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## Comparative Efficacy of Triple Assessment (Clinical, FNAC, and Mammography) in Breast Lump Diagnosis

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### ABSTRACT

**Introduction:** Breast cancer is the most prevalent malignancy and the leading cause of cancer-related mortality among women worldwide. A palpable breast lump is a common clinical manifestation associated with both benign and malignant breast pathologies. Differentiating between benign and malignant breast lesions is crucial for appropriate patient management and treatment planning. Currently, the Breast Imaging-Reporting and Data System (BI-RADS) and Fine Needle Aspiration Cytology (FNAC) are utilized as initial diagnostic modalities for breast masses. **Objective:** To evaluate the diagnostic accuracy of Fine Needle Aspiration Cytology (FNAC) and Mammography in detecting malignant breast lesions in patients presenting with palpable breast lumps, using histopathology as the gold standard. **Methodology:** This cross-sectional validation study was conducted in the Department of Histopathology, Holy Family Hospital, Rawalpindi, from October 30, 2021, to April 29, 2022. A total of 105 female patients presenting with palpable breast lumps were included in the study. Baseline demographic and socioeconomic data, including age, residential status, and socioeconomic background, were recorded. FNAC samples were obtained and processed in the Department of Histopathology for cytological assessment. The diagnosis of malignancy was established based on cytological and histopathological findings. Additionally, breast ultrasound was performed by an expert sonologist in the Department of Radiology to determine the BI-RADS score. The diagnostic outcomes of FNAC, BI-RADS, and histopathology were documented for each patient. **Results:** The mean age of the study participants was  $41.04 \pm 11.00$  years. Among them, 46 (43.81%) patients resided in rural areas, while 59 (56.19%) were from urban areas. Malignancy was detected in 42 (40.00%) cases using FNAC, whereas BI-RADS classified 44 (41.90%) cases as malignant. When evaluated against histopathology as the reference standard, BI-RADS demonstrated a sensitivity of 86.0%, specificity of 88.7%, positive predictive value (PPV) of 84.1%, and negative predictive value (NPV) of 90.2%. In comparison, FNAC exhibited a sensitivity of 93.0%, specificity of 96.8%, PPV of 95.2%, and NPV of 95.2%. **Conclusion:** The findings of this study indicate that both BI-RADS and FNAC are highly accurate and reliable diagnostic modalities for the evaluation of palpable breast lumps, with FNAC demonstrating superior diagnostic precision but the gold standard remains histopathological assessment.

**KEYWORDS:** Fine Needle Aspiration Cytology (FNAC), Mammography, Malignant Breast Lesions, Palpable Breast Lump, BI-RADS Scoring, Histopathology.

## INTRODUCTION

Breast cancer continues to be the most prevalent malignancy among women and the leading cause of cancer-related mortality worldwide [1]. Its burden is particularly pronounced in South Asia, with Pakistan exhibiting the highest incidence rate. Alarming, young women in Pakistan often present with advanced-stage breast cancer, which significantly worsens their prognosis [2]. Epidemiological data highlight that approximately one in nine Pakistani women is at risk of developing breast cancer in her lifetime, underscoring the urgent need for early and accurate diagnostic interventions [3,4]. The presence of a palpable breast lump is one of the most common clinical presentations of both benign and malignant breast lesions [5]. The ability to distinguish between these two categories is critical for timely management and improved patient outcomes. A comprehensive diagnostic approach involves a detailed clinical history, thorough physical examination, imaging modalities, and cytological or histopathological evaluation. While histopathology remains the gold standard for definitive diagnosis, routine excision of all breast lumps is neither feasible nor justifiable, given that approximately 80% of these lumps are benign [6,7]. Consequently, less invasive yet highly accurate diagnostic techniques are needed to guide clinical decision-making.

Among the various diagnostic modalities available, sonomammography is widely used for breast cancer screening due to its cost-effectiveness and accessibility. The American College of Radiology introduced the Breast Imaging Reporting and Data System (BI-RADS) to standardize mammographic reporting and enhance diagnostic reliability. BI-RADS classifies breast lesions into different categories based on imaging characteristics, aiding clinicians in risk stratification and decision-making. Fine Needle Aspiration Cytology (FNAC) is another commonly employed diagnostic tool that offers a minimally invasive approach to evaluating breast lesions. FNAC provides rapid results, is cost-effective, and reduces the need for unnecessary biopsies [8]. However, its diagnostic accuracy must be critically assessed to determine its reliability in comparison to other modalities. Several studies have evaluated the diagnostic accuracy of FNAC and BI-RADS, highlighting their potential in breast cancer detection. Pandia et al. reported BI-RADS sensitivity and specificity of 88.57% and 82.46%, respectively, while FNAC demonstrated 100% sensitivity and specificity. Their study identified malignant lesions in 38% of the

participants [9]. Conversely, Sankaye et al. documented FNAC sensitivity and specificity of 88.37% and 96.42%, respectively. Xiao et al. reported BI-RADS sensitivity and specificity of 77.9% and 88.9%, with malignant lesions detected in 55.53% of patients. These variations underscore the need for further research to determine which modality provides the most accurate and reliable results in breast cancer diagnosis [10,11].

