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# Consistency of Sonographic Patterns and Pathologic Results in The Diagnosis of Breast Mass and The Associated Factors Among Adult Female Patients Who Visits Radiology Department in Tibebe Ghion Specialized Hospital, Bahir Dar, Ethiopia

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BAHIRDAR UNIVERSITY COLLEGE OF MEDICINE AND HEALTH SCIENCES DEPARTMENT OF Clinical Radiology

# Consistency of Sonographic Patterns and Pathologic Results in The Diagnosis of Breast Mass and The Associated Factors Among Adult Female Patients Who Visits Radiology Department in Tibebe Ghion Specialized Hospital, Bahir Dar, Ethiopia

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**(MD, RADIOLOGY RESIDENT)**

THESIS REPORT SUBMITTED TO DEPARTMENT OF RADIOLOGY COLLEGE OF MEDICINE AND HEALTH SCIENCE BAHIRDAR UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE SPECIALITY CERTIFICATE IN CLINICAL RADIOLOGY

AUG, 2022

BAHIRDAR, ETHIOPIA

# BAHIRDAR UNIVERSITY COLLEGE OF MEDICINE AND HEALTH SCIENCES DEPARTMENT OF CLINICAL RADIOLOGY

## CONSISTENCY OF SONOGRAPHIC PATTERNS AND PATHOLOGIC RESULTS IN THE DIAGNOSIS OF BREAST MASS AND THE ASSOCIATED FACTORS AMONG ADULT FEMALE PATIENTS WHO VISITS RADIOLOGY DEPARTMENT IN TIBEBE GHION SPECIALIZED HOSPITAL, BAHIR DAR, ETHIOPIA

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SEP, 2022 G.C

BAHIR DAR, ETHIOPIA

## Assurance of Investigator

I the undersigned resident agreed to accept all responsibilities for the scientific and ethical conduct of the research project. I will provide timely progress report to my advisors and seek the necessary advice and approval from my advisors in the course of the research. I will also communicate timely to my advisors and all stakeholders involved in the study.

Name of the Resident: Dr. Melkamu Siraw (MD, Radiology Resident)

Signature: .....

Date: 30/02/15 E.C

**Approval of Advisors**

Name of Advisors:

Dr.Meseret Ahunem (MD, Assistant professor of Radiology)

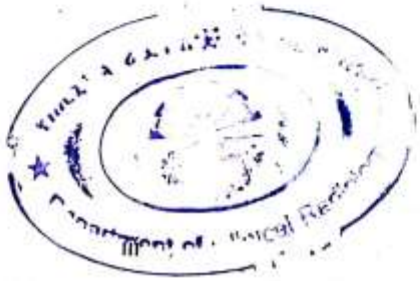
Signature ----------

Date.....30/02/15 E.C

Dr.Yeshalem Mulugeta (MPH, PhD, Associate Professor in Nutrition)

Signature----------

Date.....



# ACKNOWLEDGMENTS

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# Contents

## List of Abbreviations

ACR……American College of Radiology

BI RADs…….Breast Imaging Reporting And Data System

DCIS…… Ductal Carcinoma In Situ

FNAC……..Fine Needle Aspiration Cytology

NPV…….Negative Predictive Value

PPV…….Positive Predictive Value

TGSH…….Tibebe Ghion Specialized Hospital

US……Ultrasound

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# Abstract

**Background:** Breast mass is a common surgical problem. Such masses pose a potential threat to women especially in the era of increased cases of breast cancer worldwide. Early detection is required to decrease breast cancer related deaths. The role of ultrasound imaging is differentiating malignant and benign breast masses with intention of guiding patient management. The effective diagnosis and management of breast mass involves multidisciplinary approach to their assessment. Ultrasonography is an excellent modality, especially in patients with dense breasts. The precision of the final diagnosis can be greatly increased by ultrasound imaging and pathological diagnosis which is gold standard in confirming the diagnosis. Accurate radiologic and histopathology diagnosis is crucial in deciding the type of management a patient should undergo and to ensure a good prognosis.

**Objective:** To assess consistency of sonographic patterns and pathologic results in the diagnosis of breast mass and the associated factors among adult female patients in Tibebe Ghion Specialized Hospital, Bahir Dar, Ethiopia, 2022 G.C

**Methods and materials:** Institutional based prospective cross sectional study was conducted on 250 patients with clinical breast mass and who had ultrasound evaluation from MAR /2022 to AUG/2022, at Tibebe Ghion specialized Hospital, Bahir Dar, Ethiopia. Systematic random sampling technique was used to select to select the study participants. Structured questionnaires and check lists were used to record the sociodemographic information, the clinical information, ultrasound findings and pathologic findings. Data were entered using EpiData software and analyzed using SPSS version 26. The association between the dependent and independent variables was assessed using bivariate and multivariate logistic regression analysis. In bivariate logistic regression variables with p-value less than 0.25 were selected for multivariable analysis and in multivariate logistic regression analysis variables with P-Value less than 0.05 were considered as statistically significant.

**Results:** Out of 250 patients, 232(92.4%) patients had consistent breast ultrasound and FNAC result; and only 18(7.6%) had inconsistent result.

The sensitivity, specificity and accuracy of ultrasound in diagnosing breast cancer were 90.1%, 94.7% and 93.2% respectively. We found a PPV of 89% and a NPV of 95.2%. Strong level of agreement was found between USG and FNAC diagnosis with kappa value0.845 (95%CI).

On the multivariate logistic regression analysis, patients with young age (<35 years) [AOR=4.298, (95%CI: 1.711-10.796)] and ultrasounds done by radiologists [AOR =2.674, (95%CI: 1.041 -6.867)] were significantly associated with consistency of breast ultrasound and FNAC results.

Conclusion and recommendation: Ultrasound has high sensitivity and high consistent value with FNAC results in diagnosing breast mass; so it can be considered as the first line investigation for the evaluation of breast lump especially in young women with dense breast.

Key Words: Breast mass, ultrasound, FNAC, sensitivity, specificity

# 1. Introduction

## 1.1 Background

A breast mass is a localized swelling, protuberance, bulge, or bump in the breast that feels different from the breast tissue around it or the breast tissue in the same area of the other breast. It varies in size and texture and may cause pain. Some are not found until a physical or imaging examination[1].

Breast masses are broadly classified as benign or malignant. Although breast cancer is the most feared malignant cause, about 90% breast masses are benign. Common causes of benign breast lesions include fibrocystic disease, fibroadenoma, intraductal papilloma, and abscess. Among these fibrocystic changes and fibroadenomas are most common benign causes. Malignant breast disease encompasses many histologic types that include in situ ductal or lobular carcinoma, infiltrating ductal or lobular carcinoma, and inflammatory carcinoma[2].

The Primary goal of imaging in the evaluation of breast mass is to differentiate malignant and benign lesions. Early diagnosis of breast cancer remains to be pivotal in reducing the number of deaths due to breast cancer. Only clinical breast examination alone is insufficient to differentiate between benign and malignant lesions and hence, imaging is used for evaluation to better delineate the lesions. Currently, ultrasonography is the common diagnostic tests performed to detect breast mass[3].

