Addis Ababa University College of Health Sciences, School of Medicine, Department of Radiology

Dissertation paper for completion of radiology residency training

Title: Mammographic breast density pattern and its association with breast cancer among women sent for mammography in TASH and MCM hospitals, Addis Ababa, Ethiopia

A multicentric retrospective descriptive study

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Acknowledgement
First and foremost, God, Jesus Christ

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Abbreviations
AAU-Addis Ababa University

ACR-American college of radiology

BIRADS- breast imaging reporting and data system

BMI-body mass index

FNAC-fine needle aspiration cytology

MCM-Myung Yung Christian Medical College

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Abstract

Background

Mammography is the most effective imaging method for detecting breast cancer. It is a specialized X-ray that uses the attenuation difference in breast tissue of the fibroglandular and fibrofatty components. Breast density, which represents the ratio of fibroglandular and fatty tissue, could be assessed both quantitatively and qualitatively. Qualitative assessment based on the BIRADS category developed by ACR is the most commonly used method to assess breast density. Breast density category is described as A-almost entirely fatty, B-scattered fibroglandular, C-heterogeneously dense fibroglandular, and D-extremely dense. High breast density is defined as either category C or D, which accounts for around 50% in the US. Breast density distribution is variable among different geographic regions, ethnic groups, age, body habitus, and other factors. High breast density is a strong, established risk factor for breast cancer, evidenced in many global studies. This study aims to assess patterns of mammographic breast density; it will be a baseline for further study as there is no similar local data.

Methods and materials

A retrospective descriptive study which included 272 women with either screening or diagnostic mammography from two teaching hospitals, Tikur Anbesa Specialized Hospital/TASH/ and Myung Yung Christian Medical College/MCM/, from Addis Ababa, Ethiopia. A total of 272 cases, 141 from TASH and 131 from MCM, were included. The data was collected from the electronic PAC system retrospectively from July 2023 to May 2025, subsequently downloaded and revised by the principal investigator. For those patients with a suspicious mass, either biopsy or FNAC was performed for and those with available results were included in the study. Breast density was categorized based on the 5th edition. Finally, the data was entered, cleaned, checked for appropriateness, processed, and analysed using SPSS V27.

Result

Among the 272 women included in the study, the age range was 36-77 years, with a median age of 48years, 67.3% of these were within the range of 41-60 years. BIRADS B was the most common density pattern, which accounted for 48.5%, followed by BIRADS A, which accounted for 23.9%. So, the low-density (BIRAD A and B) pattern was the predominant pattern, 72.4%. BIRADS D was the least common and accounted for 4%. Age showed significant correlation with breast density, with a chi square of X^2=92.2, p value <0.001. The effect size, as measured by Cramer's V, was 0.34, indicating a moderate association. As age increased, the breast density decreased; BIRADS D density was not seen in those above the age of 50 years. Breast cancer prevalence was 12.1%. The prevalence of breast cancer in each category showed high prevalence in dense breast, 33.3% in BIRADS C, 27.3% in BIRADS D, 13.6% in BIRADS B and 6% in BIRADS A. Logistic regression was calculated to see if there was any association of breast cancer with high breast density, family history of breast cancer and increasing age; the calculated odds ratio were 2.08, 3.59 and 1 respectively. But the p-values were high, >0.05, so these correlations were not statistically significant. But we cannot conclude the absence of correlation as the sample size is by far too small.

Conclusion

In conclusion, scattered fibroglandular density -BIRADS B is the most common pattern, followed by almost entirely fatty density -BIRADS A. Breast density showed an inverse correlation with age.

However, there was no statistically significant correlation between breast density and breast cancer, most likely because of the limited sample size. This is a baseline study, and we recommend future research with a larger sample size.

1. Introduction

1.1Background

Mammography is a unique type of imaging that employs X-rays to make detailed pictures of the breast structure and find and describe lesions in the breast. It uses the density difference in the different breast tissue composition, which includes glandular and stromal structures (fat and connective tissue).

It is the most commonly used imaging modality for screening of breast cancer in those women with high risk, so that early detection and mortality reduction are possible. (1)

Mammographic breast density is a measurement of cumulative estrogen exposure as well as a measure of parenchymal breast patterns on the film. Women with higher tissue densities have a sixfold higher risk of breast cancer than women with lower tissue densities.(2)

Mammographic breast density represents the different amounts of stromal and epithelial tissues (white areas on mammograms) and fat (black areas) in the breast.(3)

The Breast Imaging Reporting and Data System (BI-RADS) vocabulary serves as the principal communication instrument utilized in mammography reports across most countries with established breast cancer screening initiatives.