### **OBJECTIVES OF THE STUDY:**

This study aims to assess the diagnostic accuracy of Fine Needle Aspiration Cytology (FNAC) and mammography, based on the BI-RADS scoring system, in identifying malignant breast lesions using histopathology as the gold standard. By evaluating the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of FNAC, this study will determine its reliability as a diagnostic tool for breast cancer detection. Additionally, the study seeks to analyze the diagnostic accuracy of BI-RADS in classifying breast masses and predicting malignancy. A direct comparison between FNAC and BI-RADS will be conducted to establish the most accurate and efficient diagnostic modality for breast cancer. Furthermore, this study will explore the potential advantages of a combined diagnostic approach incorporating FNAC and BI-RADS to enhance overall diagnostic precision while minimizing the need for invasive histopathological biopsies. Ultimately, the findings will provide evidence-based recommendations for optimizing breast cancer diagnostic protocols, thereby improving early detection and clinical management strategies.

### **SIGNIFICANCE OF THE STUDY:**

This study holds significant implications for refining breast cancer diagnostic strategies. Both FNAC and BI-RADS are minimally invasive, cost-effective, and widely accessible techniques. By determining the superior modality, this research aims to streamline breast lump evaluation, thereby optimizing resource utilization and improving early detection rates. The ability to accurately diagnose malignant lesions with minimal invasiveness can reduce patient morbidity, alleviate psychological distress, and facilitate timely treatment interventions. Additionally, the findings of this study may provide insights into the feasibility of a combined diagnostic approach, leveraging the strengths of both FNAC and BI-RADS to achieve superior diagnostic precision. Such an approach could be particularly valuable in resource-constrained settings where access to advanced diagnostic tools is limited. By establishing a standardized and evidence-based protocol for breast

lump assessment, this study aims to enhance diagnostic precision, reduce the burden of unnecessary biopsies, and contribute to the ongoing efforts to improve breast cancer screening and management worldwide.

## **METHODOLOGY**

This cross-sectional validation study was conducted in the Department of Histopathology at Holy Family Hospital, Rawalpindi, over a duration of six months following the approval of the synopsis. The study included a total of 105 patients, and the sample size was determined using a sample size calculator specifically for sensitivity and specificity studies. The estimation was based on the frequency of malignancy in patients presenting with breast lumps at 38%, with the sensitivity of BI-RADS reported at 88.57% and specificity at 82.46%, while maintaining a desired precision level of 10%. The sampling technique employed was non-probability consecutive sampling.

The study population included patients presenting with a palpable breast lump, aged between 25 to 65 years. However, lactating mothers, pregnant women, and patients with a prior history of chemotherapy or radiotherapy were excluded from the study. Following approval from the Institutional Research Forum of Rawalpindi Medical University and the Research Evaluation Unit (REU) of the College of Physicians and Surgeons Pakistan (CPSP), data collection commenced. Patients referred to the Department of Histopathology with a diagnosis of a breast lump and meeting the inclusion criteria were recruited. Prior to participation, written informed consent was obtained from each patient after a detailed explanation of the study objectives. Baseline demographic data, including age, living area, and socioeconomic status, were collected for each patient.

Fine Needle Aspiration Cytology (FNAC) samples were obtained and processed in the Department of Histopathology. The procedure was performed using a 23-gauge needle and a 5mL disposable syringe. The aspirated material was prepared into smears, which were wet-fixed in 95% alcohol and subsequently stained using Hematoxylin & Eosin (H&E). The remaining aspirated material in the syringe was rinsed in normal saline and subjected to centrifugation. A clot was formed by adding an equal quantity of human plasma and thromboplastin suspension to the sediment containing the majority of the cellular material. The clot was then fixed in 10% formalin, processed, embedded in paraffin wax, and sectioned at a thickness of 3–5 micrometers for histopathological examination. Routine H&E staining was performed, and the diagnosis of

malignancy was confirmed based on cytological and histopathological criteria as per the operational definitions.

