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ULTRASOUND ASSESSMENT OF FIBROADENOMA IN RELATION TO BODY MASS INDEX (BMI) IN YOUNG ADULTS

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Abstract

Background: Fibroadenoma is one of the most common benign breast lesions in young females. Ultrasound is the preferred imaging modality for its evaluation due to its safety and effectiveness. Body Mass Index (BMI) may influence breast tissue composition and could potentially affect the sonographic characteristics of fibroadenomas.

Objective: To assess the ultrasound features of fibroadenoma and determine their association with Body Mass Index (BMI) in young adult females.

Methods: A cross-sectional study was conducted on young adult females diagnosed with fibroadenoma. Ultrasound examinations were performed to evaluate lesion characteristics, including size, shape, margins, echogenicity, and vascularity. Lesions were categorized using the BI-RADS classification system. BMI was

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calculated and categorized according to standard guidelines. Statistical analysis was performed to assess associations between BMI categories and ultrasound features.

Results: The majority of fibroadenomas presented as well-defined, oval, hypoechoic lesions with minimal internal vascularity. A significant association was observed between BMI and certain sonographic features, including lesion size, echogenicity, margins, and BI-RADS classification ($p < 0.05$). Higher BMI was associated with relatively larger lesion sizes and more complex imaging features. However, the obese group had a limited sample size, which may affect the generalizability of these findings.

Conclusion: Ultrasound effectively characterizes fibroadenomas in young adults. BMI appears to influence specific sonographic features, potentially impacting diagnostic interpretation. Further large-scale studies are recommended to validate these findings.

CHAPTER 1
INTRODUCTION

The mature breast is situated on the anterior thoracic wall, and is over the pectoralis major muscle. The breast is superiorly extended to the second rib, inferiorly extended to the sixth costal cartilage, medially extended to the sternum and laterally extended to the maxillary line. This segment of the mammary gland is turned towards the axilla, and is the axillary tail of Spence [1]. Benign breast lesions is a common disease among women whereby it is made up of a host of non-cancerous diseases of the breast. Fibroadenoma, and fibrocystic changes are the most common benign lesions of the breast which are often present in women, especially in the reproductive age group [2]. In addition other common benign breast diseases are phyllodes tumors , simple cysts, intraductal pappliomas and radial scars are also commonly observed [3]. Both breasts are inclined to take a conical shape with a bottom of 10-12cm and a thickness of 5-7cm. The major part of the breast tissue is usually located in the upper outer quadrant of the breast. It is the quadrant that is more often implicated in breast cancer and in most of benign lesions of breast.

The NAC of the nulliparous women is at the fourth rib and the fifth rib, however when the women have pendulous breasts then the NAC can vary significantly. It is a multifocal situation with an average diameter of 3-4 cm, and is usually located at the center of the breast mound. It has sebaceous glands, sweat glands and which, as they appear on the eye, are accessory glands, called Montgomery glands which open in the periphery of the areola as Morgagni tubercles that secrete lubrication during lactation [4]. The bulk of the volume of the breast is comprised of the breast parenchyma and the associated fat. The fibro glandular tissue or parenchyma of the breast is then further subdivided into 1520 lactiferous ducts which originate out of deep in the breast lobules, and which converge at the nipple in a radial orientation. The alveoli (little structures) that are continuously related to the lactiferous ducts make up the secretory units of the breasts. The synthesis of milk of these secretory units is regulated by a complex web of hormones and growth factors. Their different

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extents lead to the gross histologic alterations of the breast and in the course of pregnancy and menstrual period [2].

Benign breast lesions are prevalent condition among women, characterized by variety of non-malignant breast diseases. Most common benign breast lesions are fibroadenoma, and fibrocystic changes which are frequently observed in women, particularly in reproductive age group. In addition other common benign breast diseases are phyllodes tumors, simple cysts, intraductal pappliomas and radial scars are also commonly observed [5], [6].

Fibroadenomas are widely known as the common benign breast lesion affecting the age between 18-39, and in adolescent population the overall incidence of fibroadenoma is approximately 2.2%. Noticeably, fibroadenoma accounts for 68% of all breast masses. In reteroperspective analysis in which 335 breasts were taken in which 144 cases was if benign breast lesions and usually appear unilateral. The most frequent cases of fibroadenomas were noted of 22% of all cases. A fibroadenoma is a benign tumor characterized by the mixture of glandular and fibrous tissues, predominantly affecting women aged 15 to 35 years [7]. Fibroadenomas are classified into several types such as simple, complex, giant, juvenile and myxoid. Fibroadenoma are typically painless but some individuals experience premensuratrual breast tenderness or discomfort due to hormonal fluctuations. Clinically they present as smooth, well circumscribed and mobile palpable masses that vary in size and location. Fibroadenomas also cause a breast asymmetry, contour distortion or visible skin changes [8].

Fibroadenoma development in women is influenced by hormonal, genetic and lifestyle factors. Key risk includes being under 35 years' old, early contraceptive use (under 20) and family history of breast diseases. A family history of fibroadenoma suggests predisposition. Poor nutrional status is major risk factors. Increased estrogen receptor sensitivity in breast tissue may contribute to multiple fibroadenomas. Oral estrogen-progesterone contraceptives and multiple full-term pregnancies may reduce risk. Obesity may increase the risk of fibroadenoma some studies suggest that obesity is directly linked to fibroadenoma [9].

Fibroadenoma is a common benign breast tumor arising from the terminal duct-lobular unit, where both stromal and epithelial cells multiply. Studies show fibroadenomas are hyperplastic, polyclonal lesions reflecting deviations in normal breast maturation rather than true tumors. They most often occur in the upper outer quadrant and may grow slowly without pain, nipple, or skin changes, though size can fluctuate with the menstrual cycle [9]. Typically developing between 15- and 25-years during menarche, Fibroadenoma mirror the appearance of hyperplastic lobules. Stromal growth is influenced by the epithelial component, with higher mitotic activity nearby. Estrogen, progesterone, and pregnancy-related lactation can promote growth, while lesions often regress after menopause. A Fibroadenoma typically presents as a painless, firm, movable, and slowly enlarging breast lump. On physical examination, it often feels rubbery and appears tan to white in color on gross pathology [4]. Breast ultrasound is the common modality for evaluating fibroadenomas. Typically, sonographic features include a well-defined, an oval or gently lobulated solid mass with smooth margins and wide then taller orientation, the lesion is usually appeared homogenously hypoechoic relative to

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surrounding breast parenchyma and it's may also show the heterogeneity in larger lesions. Posterior acoustic features are enhancement may show. Size of fibroadenoma can vary most commonly ranging from 1-3cm and giant fibroadenoma can be larger than 5cm. On Doppler imaging, vascularity is usually minimal or show mild peripheral vascularity [10].

Ultrasound is particularly useful for distinguishing solid from cystic lesions, however sonographic findings can overlap with those of breast cancer. Approximately 25% of the fibroadenoma may exhibit irregular margins, rasing suspicion for malignancy. Moreover, only about of 82% biopsy – confirmed fibroadenomas are visualized on ultrasound, which limits diagnostic accuracy. Ultrasound remains the preferred imaging method for evaluating fibroadenoma in women under 35 and is also useful for assessing palpable breast masses in younger patients because of non-ionizing radiations [11]. Nevertheless, because the ultrasound features of benign and malignant masses can overlap and some fibroadenoma present with irregular margins diagnostic uncertainty persist. Therefore, all solid breast lesions identified on ultrasound should be confirmed via needle aspiration or excisional biopsy for accurate histological diagnosis [2].