Breast Imaging Reporting and Data System (BI-RADS), developed by the American College of Radiology, is used to qualitatively score the density of breast tissue from mammography exams into four categories as almost entirely fat, scattered fibroglandular densities, heterogeneously dense, and extremely dense. BIRADS is also used to describe findings into seven categories and provides recommendations based on the category's probability of malignancy. BIRADS 0 -incomplete, so either more imaging or comparison with previous image is recommended; BIRADS 1- negative; BIRADS 2 benign, both BIRADS 1 and 2 require no further imaging; BIRADS 3 probably benign, 6months follow-up is recommended; BIRADS 4 suspicious abnormality and biopsy is recommended, it's further divided into three subgroups based on the probability of malignancy; BIRADS 5 highly suggestive of malignancy and biopsy is strongly recommended; BIRADS 6 biopsy-proven breast cancer.(4)

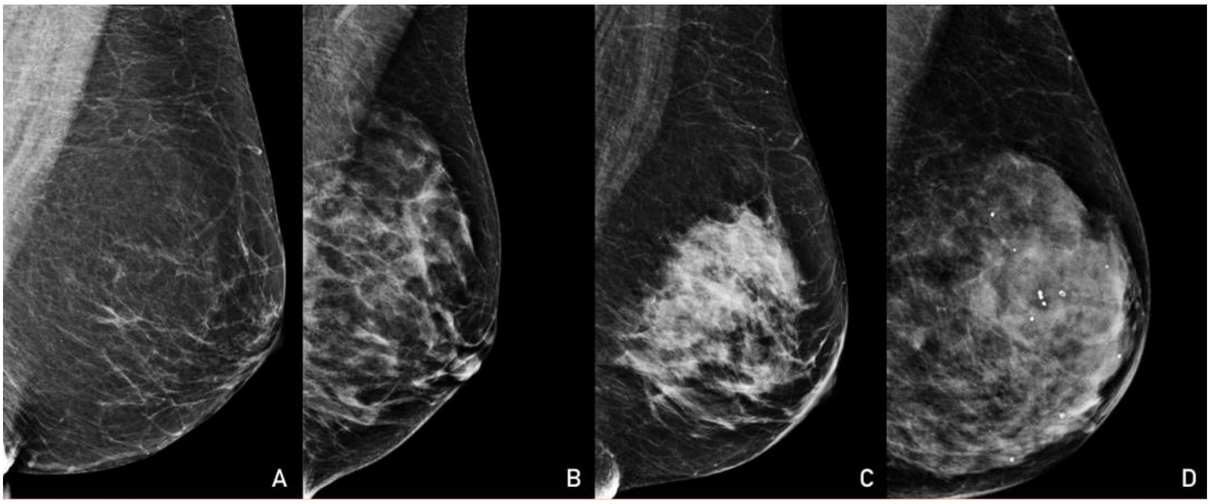

Figure 1: The four BI-RADS density categories are shown in mediolateral oblique mammography views as follows: (A) nearly completely fat (BI-RADS A density); (B) dispersed fibroglandular densities (BI-RADS B density); (C) inconsistently/heterogeneously dense (BI-RADS C density); and (D) highly dense (BI-RADS D density) (3).

In a large population study in the US, those with entirely fatty breast accounted for 10%, scattered fibroglandular densities 40%, heterogeneously dense breast accounted for 40% and extremely dense breast accounted for 10%.(3)

A mammographically dense breast is either a heterogeneously dense or an extremely dense category. (3-5)

Dense breast tissue is one of the most powerful known risk factors for breast cancer. Compared to women with low mammographic density, those with high mammographic density have a higher lifetime risk of developing breast cancer due to their higher stromal and epithelial cell and lower levels of fatty adipose tissue. Because non-calcified tumours are hidden by high breast density, mammography's sensitivity is reduced, potentially postponing diagnosis and leading to worse outcomes.(5). In dense breast tissue, mammography screening may be less effective at identifying worrisome lesions.(6)

1.2Statement of the problem

Global studies have shown variable dense breast prevalence attributable to ethnicity, lifestyle, body habitus, parity, and other factors. (7)The risk of breast cancer is higher in people with dense breast tissue, but the precise risk is unknown because breast tissue density depends on a number of factors, such as age, endogenous and exogenous hormones, radiation therapy, chemotherapy, and lactation.(8).