Ultrasound is helpful in evaluation of dense breast; even small cancers can be picked by ultrasound. It is important to recognize the ultrasound features which help in characterization of breast lesions as it helps in early diagnosis of malignancy and by this unnecessary radiation exposure and invasive procedures can be avoided. Breast Imaging Reporting and Data System (BIRADS) by American college of radiology(ACR) helps in practicing a standardized reporting system all around the world in characterization of breast masses by Sonogram.[4]

Benign and malignant characteristics of breast lesions at ultrasound allow the classification as either malignant, intermediate or benign.[5]

To be classified as benign, one of the following three combinations of benign characteristics had to be demonstrated: Intense uniform hyperechogenicity, wider-than-tall orientation, and 2 or 3

gentle lobulations with a thin echogenic capsule. Typically, a malignant lesion presents as a hypoechoic nodular lesion, which is 'taller than broader' and has spiculated margins, posterior acoustic shadowing and microcalcifications[6]

The Breast Imaging Reporting and Data System(BIRADS) is a classification that was developed by the American College of Radiology to unify the interpretation of breast findings from ultrasound and mammography[7]. These are Category 0: Incomplete — Need Additional Imaging Evaluation, Category 1: Negative, Category 2: Benign, Category 3: Probably Benign, Category 4: Suspicious, Category 5: Highly Suggestive of Malignancy, probability ≥ 95% of malignancy, and Category 6: Known Biopsy-Proven Malignancy.[8]

The investigative modality sequence that yielded high additional prediction leading to high final prediction was breast imaging (either ultrasonography or mammography) followed by Fine Needle Aspiration(FNAC).[9]

FNAC is indicated when a lesion that is not unequivocally benign appears after the age of 30. In women under the age of 30, aspiration cytology is performed when a solid lesion displays rapid growth.[10]. The overall diagnostic accuracy of this test can be improved by a good aspiration technique. Whenever there is discrepancy between clinical examination, breast FNAC and breast ultrasound, breast biopsy is recommended to arrive at a final diagnosis[11].

The cytological examination of breast lesions prior to surgical treatment serves as a rapid, economical, and valuable diagnostic tool. "Fine-needle aspiration (FNA) biopsy is an established and highly accurate method for diagnosing breast lesions"[12].

In general, an accurate correlation of US findings with their corresponding histopathologic features is considered most important in US evaluation in this setting.[13].

## 1.2 Statement of the problem

Breast masses are considered one of the most common disorders in female. It can be benign or malignant. Breast cancer is the most common public health problem and the main cause of cancer-related death worldwide, which account for 24.2% of new cancer cases. More than half of the incidence of breast cancer and 60% of deaths occur in low- and middle-income countries[14]. African countries had the highest age-standardized mortality rate (17.3 deaths per 100,000

annually) associated with breast cancer. In Ethiopia, breast cancer incidence is rising and become the foremost common cancer, causing high rates of morbidity and mortality. The incidence of breast cancer accounts for 15,244 (22.6%) all cases of cancer and 8,159 (17%) cancer mortality annually. According to the Addis Ababa cancer registry, breast cancer incidence increased from 18 to 160 new cases between 2012 and 2018 in Addis Ababa.[15]

Current recommendations vary on how to differentiate breast masses into benign or malignant lump through ultrasound. Reported guidelines show substantial overlap in what defines benign and malignant nodules, and what might be considered benign by one recommendation might be considered malignant by another since US assessment is operator-dependent. Therefore, US performers should continuously compare their readings with confirmed diagnostic results to maintain and improve proficient diagnostic abilities [16]. Current clinical practice in our hospital also varies, some clinicians prefer breast ultrasound as initial investigation modality to start patient management and others prefer FNAC as initial modality.

Although mammography is recognized as the best method of screening for breast cancer, breast sonography is now well-established as a valuable imaging technique, and, while there has been some controversy regarding its utility in evaluating solid breast masses for the likelihood of malignancy but several other studies have also suggested that sonographic appearance can be useful in differentiating malignant from benign solid breast masses[17]

Researches' have been conducted to discover method to detect, analyze, and deal with breast masses in other parts of the world. When it comes to our country, Ethiopia, I didn`t found a single study which asses the overall USG pattern of breast mass in relation with FNAC findings. Thus, studying consistency of sonographic patterns with pathologic results of breast mass provides sensitivity, specificity and diagnostic accuracy of ultrasound in our setting by evaluating the level of diagnostic strength of USG in differentiating benign from malignant breast masses and its degree of agreement with histopathologic findings. Furthermore, it would be used as a basis for further prospective studies.

### 1.3 Significant of the study

Distinguishing malignant from benign breast pathologies and their description based on imaging offers major help in patient management

This study aimed to assess the consistency of ultrasound and pathology diagnosis of breast mass at TGSH there by identifying where the gap is and to give recommendations on how to improve it. Assessing the consistency of ultrasound in relation to the standard FNAC result helps to determine the role of ultrasound in the diagnosis of breast mass.

Although there are numerous published studies done at global level assessing the diagnostic sensitivity, specificity and accuracy of US for benign and malignant breast masses and its pathologic consistency, there are no published reports done locally. Thus, findings from this study give latest information on the sensitivity, specificity and accuracy of ultrasound in differentiating benign and malignant breast masses by comparing with pathological findings. Furthermore, in low resource settings like ours, where further imaging is limited, decision on patient management could be made on USG findings. This study can also prompt those who are interested to conduct further research on this area.

## 2. Literature review

### 2.1 Sonographic pattern of breast mass

Among 110 breast masses evaluated by ultrasonography in Brazil, 69% were benign and 34 /30.9% were malignant. According to the radiologists, the sensitivity ranged from 70.5% to 82.3%, negative predictive value, from 81.1% to 87.5%, positive predictive value, from 42.1% to 45.1%, specificity from 56.58% to 55.2%, and accuracy from 60.9% to 63.6%. The global inter observer agreement was considered as moderate ( $\kappa = 0.50$)[18].

A descriptive cross-sectional study conducted in Shri Sathya Sai Medical College and Research Institute, which included 60 female patients, of age ranging between 20–85 years with history of palpable breast masses referred to the Department of Radio- Diagnosis, out of which 33 cases

(55%) were reported as benign and 19 cases (31.7%) were reported as malignant and 8 cases were reported as indeterminate (can be either benign or malignant) by ultrasound[19].

## 2.2 sonographic pattern and FNAC correlation of breast mass

An institution based prospective cross sectional study from a sample of 80 patients was carried out in India in the Department of Radio diagnosis of Kamineni Institute of medical sciences, Narketpalli hospital. A palpable breast lump alone was the most common presenting complaint. The most common shape of the index lesion was oval. Spiculated margins were only seen in malignant lesions while most of the benign lesions were found to have smooth margins. Post-acoustic enhancement was present in 35.3% of benign masses and 6.9% of malignant lesion. Most common echogenicity was hypoechoic both in malignant and benign lesions. 55.2% of malignant lesions and 3.9% of benign lesions showed micro-calcifications. Most common BI-RADS category noted in this study was type 3. All the 80 cases were subjected to histopathological examination for final diagnosis. Fibro adenoma was the commonest benign lesion (63.8%). Breast carcinoma was seen in 36.2% of patients. All of the papillary breast lesions were diagnosed as intra-ductal papilloma. Most of the tumors found were invasive ductal carcinomas (51.7%) except two that was medullary carcinoma (6.9%). Two mucin secreting adenocarcinoma (6.9%) was found[20].