Ultrasound examinations of breast masses were conducted by an expert sonologist in the Department of Radiology. The imaging analysis included key diagnostic features: shape (round/oval or irregular), margins (circumscribed or non-circumscribed), width-to-anteroposterior (AP) ratio ( $\geq 1.4$  or  $< 1.4$ ), and echogenicity (hyperechoic, isoechoic, or hypoechoic). Based on these parameters, the BI-RADS score was assigned to each lesion. The diagnosis of malignancy based on FNAC, BI-RADS, and histopathological findings was documented for each patient, and all relevant study data were recorded on a pre-designed proforma.

For data analysis, SPSS version 23.0 was utilized. Quantitative variables such as age were reported using mean and standard deviation, while qualitative variables, including living area, socioeconomic status, and malignancy diagnosis through BI-RADS, FNAC, and histopathology, were expressed as frequencies and percentages. A  $2 \times 2$  contingency table was constructed to evaluate the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of BI-RADS and FNAC, using histopathology as the gold standard. To address potential confounding variables, effect modifiers such as age, living area, and socioeconomic status were controlled through stratification, and post-stratification diagnostic accuracy analysis was performed.

Sensitivity was calculated using the formula:  $\text{Sensitivity} = \text{TP} / (\text{TP} + \text{FN}) \times 100$ . Specificity was determined using the formula:  $\text{Specificity} = \text{TN} / (\text{TN} + \text{FP}) \times 100$ . The positive predictive value (PPV) was computed as  $\text{PPV} = \text{TP} / (\text{TP} + \text{FP}) \times 100$ , while the negative predictive value (NPV) was obtained using the formula:  $\text{NPV} = \text{TN} / (\text{TN} + \text{FN}) \times 100$ . A  $2 \times 2$  contingency table was used to compute these diagnostic accuracy measures, categorizing results based on true positive (TP), false negative (FN), false positive (FP), and true negative (TN) values. The findings of this study are expected to contribute to the optimization of breast cancer diagnostic protocols by evaluating the comparative effectiveness of FNAC and BI-RADS in identifying malignant breast lesions.

Malignancy on Histopathology	Malignancy on BI-RADS or FNAC	
	Yes	No
Yes	True Positive (TP)	False Negative (FN)
No	False Positive (FP)	True Negative (TN)

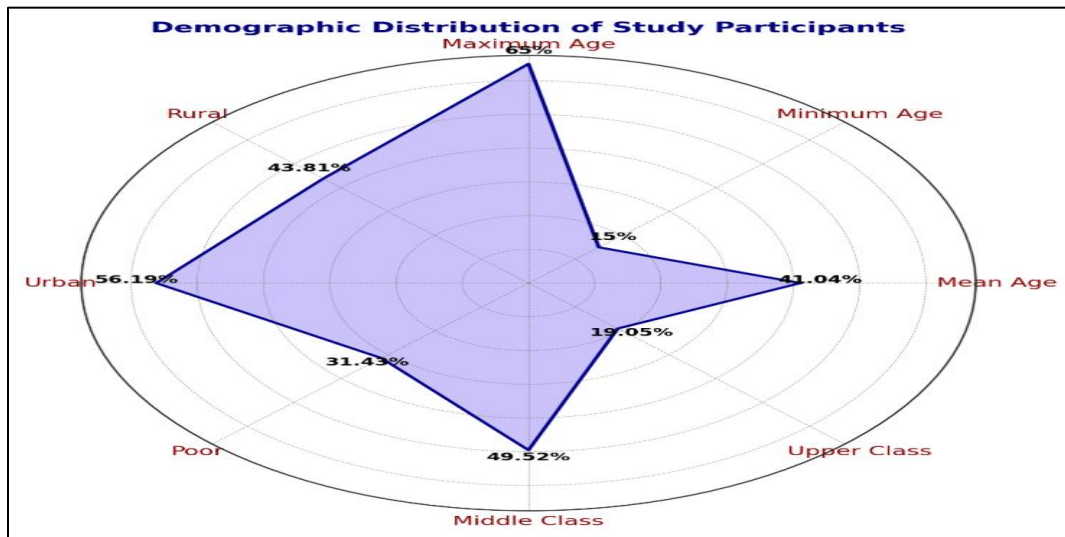
*Table 1: Sensitivity calculation criteria*

**RESULTS & FINDING**

**Sociodemographic Information of Study Participant**

A total of 105 patients were included in this study, with a mean age of  $41.04 \pm 11.00$  years. The age distribution ranged from a minimum of 15 years to a maximum of 65 years, indicating a diverse sample representing different age groups. The demographic analysis revealed that the majority of the study population resided in urban areas, with 59 patients (56.19%), while 46 patients (43.81%) belonged to rural regions. Socioeconomic status classification further demonstrated variability among the participants, with 33 patients (31.43%) categorized as belonging to the poor class, 52 patients (49.52%) from the middle class, and 20 patients (19.05%) from the upper class. This distribution highlights the diverse socioeconomic and geographical backgrounds of the study participants, ensuring a comprehensive representation of different population segments.