Obesity causes major changes in the breast tissues by maladaptation of adipose tissue functionality. Breast adipose tissue is an active endocrine organ which secretes hormones, cytokines and adipokines, which impact on the microenvironment around it. This regulatory mechanism is interrupted in obese people and results in a disproportion when secretion of adipokines occurs, that is higher leptin and lower adiponectin. Such imbalance encourages cellular proliferation and pro-inflammatory condition of the breast tissue. Moreover, obesity is characterized by adipocyte hypertrophy, which leads to the expansion of fat cells and leads to the local hypoxia and cell stress [12]. As a reaction, the stressed adipocytes and the adjacent immune cells secrete pro-inflammatory cytokine, such as tumor necrosis factor-alpha (TNF-alpha) and interleukin-6 (IL-6). This gives rise to a chronic low-grade inflammatory state of the breast tissue microenvironment. Also, obesity is linked to the enhanced activity of aromatase which results in augmented local estrogen generation [13]. Together with insulin resistance leading to hyperinsulinemia and higher levels of insulin-like growth factor-1 (IGF-1), these hormonal and metabolic alterations further affect the structure and functioning of breast tissue. Taken together, these changes indicate that there is a close relation between obesity and breast tissue remodeling that points to the significant effect of obesity on the physiology of the breast [14].

Obesity greatly affects breast imaging and diagnosis. Increased BMI is linked to fattier breast tissue, changing breast composition. Fatty breasts create a radiolucent background, making lesions more visible on imaging, especially mammography, enhancing detection sensitivity. Depending on the ratio of fibro-glandular and fatty tissue, breasts can be totally fatty or highly dense. Less dense (fatty) breasts in obese people may lessen fibroglandular tissue masking and help detect lesions. Despite this theoretical benefit, imaging obese patients is difficult. Increased tissue thickness and fat deposition can diminish ultrasound image clarity and lesion visibility due to sound wave attenuation [4].

Imaging processes may also have technological issues like:

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- Proper placement challenges
- Limitations in equipment (e.g., probe penetration, plate size in mammography)
- Longer acquisition times may increase motion artifact risk.

Ultrasound and magnetic resonance imaging can detect lesions better, but they can also cause false-positives and unneeded biopsies. Thus, obesity modifies breast tissue composition, which may improve lesion appearance, but it also presents technical and diagnostic obstacles that can lower imaging accuracy [15].

Obesity has been on the rise at a very high rate in the world, and it has already been established to be connected to a number of health-related problems, including a higher risk of postmenopausal breast cancer. Body mass index (BMI) and benign breast diseases (i.e. fibroadenoma) are a topic of continued investigation where some contradictory reports may be found in the previous literature. There have been some studies that have indicated an inverse relationship and others especially recent ones have indicated relationship that is direct [16] . Clinical research has shown that FAs are hormone-dependent, increasing during pregnancy due to progesterone, estrogen, and lactation, and decreasing after menopause. In the upper outer quadrant of the breast, fibroadenoma typically appears as a painless, rubbery, smooth, moveable mass with distinct edges that is between one and three centimeters in size. It could be small enough to be seen only under a microscope, or it might be larger than 10 cm, causing breast asymmetry and significant cosmetic deformity. The fibroadenoma may grow or shrink on its own, or it may show signs of hormonal reactivity, changing in size according to the menstrual cycle. Large fibroadenoma, juvenile fibroadenoma, fibroadenoma that develops during pregnancy and lactation, and multiple fibroadenomas are examples of fibroadenoma variations [15] .

One established risk factor for breast cancer development is body mass index (BMI). It's still unclear, nevertheless, how BMI and benign breast illnesses are related. Numerous research has demonstrated that a drop in BMI is the risk factor for benign breast illnesses, while some have suggested that a rise in BMI is a risk factor. Fibroadenomas are not quite common among post-menopausal women as they fade away after menopause. Because of their great mobility, fibroadenomas are frequently referred to as "breast mice." Fibroadenomas are a marble-like, stromal and epithelial tissue mass found under the surface of the breast. These rubbery, hard masses frequently vary in size and have regular borders [17] . The ability to determine the particular effect of obesity on the sonographic appearance and a correct evaluation of fibroadenomas is important to streamline the diagnostic protocols and enhance patient care in both adolescent and adult groups. The issue therefore requires an in-depth research study to help in explaining the exact correlation of obesity, fibroadenoma features and effectiveness of the ultrasound examination. In addition, obesity may create technical difficulties in the breast imaging. Dense breast tissue or greater volume of breast tissue obesity may also increase palpability of the lesions and palpability of the lesions and palpability of other imaging modalities and this may cause delayed diagnosis or reduce the use of some imaging modalities such as ultrasound or magnetic resonance imaging in some clinical settings [18] .

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Recent literature (especially since 2020-2023) has emphasized the possibility that high BMI is a major risk factor of the occurrence of fibroadenomas, especially among younger adolescence girls. An example is that in one study, obese women with uterine fibroids were found to have a greater than two-fold increased likelihood of also having breast fibroadenomas, which could be brought about by estrogen stimulation of adipose tissue. Conversely, other of the new results indicate that obesity could potentially relate to a decrease in risk of fibroadenoma as compared to other benign breast ones and therefore it needs to be further researched [19] .

Rationale of study:

The best non-invasive, radiation-free imaging technique for evaluating the breast in young females is ultrasound, which makes it perfect for evaluating fibroadenoma in a variety of age and body mass index (BMI) groups. It is possible to determine whether obesity is linked to changes in lesion size, number, vascularity, or growth patterns by evaluating fibroadenoma in relation to obesity using ultrasound. This information may lead to better breast health outcomes and evidence-based clinical decision-making by enhancing risk stratification, directing follow-up procedures, and supporting early, customized management strategies in both adolescents and adults. The rationale is based on the gaps in medical literature and the diagnostic peculiarities of the overlap of these conditions which are common.

AIMS AND OBJECTIVES

The aims and objectives of this research study are listed below;

1. The key goal is to evaluate the relationship between body mass index (BMI) and the sonographic features of breast fibroadenomas in young adults.
2. To evaluate the shape, margins, echogenicity, and vascularity of fibroadenoma in different weight categories of patients.
3. To examine the connection between BMI and the quantity and size of fibroadenomas found by ultrasonography.

CHAPTER 2
LITERATURE REVIEW

High intensity focused ultrasound (HIFU) is a noninvasive, safe and technically successful alternative recently discovered and has shown potential to reduce fibroadenoma volume, patient pain, as well as hospitalization period. An improvement in quality of life was also demonstrated, through disappearance of symptoms, and increase in physical activity after intervention, besides the satisfaction of the patients towards the cosmetic outcome and future referral of the procedure as a recommendation to other patients [11] .

In our hospital, core-needle biopsy was used to diagnose 113 patients diagnosed with breast fibroadenoma by the core-needle biopsy. Written informed permission and clearance were obtained by the institutional ethical committee. Follow up on ultrasound imaging and physical examination

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was done on the patients. In this research, the clinical outcome of 147 fibroadenoma in 85 people with a follow up period of over three months was studied. There were over two lesions in twelve patients, two lesions in twenty-one patients, and a single lesion in fifty-two patients. All fibroadenomas had a median localization time of 3 minutes and a median treatment time of 9 minutes during USgHIFU. An efficient and secure noninvasive alternative method for treating breast fibroadenoma is ultrasound-guided HIFU surgery [5].

One of the most prevalent malignancies worldwide is breast cancer in women. 202 women with a mean age of 28.71 SD± 7.71 and a pathological diagnosis of fibroadenoma who were enrolled in an outpatient clinic. Consequently, all contributors were classified as stage 4 on the Breast Imaging-Reporting and Data System scale for 202 women who were 28.71 ± 7.71 years old. Just 6.4% of masses were spherical, with the majority being oval in shape. 95.5% of the margin demarcations were clearly defined, whilst 4.5% of the masses were poorly defined. On ultrasound, masses seem to be hypoechoic in about 93.6% of cases. Of the masses, 20.8% had lobulation. Of them, 6.9% exhibited a heterogenic appearance and 6.4% had calcification. As a result, a hypoechoic mass with a clearly defined boundary is the most typical ultrasonography sign of fibroadenoma [20].