A prospective, quantitative and descriptive study was conducted in the department of Radiology, Father Muller Medical College Hospital, Mangalore and 158 cases were included in the study. On breast ultrasonography 98 cases of the 158 cases included were diagnosed as benign breast disease (BIRADS I, II and III). 60(38%) cases were diagnosed as suspicious for carcinoma of the breast (BIRADS IV, V). On FNAC 91 cases were diagnosed as benign and 67(42%) cases were diagnosed as malignant. Cytologically there were total of 91 benign cases, fibroadenoma being the commonest, followed by benign proliferative breast disease, fibrocystic disease, duct ectasia, mastitis and least being phylloides[11].

A retrospective study done at Napal tertiary health care center, from July 2016 to March 2017, including 121 patients presenting to the ultrasound department with complaint of palpable breast lump and on sonography, about 46% of the cases were benign, 35 % malignant and 18 %

indeterminate while tissue diagnosis revealed 63% to be benign, 34% malignant. The most common lesions in each group and sonographic characteristics were evaluated. Of the benign lesions, fibroadenoma was the most common. Most of the indeterminate lesions on sonography were histologically mastitis. Nearly 82%of benign lesions had oval shape and circumscribed margins while 78% of malignant masses were irregular in shape. Early 58% of the malignant lesions had microlobulated margins followed by spiculated margins. 50 % of benign lesions showed posterior acoustic shadow while 41.5% of the malignant lesions had significant posterior shadowing. The evaluated sonographic features of benignity or malignancy showed significant correlation with pathological diagnosis (p value<0.001)[21].

A total of 698 patients underwent fine needle aspiration cytology for breast complaints during the study period. Diagnostic outcome was classified into five categories: benign without atypia in 65.5% cases, benign with atypia in0.9%cases,inflammatory lesions in 20.8% cases, suspicious for malignancy in 0.4 % of the cases and malignant in 10.7% cases. The records of the remaining 1.6% cases were deemed to be non-conclusive[22].

## 2.3 Factors affecting the consistency of sonographic patterns and pathologic results of breast mass

According to study conducted in Switzerland sonographer experience is one of a factor affecting the consistency in which ,Mammograms were retrospectively reviewed by one breast radiologist with 5 years' experience. At the radiological review, the radiologist was unaware of the pathological prognostic features of the tumor[23].

A retrospective analysis of a multicenter study was conducted in eight US centers China. The study included 1023 consecutive female patients with 1023 breast lesions. Patients' age and BMI have been associated with breast cancer risk. Thus, growth patterns of lesions, especially benign lesions, vary greatly among different age groups. In the study, 42.5% of benign lesions in patients <35 years were misdiagnosed, compared with only 28.4% in women >35 years. Among patients with fibroadenoma, which accounted for 43.9% of benign lesions, patients <35 years had a misdiagnosis rate of 31.1%, compared with 20.1% in patients >35 years. This phenomenon may be due to the rapid growth of fibroadenoma with active ductal epithelial hyperplasia in young patients[24].

A screening ultrasound and mammography was done in northwestern united state on 622 women on the relation between BMI and breast cancer. Among women with invasive breast cancer, overweight and obese women were more likely to have tumors larger than 15 mm at time of diagnosis compared with underweight or normal weight women (33% vs 28%, *P*=.18)[25].

A total of 326 breast lesions were biopsied at Malaysia. Histology results revealed the presence of 74 breast cancers and 252 benign lesions. USG had a sensitivity of 82%, specificity of 84%, PPV = 60%, NPV = 94% and an accuracy of 84%. MMG had a sensitivity of 49%, specificity of 89%, PPV = 53%, NPV = 88% and an accuracy of 81%. A total of 161 lesions which were imaged with both modalities were analyzed to determine the significance in the differences in sensitivity and specificity between USG and MMG. Sensitivity of USG (75%) was significantly higher than sensitivity of MMG (44%) (X (2)1=6.905, p=0.014). Specificity of Mamography (91%) was significantly higher than specificity of USG (79%) (X(2)1=27.114, p<0.001). Compared with MMG, the sensitivity of USG was 50% (95% CI 10%-90%) higher in women aged less than 50 years (X (2)1=0.000, p=1.000) and 27% (95% CI 19%-36%) higher in women aged 50 years and above (X(2)1=5.866, p=0.015). Compared with Mamography, the sensitivity of USG was 40% (95% CI 10%-70%) higher in women with dense breasts (X(2)1=0.234, p=0.628) and 27% (95% CI 9%-46%) higher in women with non-dense breasts (X(2)1=4.585, p=0.032)[19].

A Retrospective Study was done in south india on the Accuracy of Clinical Examination of Breast Lumps in Detecting Malignancy and Clinical examination was found to have a sensitivity of 94.5 %, and specificity of 87.7 % with kappa 0.817 (95 % CI = 71 % to 92 %) indicating a good agreement between clinical and pathological diagnoses[26].

# 3. Conceptual framework

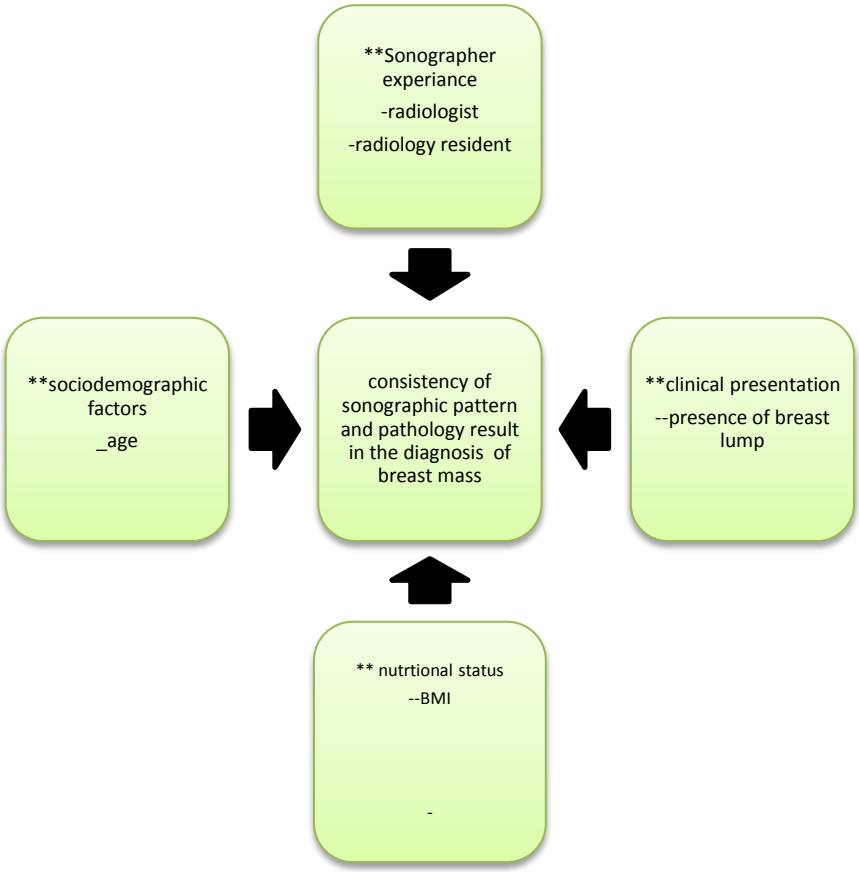


**Figure 1.conceptual frame work [15]**

# 4. Objectives

## 4.1 General objective

- To asses consistency of sonographic patterns and pathologic results in the diagnosis of breast mass and the associated factors among patients with breast mass who visits radiology department at TGSH.