Here is the summary of socio demographic information



*Figure 1: Socio Demographic Information*

*Table 2: Socio Demographic Information*

Variable	Value (n=105)
<b>AGE</b>	
Mean Age (Years)	$41.04 \pm 11.00$

Variable	Value (n=105)
<b>AGE</b>	
Minimum Age (Years)	15
Maximum Age (Years)	65
<b>RESIDENCE</b>	
Rural	46 (43.81%)
Urban	59 (56.19%)
<b>SOCIOECONOMIC STATUS</b>	
Poor	33 (31.43%)
Middle Class	52 (49.52%)
Upper Class	20 (19.05%)

### **FNAC Scoring and Malignancy Distribution**

The frequency distribution of Fine Needle Aspiration Cytology (FNAC) scoring among the study participants revealed that C2 category, indicative of benign lesions, was observed in 21 patients (20.00%). The C3 category, representing atypical or indeterminate findings, was recorded in 38 patients (36.19%). The C4 category, suggestive of suspicious malignancy, was identified in 4 patients (3.81%), whereas the C5 category, confirming malignancy, was detected in 42 patients (40.00%). Furthermore, based on FNAC results, malignancy was diagnosed in 42 patients (40.00%), while 63 patients (60.00%) had no malignant findings.

*Table 3: FNAC Scoring and Malignancy Distribution*

FNAC Category	Frequency (n)	Percentage (%)
C2 (Benign)	21	20.00%
C3 (Atypical/Indeterminate)	38	36.19%
C4 (Suspicious Malignancy)	4	3.81%
C5 (Malignant)	42	40.00%
<b>Total</b>	<b>105</b>	<b>100.00%</b>
Malignancy on FNAC		
Malignant (C5)	42	40.00%
Non-Malignant (C2, C3, C4)	63	60.00%
<b>Total</b>	<b>105</b>	<b>100.00%</b>

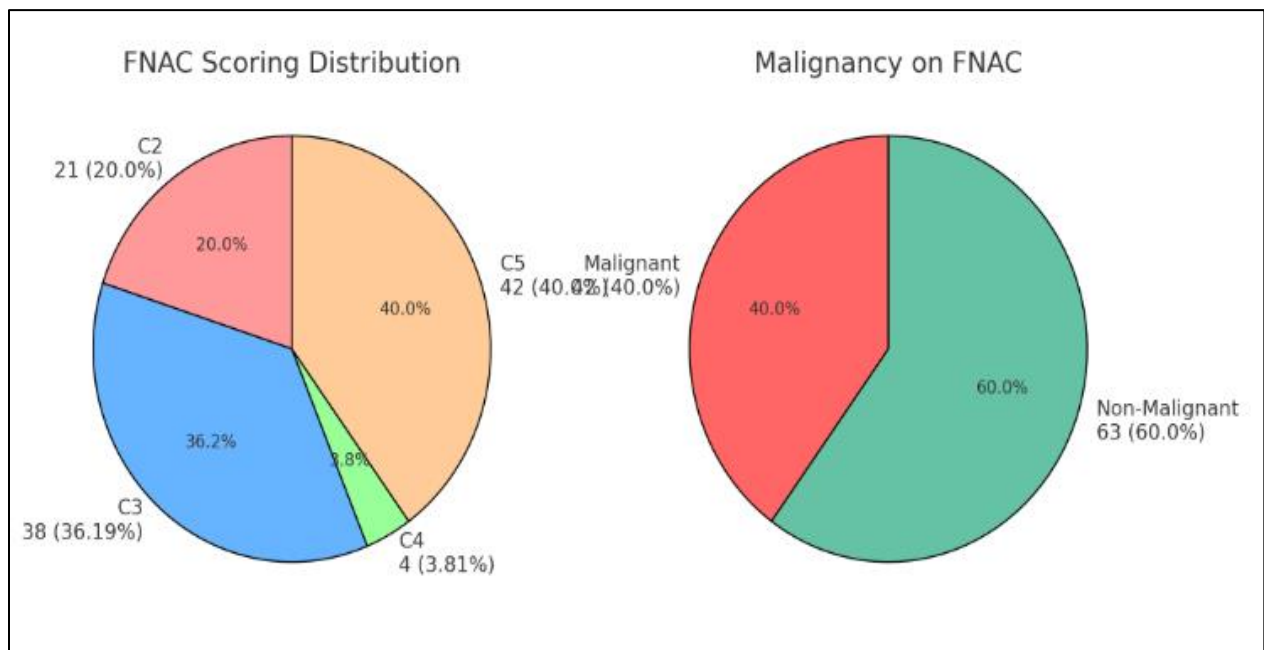


Figure 2: FNAC Scoring and Malignancy Distribution

**Ultrasonographic Findings Based on BI-RADS Classification**

In the ultrasonographic evaluation, patients were classified based on the Breast Imaging-Reporting and Data System (BI-RADS) scoring system. The distribution of BI-RADS categories among the study population is as follows:

- ✓ **BI-RADS I** was observed in 1 patient (0.95%), indicating a negative finding with no abnormality.
- ✓ **BI-RADS II** was reported in 33 patients (31.43%), suggesting benign findings.
- ✓ **BI-RADS III** was noted in 27 patients (25.71%), indicating a probably benign lesion requiring follow-up.
- ✓ **BI-RADS IV** was found in 6 patients (5.71%), representing suspicious abnormalities that necessitate further investigation.
- ✓ **BI-RADS V** was detected in 21 patients (20.00%), indicating a high probability of malignancy.
- ✓ **BI-RADS VI** was identified in 17 patients (16.19%), confirming a known malignancy.

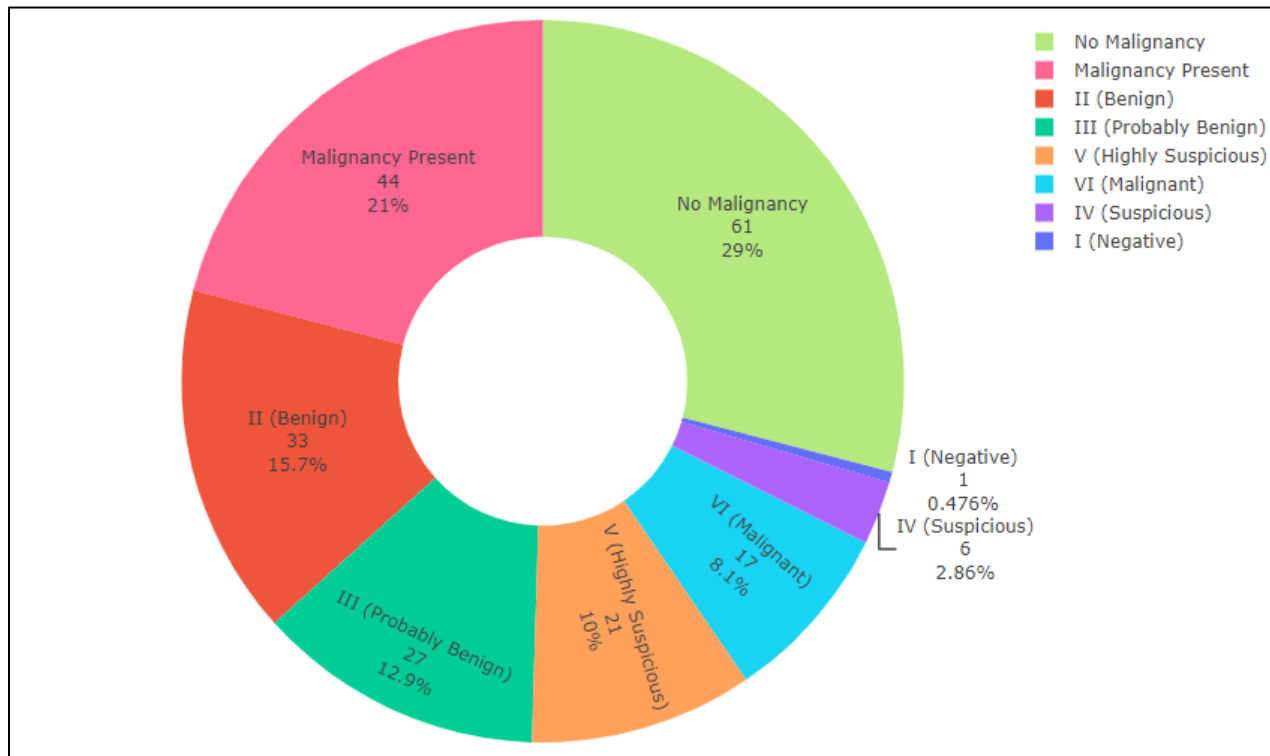
*Table 4: Ultrasonographic Findings Based on BI-RADS Classification*

BI-RADS Category	Description	Number of Patients (n)	Percentage (%)	Malignancy Status
I	Negative (No abnormality)	1	0.95%	Not Applicable
II	Benign findings	33	31.43%	Not Malignant
III	Probably benign (Requires follow-up)	27	25.71%	Not Malignant
IV	Suspicious abnormality (Biopsy may be needed)	6	5.71%	Malignancy Possible
V	Highly suggestive of malignancy	21	20.00%	Likely Malignant
VI	Known biopsy-proven malignancy	17	16.19%	Confirmed Malignant
<b>Total</b>		<b>105</b>	<b>100%</b>	-