According to a study, benign breast diseases (BBD) are 1:10 more common in clinics than breast cancer. According to a study of 168 patients in Greater Boston, fibroadenoma accounted for 55.9% of benign tumor cases, with fibroadenosis coming in second at 20.8%. Fine Needle Aspiration Cytology (FNAC) had a positive predictive value of 94.2% and a sensitivity and specificity of 89.8% and 87.8%, respectively, for the diagnosis of fibroadenoma. Benign breast conditions are frequently disregarded despite making up the majority of breast complaints, underscoring the need for additional research on their incidence and prevalence [21] .

There is a strong correlation between breast fibroadenoma and uterine fibroids in obese women. A study discovered that both lesions were present among older and postmenopausal women, despite the fact that uterine fibroids and breast fibroadenoma have different age associations. Although the mechanisms underlying this relationship are unclear, genetic and hormonal factors might still be involved. Therefore, additional research taking these factors into account is required to validate research findings [5].

The morphological transformation of previously diagnosed fibroadenoma into benign phyllodes tumors upon recurrence has been documented in case reports. Three patients, ages 2942 and 211, had their primary fibroadenoma surgically removed; however, subsequent tumors in the same site showed hyper cellular stroma with leaf-like projections, which are characteristic of benign phyllodes tumors. In contrast to polyclonal normal breast tissue, all primary fibroadenoma were monoclonal, according to clonal studies, and recurrent phyllodes tumors shared the same allelic pattern as mammae fibroadenoma. These findings suggested that some fibroadenoma, particularly those that are monoclonal in nature, may be an earlier lesion connected to phyllodes tumors; in this case, long-term monitoring is crucial to identify recurrence [22] .

According to recent clinical studies, FAs are hormone-dependent, rising during pregnancy as a result of progesterone, estrogen, and lactation and falling following menopause. Fibroadenoma usually

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manifests as a painless, movable lump that is one to three centimeters in size and has clear edges in the upper outer quadrant of the breast. It could be observed as it is greater than 10 cm, resulting in breast asymmetry and severe esthetic deformity. Studies also indicated that obese women with uterine fibroids were found to have a greater than two-fold increased likelihood of also having breast fibroadenomas, which could be brought about by estrogen stimulation of adipose tissue [2] .

Clinicians frequently have to decide whether to remove the lump or to keep an eye on it with routine follow-up exams. Surgery may result in the needless removal of benign lesions and unsightly cosmesis, even though the removal of these lesions is a permanent treatment. One established risk factor for breast cancer development is body mass index (BMI). It's still unclear, nevertheless, how BMI and benign breast illnesses are related. Numerous research has demonstrated that a drop in BMI is the risk factor for benign breast illnesses, while some have suggested that a rise in BMI is a risk factor.

Breast cancer is the predominant cancer in women in America. Body mass index (BMI) is one of the established risk factors of the onset of breast cancer. It is unclear how BMI and benign breast disease are related. Moreover, some benign diseases are associated with an increased risk of cancer. Other diseases were observed to reduce with increase in BMI except fibroadenoma which was found to reach its climax at BMI of 25 to 29.9 kg/m2. The presence of benign diseases is also associated with age. It is yet unknown, though, how BMI and benign breast illnesses are related. Various studies have indicated that the risk factor to benign breast illnesses is the decrease of BMI, although some studies have indicated the opposite, that the increase of BMI is a risk factor [24].

Excluding cancer and treating the presenting symptom are the goals of the diagnostic evaluation for a patient with a breast mass. The patient's age, risk profile, and breast type determine the extent of the evaluation. However, little information is available regarding the epidemiology of benign breast masses (BBL). At least 90% of people visiting a breast clinic have benign breast disorders. The most common symptom is pain, which is followed by a breast lump. To prevent the anxiety related to non-neoplastic disorders and, in the case of carcinoma, to prevent the transformation to metastasis, early presentation and adequate diagnosis is needed [25].

Multiple fibroadenoma were found in 12% of patients, and they were more common in younger girls, where bilateral involvement was also more common. Per canalicular and intracanalicular fibroadenoma were uncommon in both samples, and the great majority of fibroadenomas exhibited a mixed histologic appearance. The frequencies of apocrine metaplasia, adenosis, and stromal overgrowth were somewhat greater in younger females, but these differences were not statistically significant. All things considered, the research shows that whereas older women have more associated benign proliferative changes, younger females are more likely to have numerous and bilateral fibroadenoma [19] .

The study organized in 2021, showed that total 75 patients with breast pathology had visited to our institute. A total of 75 benign breast lump cases were included in the study. The most common lesion was fibroadenoma, accounting for 35 cases (46.66%), followed by fibrocystic disease with 19 cases (25.33%). Phyllodes tumor was found in 5 cases (6.66%), while breast cysts were reported in

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4 cases (5.33%). Less common lesions included galactocele, duct papilloma, and duct ectasia, each seen in 2 cases (2.7%). Fat necrosis was the least common finding with 1 case (1.33%). Additionally, bilateral fibroadenoma and bilateral fibro adenosis were observed in 2 cases (2.66%) and 3 cases (4%), respectively, completing the total of 75 cases [26] .

Nevertheless, subsequent studies indicated that complex fibroadenoma was more prominent in women who were prone to have concomitant high-risk histopathological alterations of incomplete lobular involution and proliferative disease without atypical (PDWA). Complex fibroadenoma ceased to have an independent significant risk of developing breast cancer when analyzed by stratification based on involution status and also presence of PDWA. These results imply that complex fibroadenoma itself does not provide an increased risk of breast cancer on top of the one provided by other histological risk factors. The standardized incidence ratios (SIRs) signify a high risk of breast cancer in women who had fibroadenoma. In particular, the SIR was 1.49 in case of non-complex fibroadenoma and higher in the case of complex fibroadenoma as was shown by the SIR of 2.27 in case of women [23].

Another study involving 281 of the patients, proved the existence of a fibroadenoma. However, the overall histology was benign change of the breast in 33 patients (9.2). In 15 cases (4.2) only, the histology was either tubular adenoma or fibro adenomatous hyperplasia. There were two cases (0.6%) of cysts. In six patients (1.7%) it is mentioned that the histology consisted of locational changes like locational adenoma or pregnancy-related change [27], [8] .

92 individuals, ages 40.4 ± 9.2, were included in a study reported. According to the Breast Imaging-Reporting and Data System scale, every participant was categorized as stage 4. The lesions' mean ± standard deviation was 167.4 ± 101.4 mm2. Lesions were more common in the upper outer quadrants of the breasts. As per ultrasound assessment, approximately 91.3 percent of the cases were hypoechoic. In 28.3% of the cases, lobulated masses were present. Although 9.8% and 2.2% of the masses showed calcification and heterogenic appearance, respectively, 8.7% of the masses were spongy. Examples of complex appearances that border malignant masses are noncircumscribed margins, lobulation, the presence of a posterior shadow, heterogenicity, and micro calcification [28].

A survey that was cross-sectional and study was carried out at Guangzhou, Guangdong, China's Nanfang Hospital. The fibroadenoma research comprised 11,898 women between the ages of 18 and 40 who had breast screenings. For the purpose of testing for fibroadenoma, 342 breast lesions with pathology reports and preoperative ultrasound pictures were gathered. Consequently, 27.6% (3285/11 898) of the women between the ages of 18 and 40 obtained an ultrasonography diagnosis of fibroadenoma. A single fibroadenoma was detected in nearly two-thirds of women, and the majority of fibroadenoma were less than one centimeter. Ultrasonography's sensitivity and specificity for fibroadenoma were 97.0% and 91.4%, respectively, [4].