There are a few African studies on mammographic breast density patterns and high density as a risk factor for breast cancer.(9, 10)

To the best of our knowledge, past research on the distribution patterns of breast density, its determinants, and its correlation with breast cancer has not been conducted in Ethiopia.

1.3. Justification and significance of the study

Despite being a well-established, independent, and potent risk factor for breast cancer development, high breast density is dependent on both genetic and environmental factors (7).

Our study will be a baseline for mammographic breast density patterns, their influencing factors, and the relation with breast cancer among Ethiopian women.

It will be used as a baseline study for local reference and guide for a larger study in the future.

2. Literature review

2.1. Mammographic breast density pattern

Mammographic breast density pattern shows different percentages of distribution, and depends on different factors.

In a study done in the US from the breast cancer registry center, from collected data of women with screening mammography, it showed 43.3% of dense breast, either heterogenous or extremely dense breast, among women of 40-70 years, which is the recommended screening age range.(11).

Another cross-sectional study done in Selangor, Malaysia, where the medical charts of women within the age range of 45-69 years who had screening mammography were reviewed, showed BIRAD-B category was the commonest, accounting for 56% followed by BIRAD-C, accounting for 30.7%. It also showed that while there is no discernible correlation between ethnic groupings and breast density, age does have an impact on breast density.(12).

In a prospective study done in 2015, in Bayero University, Kano, Nigeria, among women with an age range of 21-70 years during a screening campaign, it was found that 44% of participants had BIRAD-A /fatty breast, and BIRADS-D was the least common. (13).

Similarly, a cross-sectional study done in Uganda in a national referral hospital among women with an age range of 33-59 years sent to the radiology department, mammographic density interpreted by a senior experienced radiologist showed 67.9% of participants had fatty and scattered fibroglandular appearance, defined as low density. High breast density accounted for 25.8% (20.5% had heterogeneously dense and 5.3% had extremely dense breasts), showing significant disparity from studies done in the USA and Europe.

A cross-sectional study done in Israel comparing breast density among Ethiopian immigrants and their age-matched Israeli-born women, with further categorization of Ethiopian immigrants as recent if less than two years and longer-standing immigrants if above 2years, showed significantly lower breast density in Ethiopian immigrants. Recent immigrants showed lower breast density than longer-standing immigrants, showing a positive correlation between duration of migration and breast density. The Ethiopian immigrants had a higher number of live births and a significantly higher duration of breastfeeding. (14).

2.2 Factors affecting breast density

A retrospective screening mammography examination at the Breast Imaging Center of New York University (NYU) Langone Medical Center, which aimed to evaluate high breast density and age, revealed an inverse relationship between the two. The prevalence of high breast density was 74% among women aged 40–49, 57% among those in their 50s, 44% among those in their 60s, and 36% among those in their 70s (15).

A retrospective study was conducted in the US by analysing mammographic data of women who presented for screening from two centers, (Capital Breast Care Center and MedStar Georgetown University Hospital) from January 2010 to December 2014, which has compared breast density among multiethnic women, it showed Hispanic, premenopausal and lower BMI subjects had the highest breast density. On the other hand, increasing age, obesity, higher parity, and postmenopausal status had a negative relation with high breast density. (16).

Another large group cross-sectional study conducted at Washington University School of Medicine's Joanne Knight Breast Health Center over a 5-year period from 2010 to 2015 among women of various ethnic groups revealed that the most significant predictor of breast density was current BMI (17).

A similar cross-sectional study from Iraq among women with an age range of 40-75 years, sent for screening, showed that dense breast accounted for 54.3% of which 50% had heterogeneous density. In this study, breast density showed an inverse relation with age and a longer breastfeeding period. (18).

A prospective cross-sectional study in two tertiary hospitals in Pakistan in women undergoing screening mammography in the years 2015 to 2019, showed that the majority of women, (around 62.4%) had dense breasts. High breast density showed a positive association with younger age and a negative association with higher BMI. It did not show a significant association with diet and breast cancer. (19).

In order to find any correlation between high breast density and a family history of breast cancer, premenopausal women who attended for screening mammograms at the Sheikh Mohammed Hussien AL-Amoudi Center of Excellence in Breast Cancer in Saudi Arabia participated in another cross-sectional study. Women who have a family history of breast cancer are almost 87% more likely to have thick breasts, according to the study (20).