## 4.2 Specific objectives

- ✓ To determine consistency of ultrasound diagnosis of benign and malignant breast masses with pathologic result
- ✓ To identify factors affecting the consistency of sonographic and pathologic results of breast mass

# 5. Methods and Materials

## 5.1 Study area and study period

The study was conducted at Tibebe Ghion Specialized Hospital(TGSH), which is found in Bahir Dar which is the central city of Amhara region and 578km north west from Addis Ababa. The city has 3 sub cities and 16 Kebeles. The total population of the city was 750,991 populations (2016). The city has two referrals, one district hospital, 4 private hospitals, six higher clinics and five health centers owned by government and private sectors. TGSH is teaching university hospital established in 2018 and has more than 350 beds for inpatient management and serving more than 8 million peoples from parts Amhara and Benshangul Gumuz as in patient and outpatient treatment. It is the training center for undergraduate and a wide spectrum of postgraduate. The radiology department has 7 radiologists, 26 residents and 6 radiology technicians. The study was conducted from MAR 2022 to AUG 2022 G.C.

## 5.2 Study design

This was an institutional based cross-sectional study conducted among patients with breast mass having both ultrasound and pathology result.

## 5.3 Source population

All patients who have breast mass clinically and having breast ultrasound at TGSH.

## 5.4 Study population

All patients who have breast mass clinically and having breast ultrasound during the study period.

## 5.5 Inclusion and exclusion criteria

### 5.5.1 Inclusion criteria

All adult female patients clinically diagnosed with a palpable breast lump and who had ultrasound evaluation and FNAC at TGSH.

### 5.5.2 Exclusion criteria

All patients with breast ultrasound for breast abscess and post lumpectomy follow-up

## 5.6 Sample size determination

The sample size was determined by single population proportion with the following assumptions

$$n = \frac{(z_{1-\alpha/2})^2\, p(1-p)}{d^2}$$

- Z(1-α/2)=standard normal variate (at α 5% is 1.96)
- P = the proportion of the target population estimated to have particular characteristics
- d=margin of error

So, using-p value<0.05 (Z1-α/2=1.96)

- P= Earlier study reported the consistency proportion of ultrasound and pathology result 82% [27]
- d=5%

Then n is 227

Then using 10% non-respondent rate

The final sample size was 250

K=N/n~2

K=sampling interval

## 5.7 Sampling procedure

In this study systematic random sampling technique was used to select the study participants. Sampling interval was determined based on patient flow within a month prior to data collection. In the previous month (December) there was an average of 7 patients per day sent to Radiology department in TGSH with clinical diagnosis of breast mass for ultrasound evaluation; our study data collection duration was three months, with these three months we found an average of 504 patients with clinical diagnosis of breast mass who were sent to Radiology department for ultrasound evaluation. In this study k value was 2. The first patient was selected by lottery method from the appointed patients on the start of data collection day and then every other patient was selected until the required sample size achieved.

## 5.8 Variables of the study.

### 5. 8.1. The dependent variables

- Consistency of ultrasound and pathologic result in the diagnosis of breast cancer (Consistent, inconsistent)

### 5.8.2 The independent variables

- Age of the patients
- BMI
- Experience of personnel doing ultrasound
- Clinical presentation: presence or absence of breast lump

## 5.9 Operational definition

**Breast lump/masses:** three-dimensional space-occupying lesions in the breasts

**Pattern of breast mass:** benign or malignant appearance of the mass based on ultrasound and FNAC

**Benign Ultrasound features** include well circumscribed (oval, round), hyper echoic tissue, anechoic, coarse calcification, isoechoic, smooth lobulations, wider than taller shape, and pseudo capsule and coarse calcification.

**Malignant ultrasound features** include speculation, taller-than-wide orientation, angular margins, micro calcifications, microlobulation, hypo echoic nodule, internal color flow and posterior acoustic shadowing

**BI-RADS (the Breast Imaging Reporting and Data System)**: developed by the American College of Radiology, provides a standardized classification for breast ultrasound studies and demonstrates the likelihood of breast malignancy. BI-RAD 4(2-94% risk) and BI-RAD 5(>95% risk) are suspicious for malignancy/malignant appearing. BI-RAD 1, 2 and 3(probably) are benign appearing[5].

**Fine-needle aspiration** (**FNA**) is a diagnostic procedure used to investigate lumps /masses.

**Hypo-echoic;** masses with lower echogenicity when compared with normal breast

**Hyper-echoic**; masses are more echogenic when compared to background breast parenchyma.

**Micro calcification**; calcification without shadowing

**Irregular margins**; micro lobulated or speculated in appearance

**Ill-defined nodules**, the demarcation between the tumor and the surrounding normal breast parenchyma is indistinct

**Consistency of ultrasound and FNAC:** the presence of concordant ultrasound and FNAC result (having same result, either benign or malignant)

## 5.10 Data collection tools and procedures

Data were collected by using pretested checklist. After structured questionnaire was developed based on study objectives and available literature, the hospital allocated radiologic resident or radiologist who assigned to do ultrasound collected the breast ultrasound result, socio-demographic characteristics -age, and place of residents as well as the weight and height which was properly recorded for each patients who were sent to the Radiology department with the clinical diagnosis of breast mass in the study period. Before the examination, an explanation was given to the patient about how the examination was to be done and informed consent was obtained. Every woman had both breasts examined. The patient laid supine, arm raised and placed under the neck to keep the breast firm on to the chest wall and then turned slightly in oblique position to scan the breast. The contra-lateral breast was also scanned in the same way. A high frequency linear probe (7.0 MHz) was used to scan both breasts. Sonographic gel was applied over the skin of the entire breast. The probe was gently applied over the mass and both sagittal and transverse scans were done radially. This procedure was done on both breasts. The Ultrasonography findings was recorded on the Proforma as shown below- • Shape• Margin • Longitudinal axis versus anterior posterior diameter• Posterior Echo Intensity• Echogenicity • Internal Structure Complex, Homogeneous and Heterogeneous • Calcification –Micro/macro calcifications • Color Doppler App of Blood Vessel • Spectral Waveforms - Resistive index. The entire index lesions studied based on sonographic features was categorized according to BIRADS category system. Categories 2 & 3 was taken as benign while 4 & 5 as malignant/suspicious. These patients were then subjected to pathological correlation using FNAC in which sample was taken from the mass using needle aspiration and specific finding was reported by the allocated pathologist. Finally the pathology findings of the patients who had FNAC for the

diagnosis of breast mass were collected and recorded from the pathology department on the day of examination.

### 5.11 Data quality control

For this study, a standardized questionnaire was used and pretesting was carried out on 5 % (10 patients) of the sample population prior to data collection at TGSH radiology department ultrasound room. A few corrections regarding the questionnaire which was not clear, easy to comprehend and needed modifying was changed and altered accordingly. Prior to the data collection period, the data collector was given orientation and pointers on what to do, what to check for when the questionnaire is returned after filing. After the data was collected, it was checked for inconsistency, legibility issues and omission. All the data were complete. The collected data was entered into Epi data 4.6 for cross checking and reentered to secure the quality of data.

### 5.12 Data processing and analysis

The entered data was exported to SPSS version 26.0 for analysis. Descriptive statistics was used to describe the data. During the analysis, frequencies of different variables were determined, followed by cross-tabulation to compare the frequencies. Binary logistic regression was used to assess the association between independent and dependent variables by calculating the ORs and their 95% CIs. In bivariate logistic regression variables with p-value less than 0.25 was selected for multivariable analysis and in multivariate logistic regression analysis variables with P-Value less than 0.05 were considered as statistically significant.