In the other study, 23 patients (mean age, 25 years; age range, 15 47 years) had 34 juvenile fibroadenomas, confirmed by either a surgical biopsy or a sonographically-guided 8-gauge vacuum-assisted biopsy. The sonographic findings of the lesions were retrospectively examined by two radiologists using the lexicon of American College of Radiology Breast Imaging Reporting and Data

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System (BI-RADS) [29]. All fibroadenomas appeared as masses on sonography. 30 mm was the average size. There were three irregular masses, two circular masses, and 29 oval masses in terms of shape. 22 masses (65%) displayed posterior acoustic amplification, 1 had posterior shadowing, and 9 had no posterior acoustic features. This leads to a small restricted oval hypoechoic or isoechoic mass resembling simple fibroadenoma being the most common sonographic presentation of juvenile fibroadenoma. Juvenile fibroadenoma has been observed to be hyper vascular and have a posterior acoustic amplification on color Doppler sonography [30].

CHAPTER 3
METHODOLOGY

3.1. Sample collection:

Samples were collected from young adults undergoing breast ultrasound at Sargodha city from different hospitals and diagnostic centers, such as Mubarak hospital, Ashraf medical complex, and combined military hospital Sargodha. Patients with ultrasound confirmed fibroadenoma were included according to defined inclusion and exclusion criteria. Obesity was assessed using BMI to evaluate its association with fibroadenoma.

3.2. Sample size

Total 70 patients were enrolled with ultrasound confirmed fibroadenoma were included in the study. Among them, were classified as obese based on BMI, while the remaining had normal BMI. It will be clinical based and descriptive cross-sectional study.

3.3. Study duration

The study duration for my research was 3 months after approval of synopsis i.e. from January 2026 to April 2026. During this period, my duty was in ultrasound department. So, I gathered data myself from patients presenting for ultrasound of breast in Radiology Department.
Before this study, the written consent was taken from participants, and they were informed that the data would be used for research purposes only.

3.4. Selection criteria

Inclusion Criteria:

- Female's patients aged 18 to 35years
- A confirmed final diagnosis of fibroadenoma, according to a triple assessment (clinical examination).
- Patients presenting wit palpable or non-palpable breast lump evaluated on ultrasound.

Exclusion Criteria:

- Females of older than 35 years
- Patients who are ultimately diagnosed with malignancy, massive inflammation or abscess, pregnant or lactating women.

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• Patients who had prior breast surgery or other conditions that affect the calculation of BMI.

3.5. Imaging method used:

Ultrasound was used as the primary imaging modality for assessment of fibroadenoma, owing to its high diagnostic sensitivity and non-invasive nature and lack of ionizing radiations. its effective in assessment of dense breast parenchyma.

On sonographic examination fibroadenoma appear, well circumscribed, round or oval hypoechoic mass with homogenous internal echotexture. Ultrasound enables the real time evaluation of size, shape, margins, orientation and posterior acoustic enhancement while color Doppler was used to access the vascularity.

3.6. **Equipment used:**

• High-resolution ultrasound machine with ability to perform the gray scale and Doppler was used.
• Linear array transducers (7.515 MHz) that are the best in the superficial tissue resolution mode, and are preferred when it comes to identifying fibroadenoma and distinguishing between benign and suspicious lesions.
• Digital version of weighing scale.
• Stadiometer (height measurement)
• BMI chart or calculator

3.7. Scanning Techniques:

The patient was positioned either supine or supine-obliquely
• To flatten breast tissue, raise the ipsilateral arm above the head
• For improved exposure, place a tiny pillow or wedge beneath the shoulder
• Systemic approach was used employed using the Clock-face method of radial and anti-radial scanning and examination to comprehensive evaluation of all breast quadrants.
• Analyzing the retro areolar area with comparing the contralateral breast was performed to improve diagnostic accuracy.
• Color Doppler was used to evaluate peripheral and internal vascularity of lesion.
• Typically, benign fibro adenomas exhibit peripheral or minimal flow.

3.8. Ethical consideration:

• All the information and data gathering was held in high confidence. The respondents were totally anonymous in the research.
• The participants were made aware of the fact that there are no direct drawbacks and risks of using the non-invasive ultrasound procedure itself.
• There was limited access to authorized clinical staff only.
• In every circumstance, we protected patient privacy in every situation.
• Ensuring that only the patient, treating physicians, and researchers receive access to results and images.

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- They were as well be made quite aware of their right to freely withdraw their participation at any time during the study without being penalized.
- In this research study, the active participation of the participants was completely voluntary, and no personal gains are expected to be obtained in the short term, but the research should yield valuable medical information.

3.7-Data collection procedure;

It includes:

Study variables

- No. of patients in diseased groups were observed according to selected variables
- Demographical parameters were assessed (age, weight and history).

Methods for Collection of Data

- Patient history
- ultrasound report
- Clinical diagnosis and symptoms
- Patient BMI

Data Collection Tools (Proforma/Questionnaire)

- Patient consent form
- Questionnaire

Survey conduction:

- **Ethical approval** was obtained from patients
- **Informed consent was filled and signed by participants**
- Use of questionnaire (for hydration + symptoms) and MRI report
- On the basis of questionnaire, assess the symptoms and examined the patient physically
- On the basis of survey and patient's history, hydration status was evaluated.

3.9. Data analysis procedure:

The descriptive statistics was deployed on all variables with continuous variables (such as age, BMI, and lesion size) represented as mean ± standard deviation (SD) and categorical variables (such as gender, BMI categories (underweight, normal, overweight and obese) and others)., and ultrasound features of fibroadenoma presented as frequencies and percentages. To infer about the relationship between obesity and the results of fibroadenoma ultrasonography, the participants were classified as per BMI. Appropriate statistical tests such as correlation analysis, Chi-square test and analysis of variance (ANOVA.) were used to establish the association between BMI and fibroadenoma ultrasound characteristics. The statistically significant p-value was considered to be less than 0.05.

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In order to make the comparison and understanding of the data easier, the data were provided in a form of tables, graphs and charts.

Statistical analysis:

Descriptive statistics and a representation of the continuous variables in terms of mean and standard deviation of normally distributed data and percentages in the case of categorical variables e.g. BMI and ultrasound images of fibroadenoma were used to summarize the data. It is possible to determine the strength and direction of correlations between continuous variables particularly or especially BMI, fibroadenoma characteristic lesion size and number by use of correlation analysis. To test the association and the differences in the BMI groups and ultrasound features of fibroadenoma, inferential statistical tests such as Chi-square test and analysis of variance (ANOVA) were used to test the association and differences. Confidence intervals (95 percent) were reported where necessary and p-value, which was less than 0.05, was considered statistically significant. The statistical package helped in all the analyses, as SPSS.

CHAPTER 4
RESULTS

Age and frequency distribution

The age range of 18-25 is the most represented, 40 % with of respondents falling into this category, according to the statistics. 24.3% of the sample is in the 26–30 age range, suggested a moderate representation of older .35.7% of responses being between the ages of 31-35. Overall, the data indicates that people make up the majority of the sample. The bar chart represents the age of sample.

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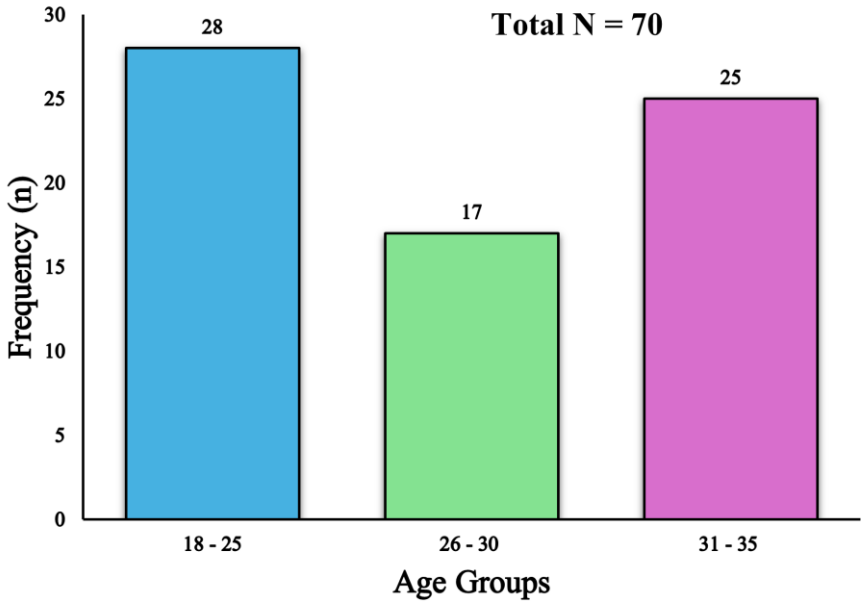

Figure 4.1: Age of patients

BMI and frequency distribution

Among the 70 participants, the highest proportion was classified as overweight (n=37,52.9%) followed by those with a normal BMI (n=30,42.9%). the smallest group was the obese category (n=3,4.3%). these findings indicates that more than half of sample fell within the overweight range. Graph Bar represented the BMI in figure 4.2.