2.3 High breast density and its association with breast cancer

A systematic review and metanalysis done in 2022 at the University Medical Center Groningen, University of Groningen, Groningen, the Netherlands, by revising articles published since 2013, that used BIRADS-5th edition, showed a 2.1times increased risk of breast cancer in those with extremely dense breast compared to those with scattered fibroglandular density, which is significant but lower estimate than previous findings which could be attributable to use of digital mammography and BIRADS-5th edition.(21).

In South Korea, case-control research was conducted at many cancer clinics to determine whether there was a correlation between breast cancer and dense breasts. The study included age-matched women with normal screening mammograms and women with breast cancer diagnoses. Women with very dense breasts had a five-fold increased risk of breast cancer compared to those with completely fatty breasts. Younger women had larger breast densities and were more likely to have breast cancer. Menopausal women also exhibited a favourable correlation with dense breasts, although the effect on breast cancer was greater in premenopausal women (22).

Another cross-sectional prospective study done in Egypt in women sent for screening data collected for a year (2020-2021), showed the incidence of breast cancer was higher in those with dense beast with incidence of 27.8% in category IV and 16.7% in category III, but category I and II incidence were 6.3 % and 8.5% respectively (23).

A case control study was done at a national Referral and teaching Hospital, Mulago in Kampala, Uganda, over six months from October 2009 to March 2010, among referred women for mammography; those with normal mammography were taken as controls, and those with breast cancer as cases. The overall prevalence of high-density breast (defined as BIRADS-III and IV) was 39%, and in the cases it was 51%, and in the controls it was 9%, establishing a positive association between high breast density and breast cancer. (9).

3. Objectives

3.1. Main objective

The study's primary goal is to determine the frequency of mammographic breast density patterns and how they relate to breast cancer.

3.2 Specific objectives

To determine the prevalence of mammographic breast density patterns

To identify the association of breast density and breast cancer

To determine factors associated with high breast density

4. Methodology and materials

4.1 Study area and period

The research was conducted at two selected teaching hospitals with functional mammographic service, in Addis Ababa, Ethiopia, between July 2023 to May 2025.

Tikur Anbesa Specialized Hospital/ TASH, Addis Ababa, Ethiopia

TASH is a tertiary hospital and academic center, one of the few cancer treatment centers in the country, and its radiology department has a breast imaging unit which provides mammographic services to patients sent to the hospital from all corners of the country; this has the advantage of different ethnic group representations. The hospital provides screening service for the staff member up on request.

MCM Comprehensive Specialized Hospital is a non-profit private teaching institution that is under the Myung Sung International Development Group. It has a well-organized radiology unit and provides mammographic services.

4.2 Study design

It was a multicentric institution-based based retrospective, descriptive, cross-sectional study.

4.3 Study population

The Source population were women older than 35 years of age who were sent for breast imaging at the respective breast imaging units of the above-mentioned hospitals. A lower age range was set at 35 years based on previous studies showing a younger age of onset of breast cancer in African women compared to the Western population.

The study population was women with complete mammographic images, either screening or diagnostic studies.

4.4 Inclusion and exclusion criteria

4.4.1 Inclusion criteria

Women who have complete mammographic images at least two standard views- craniocaudal and mediolateral oblique

For those with breast cancer pathologic diagnosis, either FNAC or biopsy should be available

4.4.2 Exclusion criteria

If there is a significant asymmetry in breast density between the two breasts (if the difference falls in the two categories, non-dense (I and II) and dense (III and IV))

Any previous breast surgery

Women with benign breast pathologies

4.5. Study variable

A. Dependent variable

-Mammographic breast density

-Breast cancer

B. Independent variable

-Age

-Family history of breast cancer

4.6. Sample size and sampling technique

The Cochran formula was used to determine the sample size because the target population was big and hard to estimate. With a 95% confidence interval, a 5% maximum allowable margin of error, and a 50% population percentage, the sample size was determined to be 385.

Cochran's sample size formula

$$n_0 = \frac{z^2 \cdot p \cdot (1 - p)}{e^2}$$

p: the population size

e: the margin of error

z: the *z*-value, extracted from a *z*-table

Convenient sampling was used as it was easier, efficient, and more practical

In this study, 272 women (70% of the calculated sample) were included because the estimated sample size could not be reached.