Furthermore, the presence of malignancy based on BI-RADS classification was analyzed. The findings showed that 44 patients (41.90%) were diagnosed with malignancy, whereas 61 patients (58.10%) did not present any malignant findings. These results highlight the distribution of BI-RADS scores among the patients and underscore the prevalence of malignancy as detected through ultrasonography. The following tables summarize these findings:

**Table 4: Frequency of Malignancy Based on BI-RADS Classification**

Malignancy Status	Number of Patients (n)	Percentage (%)
Malignancy Present	44	41.90%
No Malignancy	61	58.10%
<b>Total</b>	<b>105</b>	<b>100%</b>



**Figure 3: Ultrasonographic Findings Based on BI-RADS Classification**

### Evaluation of Diagnostic Accuracy of BI-RADS and FNAC

The diagnostic accuracy of BI-RADS in detecting malignant lesions was assessed using histopathology as the gold standard. The findings revealed that BI-RADS demonstrated a sensitivity of 86.0% and a specificity of 88.7%. Additionally, the positive predictive value (PPV) was calculated as 84.1%, while the negative predictive value (NPV) was 90.2%.

On the other hand, Fine Needle Aspiration Cytology (FNAC) exhibited superior diagnostic performance. It achieved a sensitivity of 93.0% and a specificity of 96.8%. The PPV and NPV for FNAC were both recorded at 95.2%, indicating its higher reliability in detecting malignant lesions compared to BI-RADS.

*Table 5: Comparison of Malignancy on BI-RADS and FNAC with Histopathology*

Criteria	Malignancy on Histopathology	Yes	No	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Malignancy on BI-RADS	Yes	37	07	86.0	88.7	84.1	90.2
	No	06	55				
Malignancy on FNAC	Yes	40	02	93.0	96.8	95.2	95.2
	No	03	60				

### Stratification of Age and Living Area in Malignancy Detection Using BI-RADS and FNAC

To assess the diagnostic performance of BI-RADS and Fine Needle Aspiration Cytology (FNAC), stratification was performed based on age and living area, using histopathology as the gold standard.

#### ✓ Stratification by Age

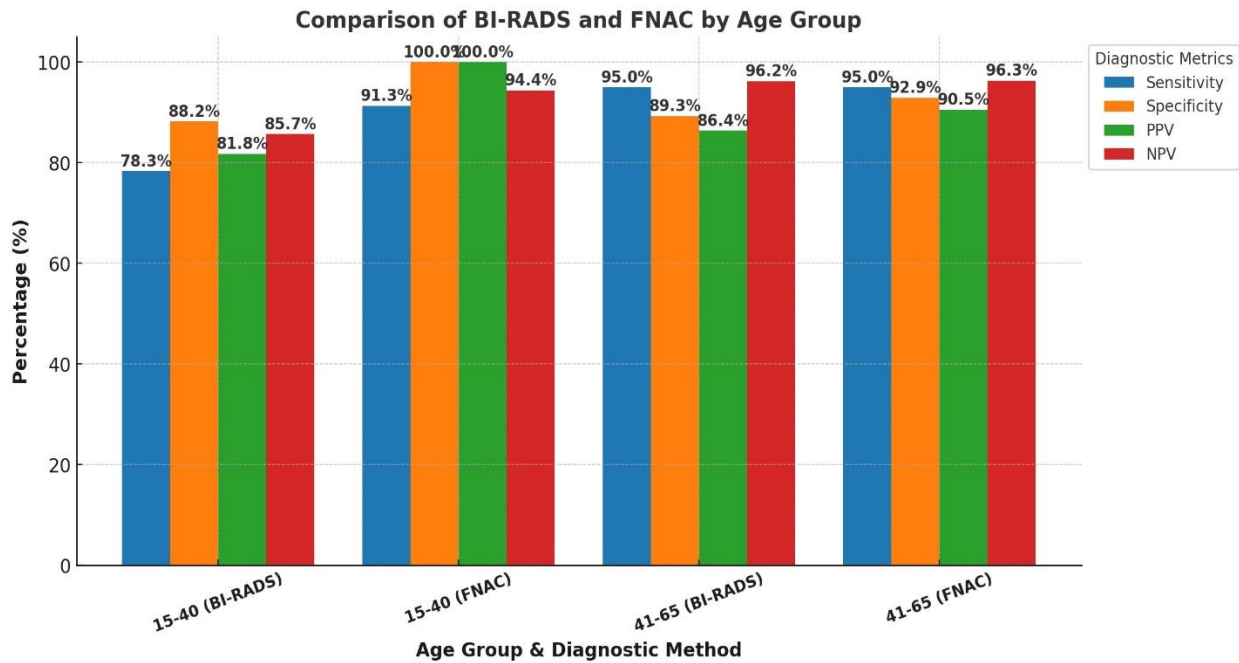
Among patients aged 15–40 years, BI-RADS demonstrated a sensitivity of 78.3% and a specificity of 88.2%, with a positive predictive value (PPV) of 81.8% and a negative

predictive value (NPV) of 85.7%. FNAC, however, showed superior diagnostic accuracy in this age group, achieving a sensitivity of 91.3% and a specificity of 100%, along with a 100% PPV and an NPV of 94.4%.