### 5.13 Ethical consideration

Before conducting the study, permission and approval letter from TGSH hospital management and research Ethical Review Committee of Bahir Dar University College of medicine and health science were received. Informed consent were obtained before the imaging. During the data collection procedure, the patient privacy and confidentiality were kept to the maximum.

### 5.14 Dissemination of results

Results of the study will be submitted to the department of radiology of Bahir Dar University as part of dissertation requirement for the postgraduate certificate program and will be presented on a seminar prepared by the research committee for all staff and residents in the department. It will also be submitted for medical journals for possible publication.

## 6. Result

### 6.1. Sociodemographic data

A total of 250 female study participants were studied with response rate of 100%. The median age of the patients was 37 (mean=36.81) with the minimum and maximum age of 15 and 75 years respectively. The majority of the respondents 173(69.1 %) were live in urban area. The majority were 138 (55.2 %) were single and 110 (43.9 %) were married. Majority 228 (91.1 %) of the respondents were Amhara in ethnicity. About 233 (93.5%) were follower of Orthodox Christian religion (Table 1).

From the total 250 patients, 197(78.8%) ultrasound scanning were done by radiology residents and 47(18.8%) were by Radiologist.

**Table 1. Sociodemographic characteristics of the patient and experience of clinician who did ultrasound in TGSH, Amhara region, North west Ethiopia, 2022. (n=250)**

| Variables | | Frequency | Percent (%) |
|---|---|---|---|
| <35 | | 140 | 56 |
| ≥35 | | 110 | 44 |
| | | | |
| Religion | Orthodox | 233 | 93.5 |
| | Muslim | **15** | 5.9 |
| | Protestant | 2 | 0.6 |
| Residence | Urban | 173 | 69.1 |
| | Rural | 77 | 30.9 |

| | | | |
|---|---|---|---|
| Ethnicity | Amhara | 228 | 91.1 |
| | Agew | 19 | 7.7 |
| | Tigrie | 3 | 0.9 |
| Marital status | Single | 138 | 55.2 |
| | Married | 110 | 43.9 |
| | Divorced | 2 | 0.9 |
| Clinician who did USG | Radiologist | 47 | 18.8 |
| | Radiology resident | 197 | 78.8 |

## 6.2. Patient clinical presentation

Among patients who have breast compliant and sent for breast ultrasound; (208)83.2 % have breast lump, 19(7.6) % have nipple discharge and (23)9.2% have mastalgia

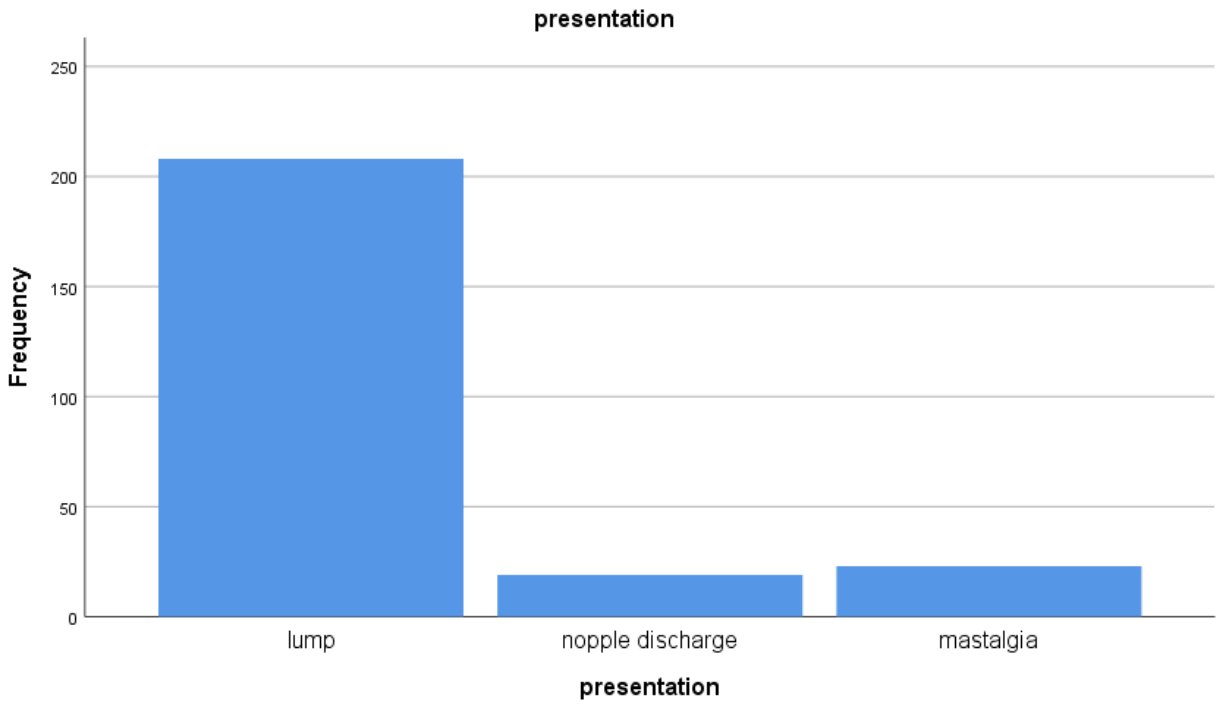


**Figure 2 patients clinical presentation in TGSH, Amhara region, North west Ethiopia, 2022. (n=250)**

## 6.3. Proportion of benign and malignant mass according to age and BMI

USG diagnosed 168(66.8%) as likely benign and 82(33.2%) as likely malignant whereas, FNAC identified 169(67.6%) as benign and 81(32.4%) as malignant. Most of the benign breast masses were seen in age group of <35 years in both USG (n=98) and FNAC (n=97) finding whereas most of the malignant masses (n=76) were seen in age group of over ≥35 years.

The mean BMI was 20.91 kg/m2. Majority of patients 237(94.8%) are in health BMI category from which 164(65.6%) had benign mass. Only 8 are under weight, out of which 5 patients were diagnosed as malignant. Only 5 patients are overweight and out of which 3 are diagnosed to have malignant breast mass.

**Table 2. Proportion of benign and malignant mass according to age and BMI group as diagnosed by USG and FNAC in TGSH, Amhara region, North west Ethiopia, 2022. (n=250)**

| | Final diagnosis of ultrasound | | FNAC diagnosis | |
|---|---|---|---|---|
| Age category | Likely benign | Likely malignant | benign | Malignant |
| <35 | 98 | 7 | 97 | 5 |
| ≥35 | 70 | 75 | 72 | 76 |
| BMI | | | | |
| Underweight | 4 | 4 | 3 | 5 |
| Healthy | 162 | 75 | 164 | 73 |
| Overweight | 2 | 3 | 2 | 3 |
| | | | | |

## 6.4. Ultrasound findings

On USG finding the characteristics of mass (lump) including shape, margin, calcification, acoustic shadowing and echogenisity was assessed and the most common shape of the index lesion was irregular (n =109) followed by oval (n=105) and round (n = 28). Most common shape in benign lesions was oval comprising of 101(96.2%) whereas in malignant lesions it was irregular shape comprising of 75(68.8%). Margins of the index mass lesions were speculated (n = 31), microlubulated(n=37),indistinct(n=37) and smooth in (n = 116), angular was least common (n =29). Speculated margins were only seen in malignant lesions while most of the benign lesions were found to have smooth margins. Post-acoustic attenuation was present in 25% of benign masses and 75% of malignant lesion. Most common echogenicity in malignant mass was hypoechoic (85.4%) and in benign was isoechoic (97.5%).

