breast cancer in our study falls between 20 and 78 years, with a mean age of 49 years, which is consistent with findings reported by McGuire et al. (10). Histological findings in this study indicated that out of the 520 participants, 124 (23.85%) had malignant results, 85 (68.55%) of them were with invasive ductal carcinoma and 39 (31.45) of them were with ductal carcinoma in situ, were the most common types of breast cancer. Quite in line with our study, ductal carcinoma was found to be the most common type of breast cancer in other studies carried out in different countries (11,12). Also, related to radiation effects, Berg et al. (13) suggested that combining ultrasound and mammography for screening might be beneficial for women at high risk of breast cancer. However, existing literature and our study findings contradict this notion, as they indicate that mammography alone poses minimal risk of radiation-induced cancer (14,15). Our study revealed that both mammography and ultrasonography yielded predominantly positive results in breast cancer patients, with a small percentage of false negatives, particularly among patients aged 50 and above. This finding aligns with the results reported by Farokh et al. (16), where ultrasonography demonstrated high diagnostic accuracy in detecting breast cancer among patients with high-density breasts (stages 3 and 4). Additionally, the study highlighted that mammography outperformed ultrasonography in accurately determining tumor size pre-surgery. The comparison of sensitivity and specificity between ultrasonography and mammography findings and clinical examination further supported these observations. In a study conducted by Shafiee et al., the sensitivity and specificity of ultrasonography were compared with mammography findings and clinical examination. The results showed that ultrasonography had higher sensitivity and specificity than mammography examination (25.8% and 71.9% vs. 5% and 7.1%, respectively). However, in our study, we found that the sensitivity of mammography was 94%, with a specificity of 89%, while the sensitivity of ultrasound was 97.8%, with a specificity of 41%. These findings suggest that mammography may not be a reliable diagnostic test for the diagnosis of breast cancer (17). Breast cancer screening programs offer significant advantages, including early detection, risk factor identification and prevention, and prompt treatment, leading to a notable reduction in morbidity and a 20% decrease in mortality rates. However, they also present drawbacks such as overdiagnosis, high financial costs, and potential exposure to ionizing radiation. On a global scale, most countries advocate biennial breast cancer screening for individuals aged 50–74 years (18). However, some nations opt for earlier screening, beginning at age 40 and extending to 70–74, particularly in regions with higher breast cancer incidence rates or among populations deemed at higher risk (18,19). Furthermore, a study conducted in Iran revealed notable variations in the sensitivity of ultrasonography for breast cancer diagnosis based on factors like age and previous history of breastfeeding and pregnancy. While mammography remains the preferred screening modality, especially for high-risk women, complementary tests such as ultrasonography enhance diagnostic accuracy (12).

5. Conclusions:

Firstly: Findings

1. Mammography vs. Histology Findings:

- Mammography demonstrated relatively high sensitivity in detecting positive cases compared to histological findings, with most positive cases correctly identified. Specificity was not explicitly calculated but appeared high, as evidenced by accurately identifying negative instances. However, there were false-positive and false-negative results, suggesting potential areas for improvement in mammography screening accuracy.

2. Ultrasound vs. Histology Findings:
- Ultrasound screening showed good sensitivity in detecting positive cases, with a a significant proportion of positive cases were correctly identified based on histological evidence. Despite the relatively lower specificity, ultrasound screening demonstrated utility in detecting breast abnormalities, particularly in identifying suspicious lesions that warrant further evaluation.

3. Related age:
The analysis of investigation results, including histopathology, mammogram, and ultrasound findings, about age groups revealed significant associations between age and detecting malignant breast lesions. Specifically, the study found that the likelihood of detecting malignancy was significantly higher in patients aged 50 years and above than those below 50 years across mammogram results. However, no significant association was observed between age groups and ultrasound findings. These findings highlight the importance of age as a significant factor influencing the detection of breast cancer through mammography. Younger patients (<50 years) had a lower likelihood of malignancy detection on mammograms compared to older patients (≥50 years), indicating potential differences in disease prevalence or imaging sensitivity between age groups.

Secondly: Recommendations:

1. Quality Improvement Measures:

Enhance the accuracy of mammography and ultrasound screening through regular review of protocols, ongoing training for radiologists and sonographers, and calibration of imaging equipment.

2. Integration of Modalities:

Consider the complementary roles of mammography and ultrasound in breast cancer screening, recognizing that each modality has its strengths and limitations.

3. Patient-Centered Care:

- Prioritize patient education and informed decision-making regarding the benefits and limitations of mammography and ultrasound screening.
- Provide comprehensive counseling and support services to individuals undergoing breast cancer screening, addressing concerns, and facilitating follow-up care as needed.

4. Research and Innovation:

- Invest in research to develop advanced imaging techniques and technologies for both mammography and ultrasound screening, with a focus on improving sensitivity, specificity, and overall diagnostic performance.
- Explore the potential of emerging technologies such as tomosynthesis and elastography to augment existing screening modalities and further enhance breast cancer detection rates. Also, healthcare providers should consider incorporating age-specific screening guidelines for breast cancer detection, particularly emphasizing the importance of mammography screening for women aged 50 years and above. Regular screening mammograms should be encouraged for early detection and improved outcomes in thisn age group.

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