In the 41–65 years age group, BI-RADS exhibited improved performance, with a sensitivity of 95.0% and a specificity of 89.3%. The PPV and NPV were 86.4% and 96.2%, respectively. FNAC maintained high diagnostic accuracy in this age group as well, recording a sensitivity of 95.0%, specificity of 92.9%, PPV of 90.5%, and NPV of 96.3%.

**Table 6: Diagnostic Accuracy of BI-RADS and FNAC by Age Group**

Age Group (Years)	Diagnostic Method	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
15–40	BI-RADS	78.3	88.2	81.8	85.7
	FNAC	91.3	100.0	100.0	94.4
41–65	BI-RADS	95.0	89.3	86.4	96.2
	FNAC	95.0	92.9	90.5	96.3



**Table 4: Diagnostic Accuracy of BI-RADS and FNAC by Age Group**

### ✓ Stratification by Living Area

When stratified by living area, differences in diagnostic accuracy were observed. Among patients from rural areas, BI-RADS had a sensitivity of 85.7%, specificity of 92.0%, PPV of 90.0%, and NPV of 88.5%. FNAC performed better in this group, with a sensitivity of 95.2%, specificity of 96.0%, PPV of 95.2%, and NPV of 96.0%.

In urban areas, BI-RADS showed a sensitivity of 86.4% and a specificity of 86.5%, with a PPV of 79.2% and an NPV of 91.4%. FNAC remained highly effective, demonstrating a sensitivity of 90.9%, specificity of 97.3%, PPV of 95.2%, and NPV of 94.7%.

*Table 7: Diagnostic Accuracy of BI-RADS and FNAC by Living Area*

Living Area	Diagnostic Method	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Rural	BI-RADS	85.7	92.0	90.0	88.5
	FNAC	95.2	96.0	95.2	96.0
Urban	BI-RADS	86.4	86.5	79.2	91.4
	FNAC	90.9	97.3	95.2	94.7

## DISCUSSION

Breast cancer remains one of the most prevalent malignancies affecting women globally, necessitating precise diagnostic modalities for early detection and management. Fine Needle Aspiration Cytology (FNAC) has been well established as a highly accurate and minimally invasive method for evaluating breast lumps. The utilization of FNAC for diagnosing palpable breast masses was first introduced by Martin and Ellis in 1930, and since then, it has become an essential diagnostic tool [12]. Additionally, ultrasonography (USG) serves as a valuable adjunct to FNAC, particularly in the assessment of dense breast tissue where mammographic sensitivity is limited. The present study aimed to determine the diagnostic value of FNAC and ultrasonography

in breast carcinoma detection and to compare their results with histopathological diagnoses to assess their accuracy [13].

Ultrasonography, when integrated with clinical evaluation and imaging techniques such as diagnostic mammography for symptomatic cases or screening mammography for asymptomatic patients, enhances the detection of malignancies that might otherwise remain undetected, particularly in glandular breasts. Literature data suggest that tumor orientation serves as one of the most objective ultrasound descriptors, with horizontal orientation being indicative of benign lesions and vertical orientation being more characteristic of malignant ones [14,15]. Conversely, the assessment of lesion contour and echogenicity presents greater variability among examiners, with well-defined contours typically associated with benign pathology, while poorly defined margins suggest malignancy. Hyperechoic and anechoic lesions are more commonly benign, whereas hypoechoic, isoechoic, and complex lesions are more suspicious for malignancy. Additional factors such as lesion shape, surrounding tissue involvement, and posterior acoustic phenomena contribute to the overall sonographic assessment [16].

The findings of this study are consistent with previously reported data on the diagnostic performance of FNAC and ultrasonography. Rahman et al. demonstrated a sensitivity of 82.76%, specificity of 90.36%, positive predictive value (PPV) of 75%, negative predictive value (NPV) of 93.75%, and overall accuracy of 88.39% for ultrasonography. In comparison, FNAC exhibited superior diagnostic performance with 97.22% sensitivity, 99.46% specificity, 97.22% PPV, 99.46% NPV, and 99.09% accuracy [17]. Similarly, Shrestha et al. reported a sensitivity of 78.9% and specificity of 95% in distinguishing benign from malignant breast lesions using the BIRADS classification system [18]. The study by Shumaila et al. indicated that mammography identified malignancy in 90% of cases, whereas sonomammography was positive in 93% of cases [19]. Stavros et al. further supported the role of ultrasonography in differentiating benign from malignant lesions, reporting a negative predictive value of 99.5%, specificity of 67.8%, and an overall accuracy of 72.9% [20].