4.7 Data source and collection method

Mammographic data of women above 35 years of age who were sent for breast imaging, both diagnostic and screening mammograms from July 2023 to May 2025, taken from the PACS of both TASH and MCM hospitals, were collected and then downloaded. Images were then assessed for completeness and adequacy.

From the electronic system of both hospitals, demographic data of patients (women's age and family history of breast cancer) and for those with breast cancer biopsy or FNAC results were obtained from the electronically attached pathology report.

Breast density category was assessed by one radiologist who was blinded to the women's age, family history of breast cancer, and self-history of breast cancer diagnosis and classified based on BIRADS 5th edition into four categories and final mammographic breast density as either low density or high density breast.

4.8 Data entry, quality control, cleaning, and processing

The mammographic data used were obtained from PACS of the above-mentioned hospitals and demographic data were collected through electronic data collecting tools. Data were entered into SPSS V27, imported from Excel, and thoroughly checked for accuracy. Missing values were identified and handled using imputation.

IBM SPSS V27.0 was used for processing and analysis. The frequency distribution of demographic characteristics and clinical risk factors were calculated.

4.9 Ethical consideration

Ethical clearance was obtained from the research and ethics committee of the Department of Radiology of Addis Ababa University. All patient identifications- name, card number, and specific address- were de-identified, and anonymity was assured. Individual consent was not obtained, as the study was retrospective; it was difficult to contact the participants.

At MCM Christian Medical College comprehensive specialized hospital, ethical clearance was also obtained.

5. Result

Around 272 women with 1088 mammographic images consisting of two standard views, craniocaudal and mediolateral oblique images of each breast, were revised by a radiologist. Images were assessed for completeness and adequacy.

Breast Imaging Reporting and Data System (BI-RADS) 5th edition, created by the American College of Radiology, was used to evaluate the breast density pattern and assign it to one of four groups. The final mammography density was classified as either dense breast (BIRADS C and D) or low density (BIRADS A and B).

5.1. Age category

In the 272 women included in the study, the age range was 36–77 years old, with a median age of 48years. The majority were in the age group of 41-50 years, accounting for 43.4% (118 cases from 272) of cases, followed by those between 51-60years of age, which accounted for 23.9% (65 cases from 272) (chart 1).

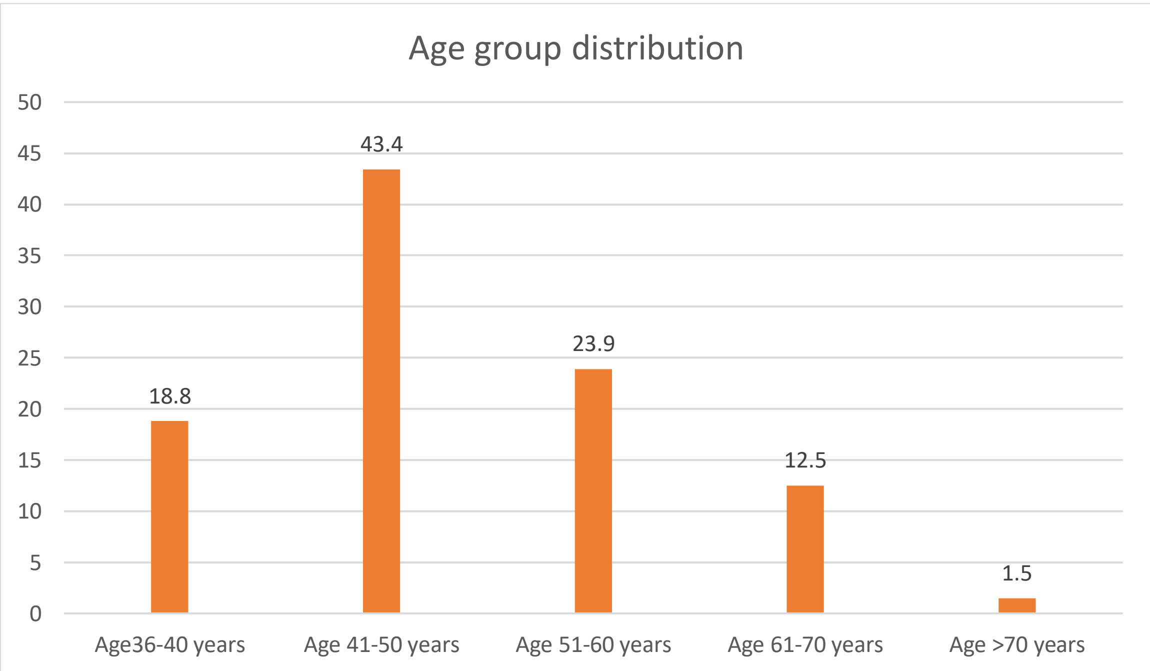

Chart 1: Shows the distribution among different age groups

5.2. Breast density pattern

The mammographic density pattern of 272 women was revised according to the 5^{th} edition of BIRADS, designed by ACR. Two standard mammographic views of each breast were analysed.