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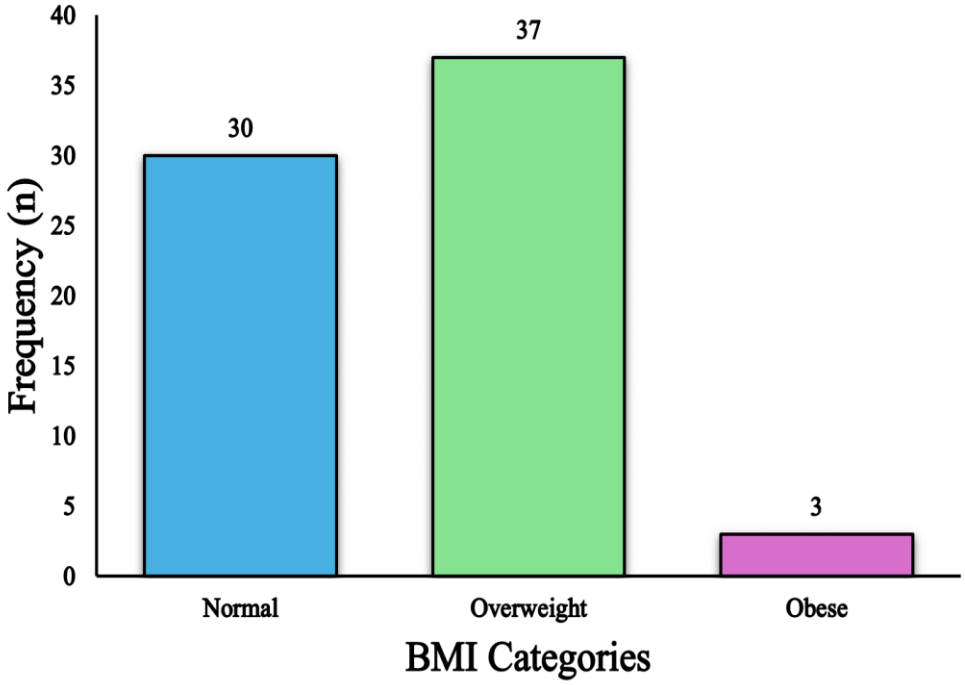

Figure 4.2: BMI in number of patients

Number of lesion and frequency distribution

Among the 70 participants the majority of them 58 participants (82.9%) presented with. Single lesion, 11 participants (15.7%) presented with two lesions and one participant (1.4%) had three lesions. These findings indicates that solitary lesions are relatively more common than multiple lesions in clinic. The bar chart represented the number of lesions in figure 4.3.

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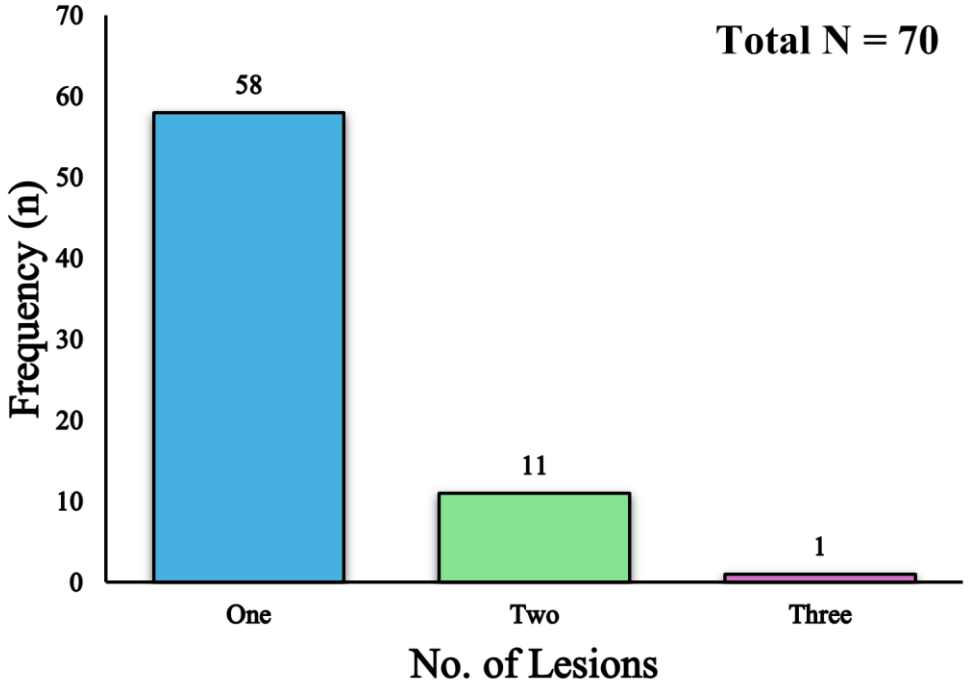

Figure 4.3: Number of lesions in fibro adenoma

Lesion shape and frequency distribution

Out of 70 cases, the majority were, the majority of lesions are oval in shape (n=59,84.3%), while 7 lesions (10.0%) were round to oval and 4 lesions (4.5%) were oval to round. overall findings indicates that most of lesions were oval in shape and oval to round and oval to round are less common. The bar chart presented the lesions shape Figure

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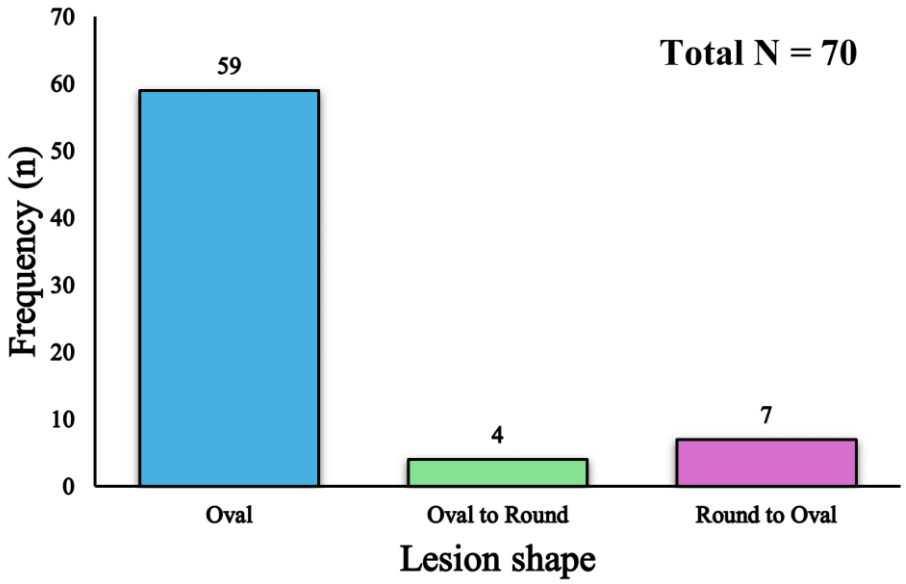

Figure 4.4: Distribution of lesion shape among patients

Echogenicity and frequency distribution

Among the 70 cases, most of the lesions (n=39,55.7%) were appeared hypoechoic. Heterogenous lesions were observed in 18 cases (25.7%), followed by isoechoic lesions were observed in 7 cases (10.5%) **mild heterogenous lesions accounted for 6 cases** (8.5%). overall findings suggest that hypoechoic lesions were most common in presented cases. Graph chart represented the echogenicity in fibroadenoma in figure 4.5.