85.7% of malignant lesions and 14.3% of benign lesions showed micro-calcifications. All the 250 index lesions were evaluated by color Doppler sonography for detection of color signals and 124(49.6%) have color flow of which 78 are malignant.(Table 4)

**Table 3. sonographic features of breast mass in TGSH, Amhara region, North west Ethiopia, 2022. (n=250)**

| | USG | | FNAC result | |
|---|---|---|---|---|
| Shape | Likely benign (%) | Likely malignant (%) | Benign | Malignant |
| Irregular | 33(20.6) | 76(92.7) | 34 | 75(92.6) |
| oval | 102(63.7) | 3(3.7) | 101 | 4(4.9) |
| round | 25(15.6) | 3(3.7) | 26 | 2(2.5) |
| Margin | | | | |
| Angular | 9(5.4) | 20(24.4) | 9 | 20(24.70 |
| Microlobulated | 11(6.5) | 26(31.7) | 13 | 24(29.6) |
| Speculated | 1(0.6) | 30(36.6) | - | 31(38.3) |
| Smooth | 114(67.9) | 2(2.4) | 112 | 2(2.5) |
| indistinct | 33(19.6) | 4(4.9) | 35 | 2(2.5) |
| Posterior echo | | | | |
| attenueted | 29(17.3) | 71(86.6) | 25(14.4) | 75(92.6) |
| Enhanced | 51(30.4) | 7(8.5) | 54(32) | 4(4.9) |
| combined | 88(52.4) | 4(4.9) | 90(53.3) | 2(2.5) |
| echogenesity | | | | |
| hypoechoic | 15(8.9) | 74(90.2) | 13(7.7) | 76(93.8) |
| isoechoic | 115(68.5) | 5(6.1) | 117(69.7) | 3(3.7) |
| Anechoic | 2(1.2) | - | 2(1.2) | - |
| mixed | 34(20.2) | 3(3.7) | 35(20.7) | 2(2.5) |
| hyperechoic | 2(1.2) | - | 2(1.2) | - |
| microcalcification | | | | |
| present | 13(7.8) | 64(78) | 11(6.5) | 77(30.9) |
| absent | 154(92.2) | 18(22) | 157(93.5) | 15(18.5) |
| Color flow | | | | |
| present | 46(27.2) | 78(96.3) | 47(28) | 77(93.9) |
| absent | 123(72.8) | 3(3.7) | 121(72) | 5(6.1) |

## 6.6. FNAC results

Among 250 female patients who have FNAC examination after ultrasound result recommendation; 81(32.4%) have malignant result and 169(67.6%) were have benign result. Among the benign fibro adenoma accounts 133(53.3%), fibrocystic change accounts 24(9.6%), intraductal papiloma were 8 (3.2%), and lipoma 4(1.6%). Among the malignant 69(27.6%) were ductal carcinoma, 10(4%) were lobular carcinoma and 2(0.8%) were inflammatory carcinoma.

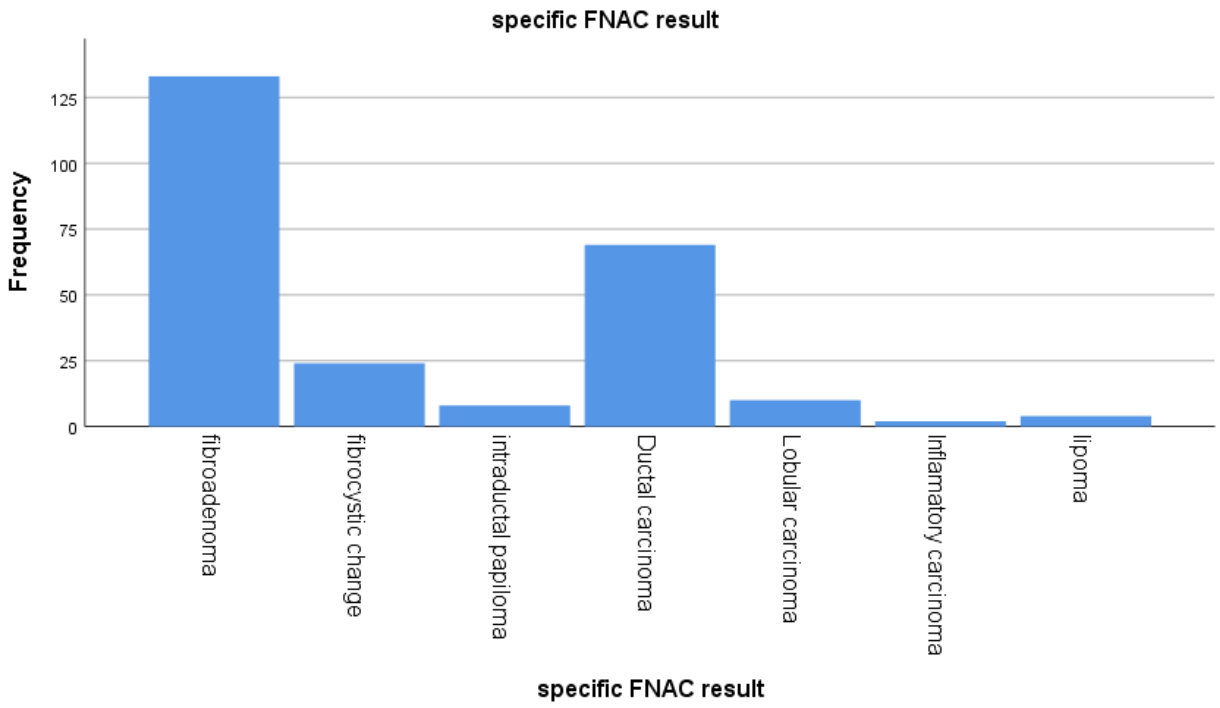


**Figure 3.specific breast FNAC results in TGSH, Amhara region, North west Ethiopia, 2022. (n=250)**

## 7. Agreement of ultrasound and FNAC result in the diagnosis of malignant breast mass

There is very good (strong) agreement between ultrasound finding and FNAC finding with Kappa value of 0.845.

**Table 4. Measure of agreement between ultrasound and FNAC, in TGSH, Amhara region, North west Ethiopia, 2022. (n=250)**

| | | Value | Asymptotic Standard Error[a] | Approximate T[b] | Approximate Significance |
|---|---|---|---|---|---|
| Measure of Agreement | Kappa | .845 | .036 | 13.365 | .000 |
| N | | 250 | | | |

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

## 8. Sensitivity, specificity, accuracy, NPV, PPV of ultrasound in the diagnosis of breast mass

Compared with FNAC (gold standard), USG diagnosed 73 cases as malignant correctly (TP) and 9 incorrectly (FP), it also diagnosed 160 cases as benign correctly (TN) and 8 cases incorrectly (FN). Thus, sensitivity and specificity of USG in diagnosing breast mass as malignant and benign was 90.1% and 94.7% respectively with diagnostic accuracy of 93.2%. Its positive and negative predictive values were 89.0% and 95.2% respectively, and kappa value as 0.845.