Among the 272 women, 132 had BIRADS B (scattered density), accounting for 48.9%, followed by 65 patients with BIRADS A /fatty breast density, accounting for 23.9%. BRADS-D (extremely dense) category was the least common, 11 cases out of 272, accounting for 4% of cases. BIRADS C (heterogeneously dense) category accounts for 23.2% (63 cases out of 272).

Breast BIRADS categories seen

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	BIRADS_A	65	23.9	23.9	23.9
	BIRADS_B	132	48.5	48.5	72.8
	BIRADS_C	64	23.5	23.5	96.0
	BIRADS_D	11	4.0	4.0	100.0
	Total	272	100.0	100.0	

Table 1 shows the number of women in each breast category and their corresponding percentage.

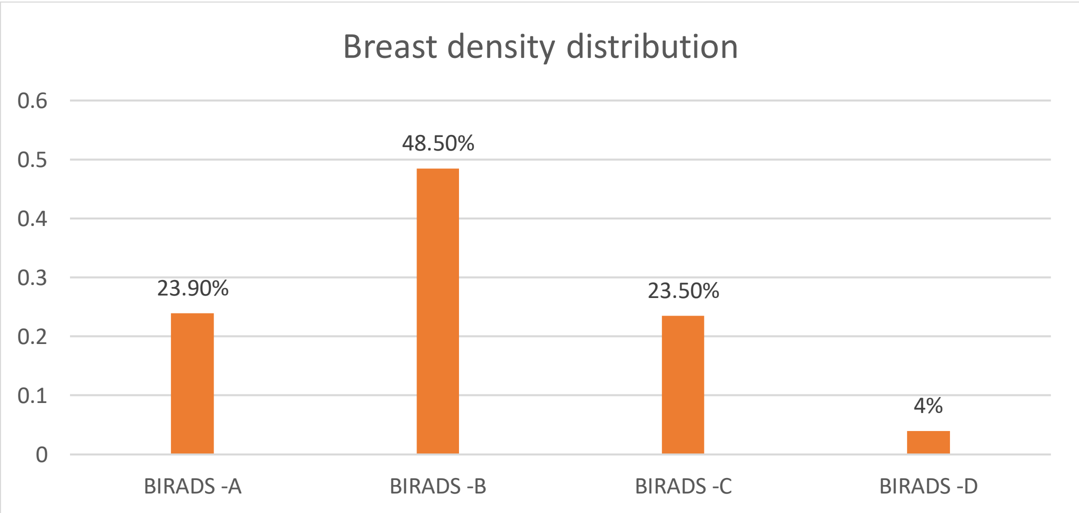

Chart 2 shows the distribution of mammographic breast density classified into four categories based on BIRADS.

Breast density can be grouped into low (BIRADS A and BIRADS B) and high (BIRADS C and BIRADS D). In this study, the majority of the cases, 197 out of 272 cases, accounting for 72.4% had low density pattern.

Final mammographic density

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High density (BIRADS C and D)	75	27.6	27.6	27.6
	Low density (BIRADS A and B)	197	72.4	72.4	100.0
	Total	272	100.0	100.0	

Table 2 shows the breast density proportion into two groups as low density and high density.

5.3. Breast density and women's age

When we see the breast density pattern, it has a variable distribution in different age groups. In the first age group between 35 to 40 years of age among 51 women 24 accounting for 47% had heterogeneously dense breast /BIRADS C, followed by 20 women (39.2%) having scattered fibroglandular density /BIRADS B, 6 women (11.8%) had extremely dense pattern and only 1 had almost entirely fatty pattern (chart 2).

In those between 41 to 50 years of age among 118 women, 65 cases, accounting for 55% have scattered fibroglandular density, followed by 34 cases, accounting for 28.8% have heterogeneously dense breast, and 14 cases, accounting for 11.8 % have almost entirely fatty breast and 5 cases, accounting for 4.2% have extremely dense pattern (chart 3).