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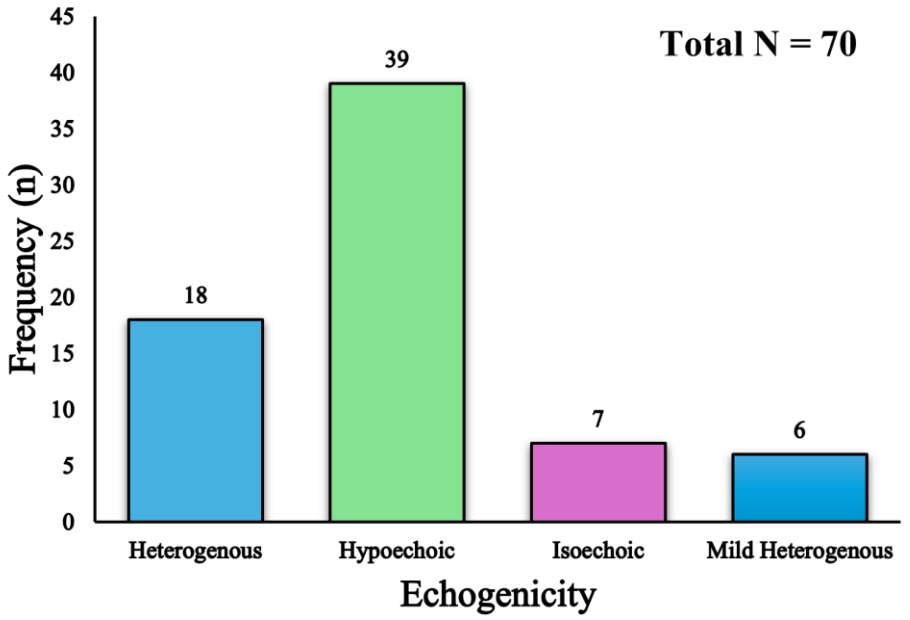

Figure 4.5: Distribution of lesion echogenicity among patients

Margins and frequency distribution:

Among the 70 participants, the majority of lesions (n= 50 ,71.4%) had smooth margins, suggesting the benign features, irregular margins were seen in (n=16, 22.9%), mildly irregular margins in (n=4,5.7%). the findings indicates that lesions with smooth margins are more common than irregular margins. The bar chart represented the margins of lesion in figure 4.6.

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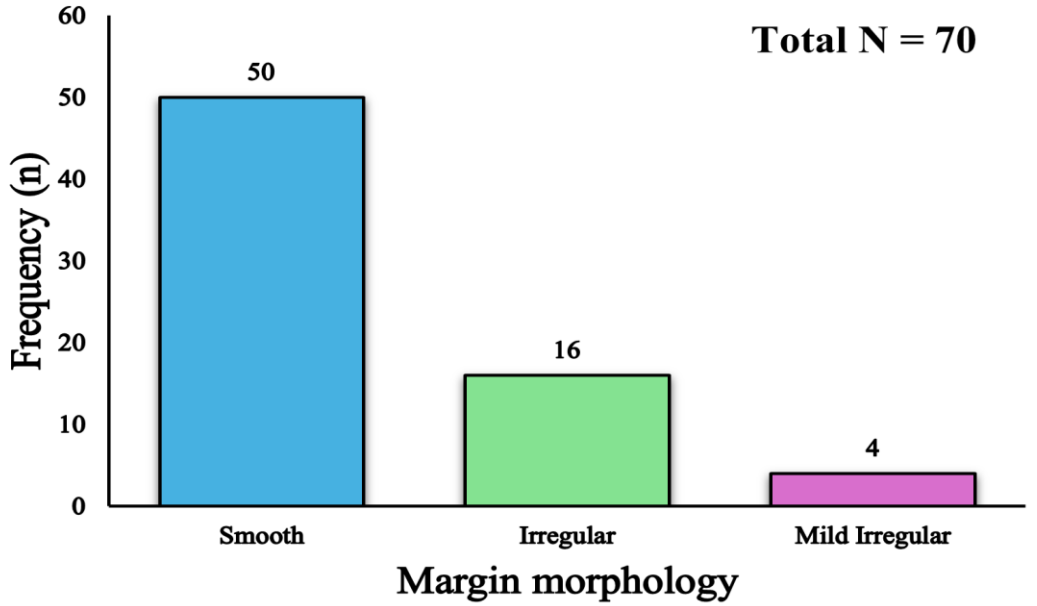

Figure 4.6: Distribution of lesion margins among patients

Breast side and frequency distribution

Amon the 70 participants. The distribution of patients is generally indicated left-sided involvement was predominance (n=42,60.5%). Right side of breast was observed in 19 cases (27.1%) and bilateral breast involvement were in 9 cases (12.8%) The bar chart represented the breast side involved in fibro-adenoma shown in figure 4.7.

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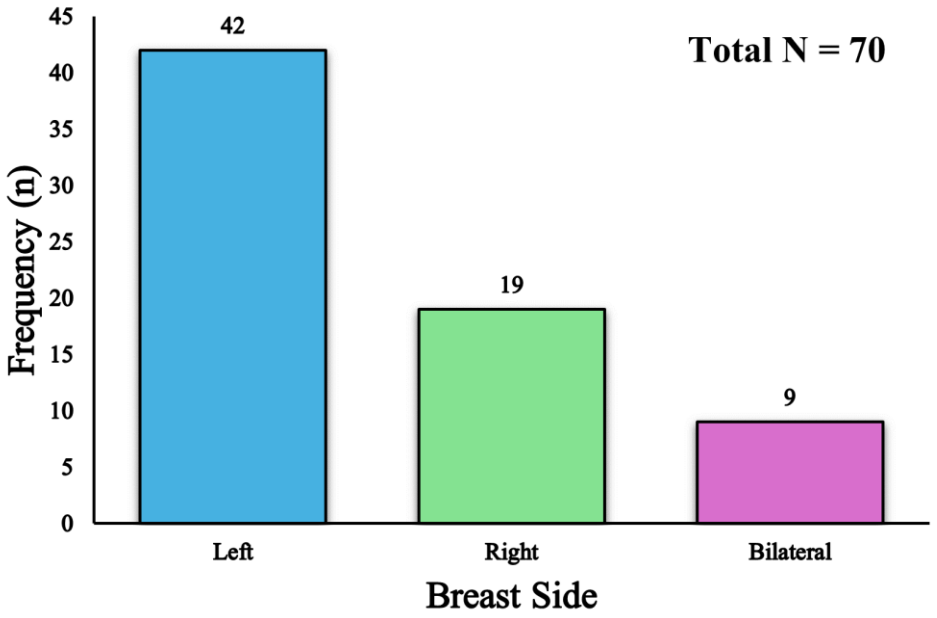

Figure 4.7: Distribution of breast side in fibroadenoma

Vascularity and frequency distribution:

Among the 70 lesions, 68 lesions were observed with no blood flow (vascularity), while 2 lesions (2.9%) showed vascularity .so findings indicates that vascularity is rare feature of the fibroadenoma. The bas chart represents the vascularity in lesions.