In a large-scale study conducted by Emine D et al. on 546 breast lesions with histopathological correlation, the sensitivity and specificity of sonomammography were reported to be 72.6% and 88.5%, respectively [21]. Our study yielded comparable findings, with sonomammography

demonstrating a sensitivity of 86.0%, specificity of 88.7%, PPV of 84.1%, and NPV of 90.2% in distinguishing benign from malignant masses using the BIRADS lexicon.

FNAC has long been regarded as an effective and reliable diagnostic tool for breast lump evaluation, offering high accuracy while minimizing the need for more invasive procedures [22]. Its application not only reduces patient anxiety but also prevents unnecessary surgical interventions and minimizes diagnostic delays. FNAC is a relatively safe procedure with minimal complications, making it a widely accepted diagnostic modality. The present study found FNAC to have a diagnostic accuracy of 93%, sensitivity of 96.8%, PPV of 95.2%, and NPV of 95.2%. These findings align with those of Qin et al., who reported a sensitivity of 97.1% and specificity of 97.3% for FNAC in diagnosing breast lesions [23]. Likewise, Tiwari M observed similar results, reporting an 83.3% sensitivity and 100% specificity [24]. The study conducted by Bukhari et al. further corroborates these findings, with FNAC demonstrating a sensitivity of 98%, specificity of 100%, overall accuracy of 98%, NPV of 100%, and PPV of 97% [25].

Beyond its diagnostic utility, FNAC plays a crucial role in the prognostication of breast tumors by providing information on nuclear grading, mitotic index, hormone receptor status, and DNA content, thereby aiding in treatment planning. Although FNAC offers high diagnostic accuracy, histopathological examination remains indispensable in cases of diagnostic uncertainty or when further characterization of tumor invasiveness and histological subtyping is required [26]. In the present study, histopathological diagnosis was employed as the gold standard for validating FNAC and ultrasonographic findings. Histopathology is internationally recognized as a valid and reproducible diagnostic reference standard, ensuring the reliability of the study outcomes [27].

The findings of this study reaffirm the high diagnostic accuracy of FNAC and ultrasonography in the evaluation of breast lesions. FNAC remains an invaluable tool in breast cancer diagnostics, facilitating early detection and effective treatment planning. Ultrasonography, particularly when used in conjunction with FNAC, enhances diagnostic confidence and reduces unnecessary invasive procedures. While FNAC offers high sensitivity and specificity, histopathological examination should be considered in cases requiring definitive confirmation of tumor invasiveness or histological classification [28]. By integrating FNAC, ultrasonography, and histopathological evaluation, a comprehensive and accurate diagnostic approach to breast lesions can be achieved, ultimately improving patient outcomes.

## CONCLUSION & FUTURE RECOMMENDATION

Breast cancer remains one of the most prevalent malignancies affecting women globally, necessitating precise diagnostic modalities for early detection and management. Fine Needle Aspiration Cytology (FNAC) and ultrasonography (USG) have proven to be highly valuable in the evaluation of breast lumps, offering high sensitivity and specificity. FNAC, a minimally invasive procedure, has demonstrated excellent diagnostic accuracy, reducing patient anxiety and unnecessary surgical interventions. Ultrasonography serves as a complementary imaging modality, particularly useful in dense breast tissue where mammography has limitations. This study reaffirmed the high diagnostic accuracy of FNAC and ultrasonography in detecting breast malignancies. Our findings align with previous studies, with FNAC exhibiting superior sensitivity and specificity, while ultrasonography provided additional diagnostic confidence in lesion characterization. The integration of FNAC and ultrasonography enhance the histopathological evaluation diagnostic precision, ultimately improving patient outcomes.

Future research should focus on advancing imaging technologies, incorporating artificial intelligence-driven diagnostic models, and exploring novel biomarkers for early breast cancer detection. Larger multicenter studies are needed to validate the effectiveness of FNAC and ultrasonography across diverse populations. Additionally, integrating molecular and genetic profiling in FNAC samples could contribute to personalized treatment strategies. Continued innovations in breast cancer diagnostics will facilitate earlier detection, reduce patient morbidity, and improve overall clinical management.

## CONFLICT OF INTEREST

The authors declare no conflict of interest related to this study.

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