**Table 5. Sensitivity, specificity, PPV and NPV of ultrasound in the diagnosis of breast mass in TGSH, Amhara region, North west Ethiopia, 2022. (n=250)**

| | FNAC | | |
|---|---|---|---|
| USG | Malignant | Benign | Total |
| Malignant | 73<br>Sensitivity=90.1%<br>PPV=89.0% | 9 | 82 |
| Benign | 8 | 160<br>Specificity=94.7%<br>NPP=95.2% | 168 |
| Total | 81 | 169 | 250 |
| Accuracy=93.2% | | K=0.845 | p=0.000,significant |

## 9. Consistency of ultrasound and FNAC result

Out of 250 patients, 92.4% patients had consistent breast ultrasound and FNAC result; and only 7.6% had inconsistent result.

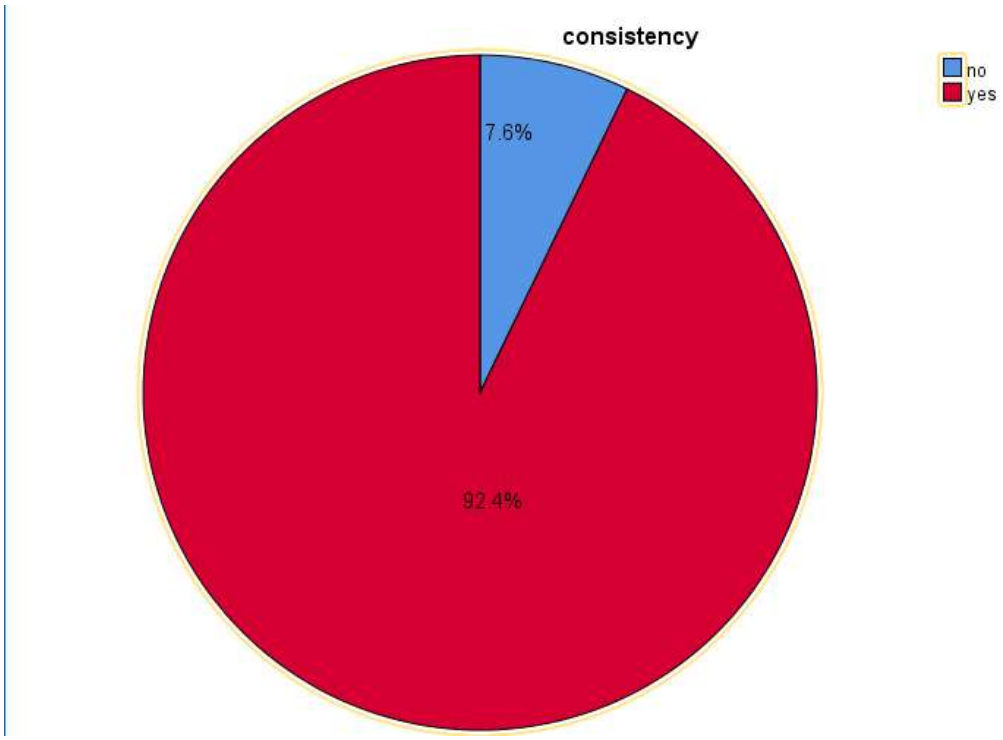


**Figure 4.consistency of ultrasound and FNAC result in TGSH, Amhara region, North west Ethiopia, 2022. (n=250)**

## 10. Associated factors

In the multivariate logistic regression: age of the patients and qualification of personnel who did ultrasound were significantly associated with consistency of ultrasound finding and FNAC result

of breast mass. Patients with young age (<35 years) had 4.298 times higher odds of having consistent value of breast ultrasound and FNAC than older age group (≥35 years). [AOR=4.298, (95%CI: (1.711-10.796)]. The odds of consistent value for ultrasounds done by radiologists were 2.674 times higher than ultrasound done by radiology residents [AOR =2.674, (95%CI: (1.041 - 6.867)].

**Table 6.Multivariate logistic regression showing the association of independent variables on consistency of ultrasound and FNAC result of breast mass in TGSH, Amhara region, North west Ethiopia, 2022. (n=250)**

| Variables | Consistency of US & FNAC | | COR (95%, CI) | AOR (95%, CI) | P-value |
|---|---|---|---|---|---|
| | Yes | No | | | |
| **<35** | **197** | **10** | **3.83(1.068-9.503)** | **4.298(1.711-10.796)** | **0.006** |
| **≥35** | 36 | 7 | | | |
| Clinician who have done ultrasound | | | | | |
| **Radiologist** | **43** | **7** | **1.13(1.094-4.573)** | **2.674(1.041-6.867)** | **0.041** |
| Radiology resident | 164 | 30 | | | |
| Presence of lump | 193 | 15 | 2.15(1.287-3.757) | 3.577(0.733-14.771) | 0.115 |
| Nipple discharge and nipple discharge | 36 | 6 | | | |

## 10. Discussion

Ultrasound is widely applied for evaluating the risk of malignancy in relation to morphological features of breast lesions. The advantages of ultrasound are that it is simple, cost-effective, and has radiation-free imaging, which is desirable by patients and physicians[28].Breast cancer is the leading cause of cancer-morbidity among adult women, accounting for one-third of all cancer

cases among women and one in five of all cancer cases[29]. It is known that some patients with benign breast lesions might underwent unnecessary extensive surgery/FNAC whereas patients with potentially malignant mass might inadvertently triaged into expectant management[30]. So pre-operative prediction of breast masses as benign and malignant using USG, which is widely available and inexpensive help optimize patient management.

In our study out of 250 ultrasound results, 92.4% of ultrasound results had consistent value with FNAC result and there is strong agreement between ultrasound finding and FNAC finding of breast mass with Kappa value of 0.845[95%CI:(0.002-0.017)]. This finding is similar with a cross sectional study done in the Northwestern region of the Rio Grande do Sul state (Brazil) in accuracy of sonographic findings in breast cancer: correlation between BI-RADS® categories and histological findings on 110 patients which showed a good agreement between sonographic and FNAC, which was statistically significant (κw=0.70 [95% CI, 0.49–0.91])[18].In other study at India showed in diagnosing malignant breast lesion, USG and FNAC were 100% specific[31], this result is higher than our study and this discrepancy might be in the later study all the ultrasound was done by more experienced radiologists and the gold standard was biopsy unlike FNAC in our study.

In this study, of 250 patients with malignant breast mass confirmed with FNAC, 73 patients were correctly labeled as malignant on gray scale USG using sonomorphologic criteria as predictors of malignancy and benignity of breast masses with a sensitivity, specificity and accuracy of 90.1%, 94.7% and 93.2%respectively with positive predictive value of 89% and negative predictive value of 95.2%. It is comparable with majority of the studies and also comparable with a prospective, quantitative and descriptive study conducted on Radiological and Cytological Correlation of Breast Lesions with histopathological findings in a Tertiary Care Hospital in Costal Karnataka Mangalore in which the sensitivity was 90.6% and specificity was 97.8%[11]. A comparative result also found in a study done in Egypt on Comparative study between contrast-enhanced mammography, tomosynthesis, and breast ultrasound as complementary techniques to mammography in dense breast parenchyma which shows breast ultrasound had a sensitivity of 94%, a specificity of 85%, a positive predictive value of 90%, a negative predictive value of 96%, and a diagnostic accuracy of 92%[32]. A research done at Netherlands on Ultrasound for breast cancer detection globally: a systematic review; shows sensitivity,

specificity, positive predictive value, and NPV (95% CI) of 82.1% , 88.4%, 0.86 , and 0.80 respectively which has slightly lower sensitivity than our study[19].