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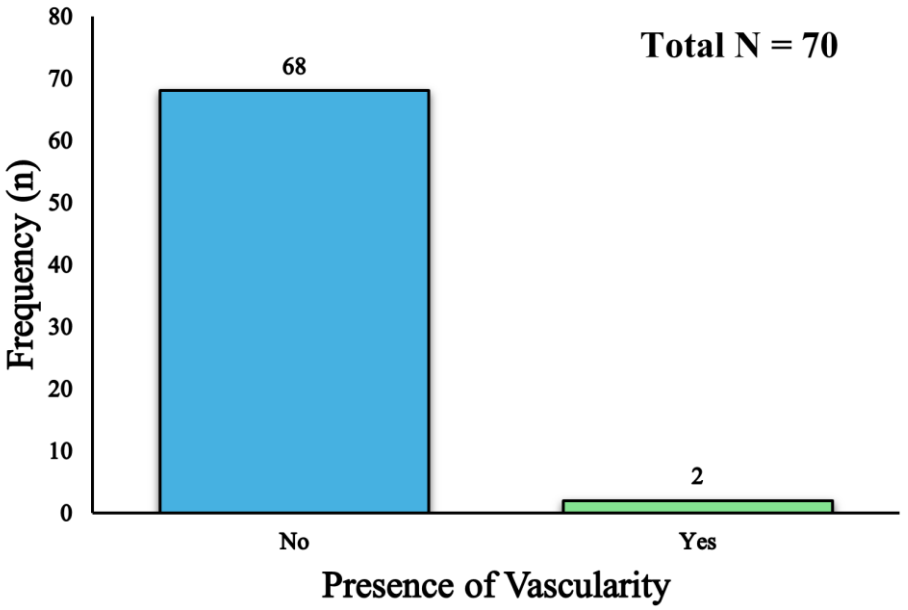

Figure 4.8: Distribution of lesion vascularity among patients

BIRADS and frequency distribution

Out of 70 cases, the majority were benign fall into BIRADS-II category (n=48, 68.6%) and (n= 22 ,31.4%) were in BIRADS-III category (probably benign) .so overall most lesions are in study were in benign category Only a very limited number showed suspicious findings. Bar chart represented the BIRADS categories in figure 4.9.

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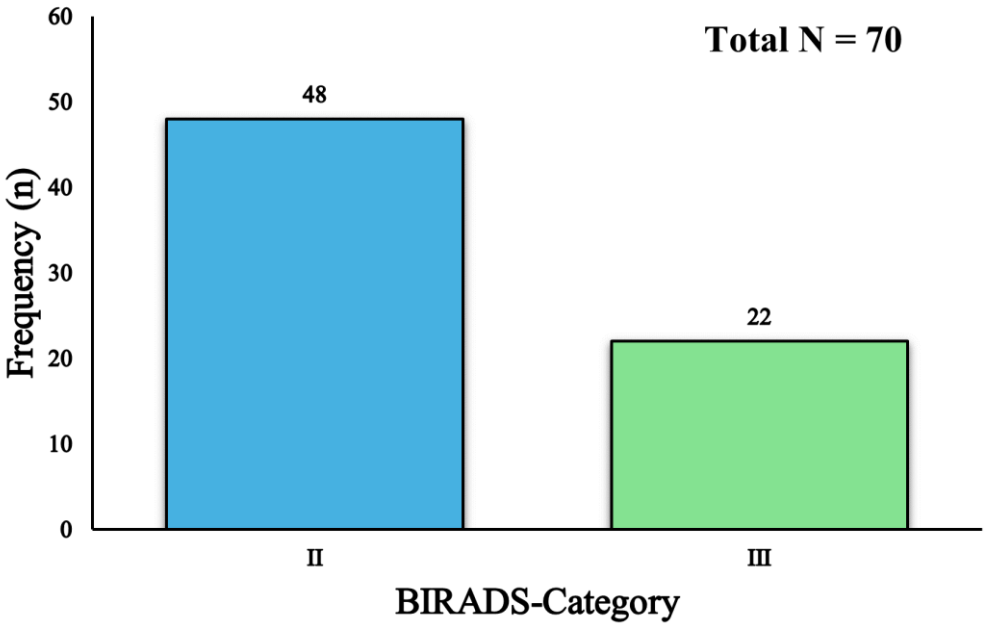

Figure 4.9: BIRADS categories in number of patients

Table 1. Descriptive Statistics

	Mean	Mode	Standard Deviation	Maximum	Minimum
Age	27.27	20	5.288547727	35	18
BMI value	25.52	26	3.050314653	32.2	18.8
Lesion size(cm)	1.6	1.4	1.007779265	7.5	0.6
No of lesions	1.18	1	0.427085069	3	1

Descriptive Statistics of Age, BMI, Lesion size (cm), and no of lesions

Table 1 presents the descriptive statistics of key continuous variables, including body mass index (BMI), lesion size and no of lesions among the study participants.

The **mean age** of participants was 27.27 + 5.29 years, with range from 18 to 35years, indicating that majority of study population consisted of young adults. The **mean BMI** was 25.52 +3.05kg/m with values ranging from 18.8 to 32.2kg/suggesting that most participants fell within the normal to overweight categories.

Regarding lesion characteristics, **the lesion size** was 1.6 +1.01cm, with minimum of 0.6cm and maximum of 7.5cm, demonstrating variability in tumor size among patients. The mean **number of**

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lesions was 1.18+ 0.43, indicating the most patients presented with a single fibroadenoma, reflected by the mode value of 1.

Overall, these findings indicate that fibroadenoma in this study population predominantly occurred as small, solitary lesions in young adults.

Table 2. Association between BMI and Sonographic features of breast fibroadenoma

Sonographic features	Normal N = 30	Obese N = 3	Overweight N = 37	*p*-value
Echogenicity				0.0038*
Heterogenous	2 (6.66%)	3 (100%)	13 (35.13%)	
Hypoechoic	21 (70%)	0	18 (48.64%)	
Isoechoic	5 (16.66%)	0	2 (5.4%)	
Mild heterogenous	2 (6.66%)	0	4 (10.81%)	
Margins				0.023*
Irregular	4 (13.33%)	3 (100%)	9 (24.32%)	
Mild irregular	1 (3.33%)	0	3 (8.10%)	
Smooth	25 (83.33%)	0	25 (67.56%)	
Lesion shape				0.23
Oval	28 (93.33%)	2 (66.66%)	29 (78.37%)	
Oval to round	1 (3.33%)	0	3 (8.10%)	
Round to oval	1 (3.33%)	1 (33.33%)	5 (13.5%)	
Vascularity				1
No	29 (96.66%)	3 (100%)	36 (97.29%)	
Yes	1 (3.33%)	0	1 (2.70%)	
BIRADS-category				0.016*
II	24 (80%)	0	24 (64.86%)	
III	6 (20%)	3 (100%)	13 (35.13%)	

Note: Data presented as n (%). *p-values calculated using Fisher's Exact Test

Table 2 illustrates the association between BMI categories (normal, overweight and obese) and the sonographic features

1-Echogenicity: A statistically significant association was observed between BMI and echogenicity (p=0.003). the majority of lesions in the normal BMI group were hypoechoic (70%) where's all lesions in the obese group were heterogenous (100%).in overweight group lesions showed a mixed pattern with hypoechoic (48.64%) and heterogeneous (35.13%) appearances being most common.

2-Margins: A significant association was also found between BMI and lesion margins(p=0.023). Most lesions in the normal BMI group demonstrated smooth margins (83.33%) consistent with benign characteristics.in contrast, all lesions in the obese group showed irregular margins (100%),

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while the overweight group observed a combination of smooth (67.56%) and irregular (24.32%) margins.

3-Lesion shape: no statistically significant association was observed between BMI and lesion shape (p=0.23). the majority of lesions across all BMI were oval in shape, particularly in the normal BMI group (93.33%) and overweight group (78.37%) indicating a consistent benign morphological pattern.

4-vascularity: There was no significant association between BMI and vascularity (p=1.00). the vast majority of lesions across all BMI groups shoed absence of vascularity.

5-BIRADS: A statistically significant association between BMI and BIRADS category (p=0.016). most lesions in the normal and overweight groups were classified as BIRADS-II (benign), where's all lesions in the obese group were categorized as BIRADS-III (probably benign)

Table 3: Test of Normality

Tests of Normality							
	BMI Group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Lesion Size	normal	.341	30	**.000**	.451	30	.000
	overweight	.242	37	**.000**	.807	37	.000
	obese	.253	3	**.**	.964	3	**.637**
No of Lesions	normal	.517	30	**.000**	.404	30	.000
	overweight	.485	37	**.000**	.502	37	.000
	obese	.385	3	**.**	.750	3	.000
Age	normal	.172	30	**.023**	.906	30	.012
	overweight	.144	37	**.051**	.910	37	.006
	obese	.253	3	.	.964	3	**.637**
a. Lilliefors Significance Correction							

The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to test the key variables on test of normality. The results indicate that more variables, did not follow the normal distribution ($p < 0.05$). The size of lesions and the number of lesions had significant deviation of normality whereas the age had partial deviation of normality. Hence, non- parametric test was taken and Kruskal-Walli's test were used to compare across BMI group.

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Table 4: Kruskal-wallis test

Test Statistics[a,b]			
	Lesion Size	No of Lesions	Age
Kruskal-Wallis H	10.534	.944	1.338
df	2	2	2
Asymp. Sig.	.005	.624	.512
a. Kruskal Wallis Test			
b. Grouping Variable: BMI Group			

Kruskal-Wallis test revealed that there is a statistically significant difference in the size of the lesions between BMI group which showed that the size of lesions depends on the BMI. However no significant difference were found for the no of lesions and age, suggesting that these variables are not affected by BMI.

Table 5: Master table

	BMI Group	N	Mean Rank	Test Statistics[a,b]		
				Kruskal-Wallis H	df	Asymp. Sig.
Lesion Size	normal	30	28.63	10.534	2	0.005
	overweight	37	38.72			
	obese	3	64.50			
	Total	70				
No of Lesions	normal	30	34.10	0.944	2	0.624
	overweight	37	36.19			
	obese	3	41.00			
	Total	70				
Age	normal	30	33.13	1.338	2	0.512
	overweight	37	36.55			
	obese	3	46.17			
	Total	70				
a. Kruskal Wallis Test						
b. Grouping Variable: BMI Group						

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Descriptive Statistics									
		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Lesion Size	normal	30	1.6233	1.23419	.22533	1.1625	2.0842	.90	7.50
	overweight	37	1.6189	.59667	.09809	1.4200	1.8179	.60	4.00
	obese	3	3.3333	1.52753	.88192	-.4612	7.1279	2.00	5.00
	Total	70	1.6943	1.00778	.12045	1.4540	1.9346	.60	7.50
No of Lesions	normal	30	1.1333	.34575	.06312	1.0042	1.2624	1.00	2.00
	overweight	37	1.2162	.47930	.07880	1.0564	1.3760	1.00	3.00
	obese	3	1.3333	.57735	.33333	-.1009	2.7676	1.00	2.00
	Total	70	1.1857	.42709	.05105	1.0839	1.2875	1.00	3.00
Age	normal	30	26.6000	5.30842	.96918	24.6178	28.5822	19.00	35.00
	overweight	37	27.5405	5.41907	.89089	25.7337	29.3473	18.00	35.00
	obese	3	30.6667	1.52753	.88192	26.8721	34.4612	29.00	32.00
	Total	70	27.2714	5.28855	.63210	26.0104	28.5324	18.00	35.00

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			BIRADS Category		Total
			II	III	
BMI Group	normal	Count	24	6	30
		Expected Count	20.6	9.4	30.0
	overweight	Count	24	13	37
		Expected Count	25.4	11.6	37.0
	obese	Count	0	3	3
		Expected Count	2.1	.9	3.0
Total		Count	48	22	70
		Expected Count	48.0	22.0	70.0

			Echogenicity				Total
			isoechoic	hypoechoic	heterogenous	mild heterogenous	
BMI Group	normal	Count	5	21	2	2	30
		Expected Count	3.0	16.7	7.7	2.6	30.0
	overweight	Count	2	18	13	4	37
		Expected Count	3.7	20.6	9.5	3.2	37.0
	obese	Count	0	0	3	0	3
		Expected Count	.3	1.7	.8	.3	3.0
Total		Count	7	39	18	6	70
		Expected Count	7.0	39.0	18.0	6.0	70.0

			Margins			Total
			smooth	irregular	mild irregular	
BMI Group	normal	Count	25	4	1	30
		Expected Count	21.4	6.9	1.7	30.0
	overweight	Count	25	9	3	37
		Expected Count	26.4	8.5	2.1	37.0
	obese	Count	0	3	0	3

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		Expected Count	2.1	.7	.2	3.0
Total		Count	50	16	4	70
		Expected Count	50.0	16.0	4.0	70.0

			Lesion shape			Total
			oval	round to oval	oval to round	
BMI Group	normal	Count	28	1	1	30
		Expected Count	25.3	3.0	1.7	30.0
	overweight	Count	29	5	3	37
		Expected Count	31.2	3.7	2.1	37.0
	obese	Count	2	1	0	3
		Expected Count	2.5	.3	.2	3.0
Total		Count	59	7	4	70
		Expected Count	59.0	7.0	4.0	70.0

			Vascularity		Total
			no	yes	
BMI Group	normal	Count	29	1	30
		Expected Count	29.1	.9	30.0
	overweight	Count	36	1	37
		Expected Count	35.9	1.1	37.0
	obese	Count	3	0	3
		Expected Count	2.9	.1	3.0
Total		Count	68	2	70
		Expected Count	68.0	2.0	70.0

CHAPTER 5
DISCUSSION

The age of most respondents (18-35 years old) indicates that the fibroadenoma mostly affects younger women. This observation concurs with existing literature with identifies fibroadenoma as the most common benign lesion in women of reproductive age, the mean age of 27.27+5.29 years

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further support the propensity of fibroadenoma to be present in early adulthood [31]. Where's respect to BMI distribution, most participants were categorized as overweight (52.9%), followed by normal BMI (42.9%) where's only small per portion fell into obese category (4.3%). the distribution suggests that fibroadenoma is not restricted to a specific BMI group, however overweight individuals formed a larger proportion of the sample. These results are in line with earlier researches, which recommend the possibility of association between the high BMI and benign breast conditions, although the relationship between the two are controversial [33].

The correlation between lesion size and BMI showed a statistically significant association (p=0.005 with larger lesions being identified in higher BMI groups. This evidence the idea that obesity modulates the tumor growth dynamics, probably through the action of hormonal and metabolic changes, including upsurge of estrogen levels, disbalance of adipocytes, chronic inflammation of the breast tissues [4]. Also, a strong correlation was observed between BMI and echogenicity, lesions margins and BIRADS classification suggesting that BMI could be a determinant of the ultrasound appearances and diagnostic categorization of fibroadenomas. Changes in echogenicity could be due to changes in breast composition with more adiposity and margins of lesions may be affected by changes in lesion growth pattern and surrounding tissue contrast. In the same line of thought, variability in BIRADS classification implies that BMI can influence radiological interpretation either by enhancing lesion conspicuity in fatty breast, or by creating technical impediments to image acquisition [34]. Conversely, vascularity and lesion shape showed no statistically significant correlation with BMI (p=0.624), indicating that vascularity or lesion shape are probably predetermined by hormonal or genetic factors instead of being influenced by the external factors [35].

One of the most notable limitations of this study is that the obese group is represented by a small sample (n=3) that might limit the generalizability of the results and lead to variability in both morphological and imaging characteristics. It is suggested that future researches that include larger and more balanced population be conducted to confirm these findings [36].

CONCLUSIONS / RECOMMENDATIONS

In summary, fibroadenoma in young adults predominantly presents as benign, well –circumscribed, hypoechoic lesions with minimal vascularity with minimal vascularity however, BMI appears to influence certain sonographic features, particularly echogenicity, lesion margins, and BIRADS category. higher BMI may be associated with relatively complex or less typical imaging features. Which could complicate interpretation, despite these variations, benign features as shape and vascularity remain largely unaffected by BMI. This study is limited by small sample size (n=70), geographical settings (Sargodha), short study duration, used only ultrasound modality and used the BMI as the solo for measuring obesity.

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