This study shows that there were higher consistent value of ultrasound and FNAC in younger age group (<35 years) than older age group (≥35 years). [AOR=4.298, (95%CI: 1.711-10.796)]. This is similar with a study done in USA which indicated that sensitivity and specificity of ultrasound was statistically significantly greater than mammography in patients with breast symptoms for the detection of breast cancer and benign lesions particularly in dense breast and in young women($p<0.01$)[33]. Other study at Japan also showed USG in younger age group (<35 years of age), the sensitivity, specificity, PPV, and NPV of USG in the diagnosis of malignant breast mass were all 100% against the respective values of 91.11, 100, 100, and 71.43% when considering those ≥35 years of age[34]. There was a significance difference among age group on incidence of benign and malignant masses on US findings in the current study suggesting that there was an increased chance for a breast mass to be malignant with increasing age of the patient and benign with younger age($p<0.05$). Most of the malignant breast masses were found in patients aged more than 40 years and benign masses were most common in patients between 21-30 years of age. The highest incidence of breast malignancy reported in study done in China was age greater than 50 years which was older age group than the present study (40 year)[24]. This is because our study was done in a majority of younger population. A study done at Shanghai on application of second opinion on breast imaging and reporting system shows independent factors associated with malignancy was age >40 years($p=0.009$) which is similar to our study. Qualitative changes in mammary tissue increase the risk of malignant transformation and may explain the significantly higher rate of malignancy in patients older than 40 years[28].
In our study BMI is not significant predictor of the consistency of breast ultrasound result and FNAC result with ($p= 0.504$) with OR of 0.948. It is not similar with many other literatures and a study done at Vietnam identified an approximate 30% higher risk of breast cancer in postmenopausal women with obesity compared to women who were not obese (RR: 1.29; 95% CI: 1.22-1.36)[35]. This is because majority of the study population in our study were young age group.

Although the BI-RADS lexicon was set to ensure that ultrasound diagnoses are standardized and objective, there are still influential characteristics, such as clinical experience by radiologists. In

our study the qualification of personnel who did ultrasound has significant association with agreement of ultrasound and FNAC findings in the diagnosis of breast mass and shows ultrasound done by radiologist is 2.674 times more consistent with FNAC than done by radiology residents. [(AOR =2.674,(95%CI:1.041-6.867)]. A study in USA 2020,showed experience of Radiologists significantly improve their breast cancer detection rates ($p < 0.001$)[36].

In our study the characteristic sonographic findings of breast mass suggesting malignancy include hypoechogenicity, posterior acoustic shadowing, microlobulation, speculated and angular margin, presence of micro calcification, presence of color flow, irregular margin and taller than wider orientation(all $p<0.05$). This is similar with a research done in Shanghai which showed irregular tumor margin, taller than wider orientation of the tumor, presence of micro calcification and presence of blood flow were significant independent factors for malignancy (all $P < 0.05$)[28]. Sonographic features predictive of malignancy on other literature also include masses with spiculated margins (PPV 86%), irregular shape (PPV 62%) and non-parallel orientation (PPV 69%), whereas masses with a thin echogenic capsule (NPV 95%), circumscribed margin (NPV 90%), and parallel orientation (NPV 78%) are predictive of benignity[37].The typical features of benign tumors include oval and round shape, hyperechoic lesion with smooth lobulations, a thin echogenic pseudo capsule which is similar with other literatures[38].

In our study the presence micro calcification within solid nodule is indicative of malignany in which out of 30.8% of cases with microcalcification , 4.4% were benign and 26.4 were malignant and similar study done by Berg WA et al. reported micro calcification in 9.6% of benign masses and 48% of malignant masses, similar to our study[39].

In our study there were 124 cases with internal color flow within the mass on Doppler study out of which 78 were malignant, similar with Del Cura et al. reported that 97% of tumors with RI>0.4 were carcinomas[40].

Among 250 patients with breast masses, 67.6% were benign and 32.4% were malignant. And from the specific FNAC result fibro adenoma accounts (53.3%) and fibrocystic change accounts (9.6%) are commonly seen benign result; and from malignant 27.6% were ductal carcinoma, 4%

were lobular carcinoma. This is similar with a study done in Kamineni which shows Fibro adenoma was the commonest benign lesion (63.8%)[20].

In the current study there were eight (8) cases reported as benign on USG but turned out to be malignant on pathologic examination. These were one case of lobular carcinoma, two cases of inflammatory carcinoma and three cases of ductal carcinoma which were early cancerous stage and were reported as benign. These cases were described on USG as having irregular shape and hypo echogenisity but no micro calcification and color flow seen. To correctly classify breast mass as benign and malignant on USG opinions vary among existing literatures regarding the predictive power of shape of the mass and echogenisity alone. Benign inflammatory and fibrotic breast conditions constitute heterogonous group of breast mass which closely mimic and are often clinically and radiologicaly indistinguishable from inflammatory breast cancer. Most predictors with the presence of microcalcification and color flow add predictive power for malignancy[41].

There were also 9 patients with malignant USG turned out to be benign on pathology. 3 cases were inflammation, 2 cases with fibrocystic change and 1 case were fibroadenoma with hypo echoic and ill-defined mass. Infectious, fibrotic and inflammatory breast pathologies are among the difficult lesions to classify as benign and malignant based on sonomorphologic features[42].

## 11. Conclusion

This study revealed that ultrasound and FNAC had high consistent value in the diagnosis of breast mass.

Ultrasound had high sensitivity, PPV and accuracy in the diagnosis of breast cancer. The sensitivity and specificity of ultrasound in the diagnosis of breast mass was 90.1% and 94.7% respectively with positive predictive value of 89% and negative predictive value of 95.2%.

Age of the patient especially in young is significant predictors of agreement of ultrasound and FNAC findings of breast mass.

Qualification of personnel doing ultrasound had significant association; Ultrasound done by experienced radiologist more correctly classify as benign and malignant. So Ultrasound is an

operator-dependent investigation and hence if it is done by an experienced sonologist, sensitivity can reach equal to or even surpass the sensitivity of FNAC.

## 12. Recommendation

### To hospital staff and both radiology and other departments

We recommend the treating clinicians in other departments to strongly consider ultrasound for the diagnosis of breast cancer to reduce unnecessary invasive procedure.

Ultrasonography has proven its efficacy in all ages and should be considered as the first line investigation for the evaluation of breast lump especially in young women with dense breast.

We recommend consultation for Radiologist should be encouraged to reduce negative result.

### To regional and federal administrative

We recommend the regional health beauro and ministry of health to facilitate diagnostic ultrasound facility to the level of primary hospital to avoid unnecessary referral and invasive FNAC procedures for benign breast lesions.

### To the researchers

We recommend further research with large population, long study period, on mammography and MRI appearance; and using biopsy result as a gold standard.

## 13. Limitations and strength

This is a single centered hospital based study and results cannot be generalized to the general population since patients that present to this hospital may not represent patients in the whole country.

Because our study focused on the clinical value of Ultrasound, the results of mammography and magnetic resonance imaging were not included. The importance of multimodal radiological examination should be analyzed in future studies.

The major strength of the study was that it used primary data.

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