In 51 to 60 years of age among 65 women, 35 of them accounting for 53.8% had scattered fibroglandular density, 27 of them accounting for 41.5% had almost entirely fatty density, and the remaining 3 cases accounting for 4.6% had heterogeneously dense breast (chart 4).

In the 61 to 70 years of age category among 34 women, 20 cases accounting for 58.8% had almost entirely fatty density, 12 of the cases accounting for 35.3% had scattered fibroglandular density, and 2 cases had a heterogeneously dense pattern (chart 5).

Above the age of 70 years, only 4 cases were seen, 3 of them had almost entirely fatty breasts, and 1 case had scattered fibroglandular density (chart 6).

BIRADS D category (extremely dense pattern) was not seen in those above 50 years of age in our study.

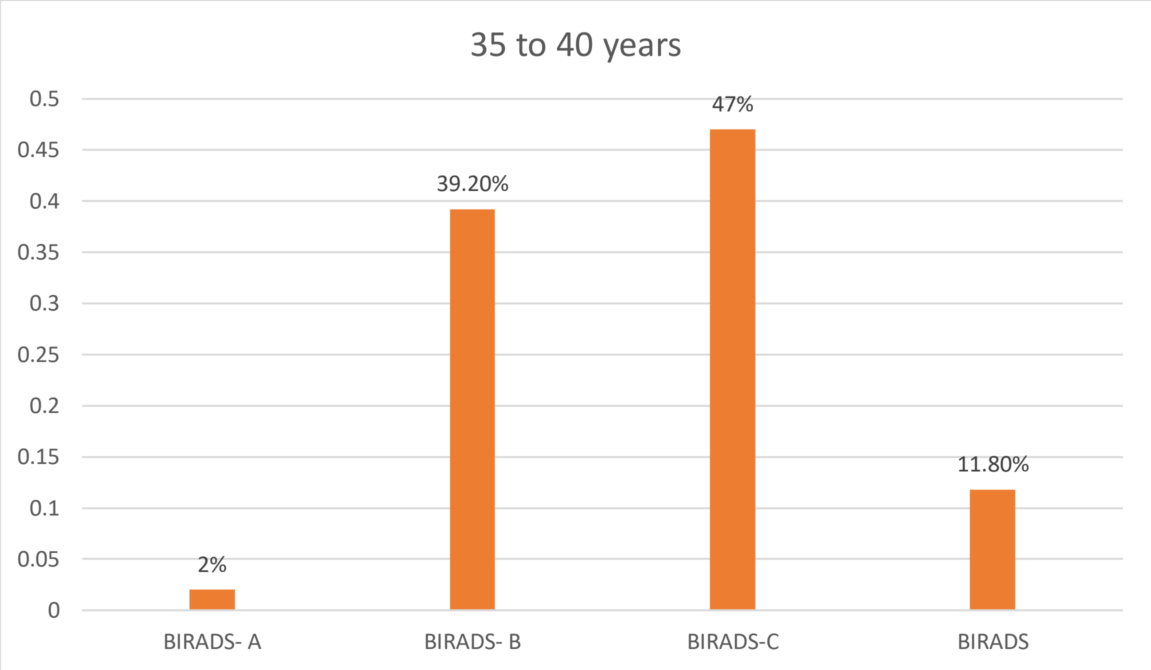

Chart 3: In 35 to 40 years, the BIRADS C category is the highest

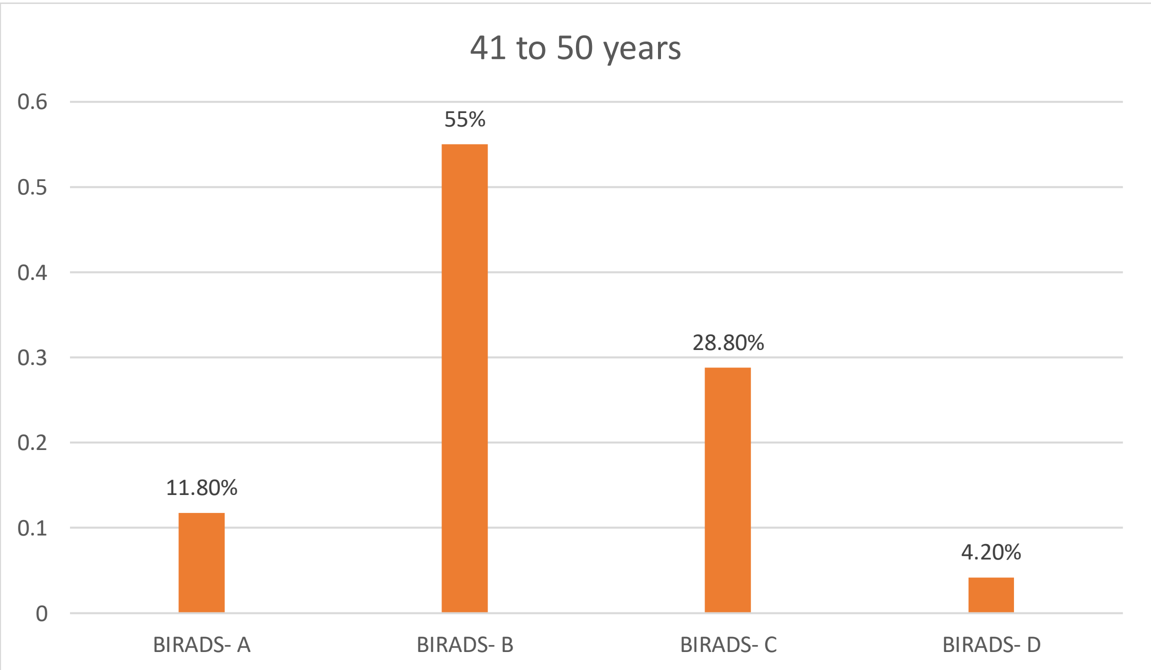

Chart 3: In 41 to 50-year-olds, BIRADS B is the most common pattern

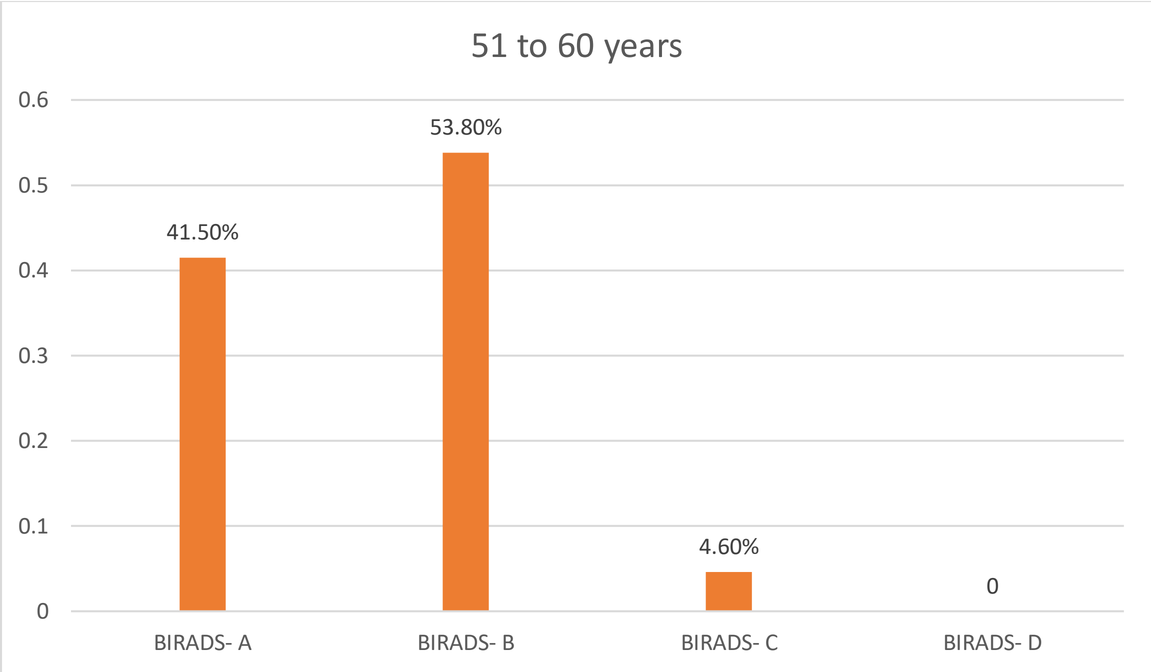

Chart 4: In the age range of 51 to 60 years, BIRADS B is the most common pattern

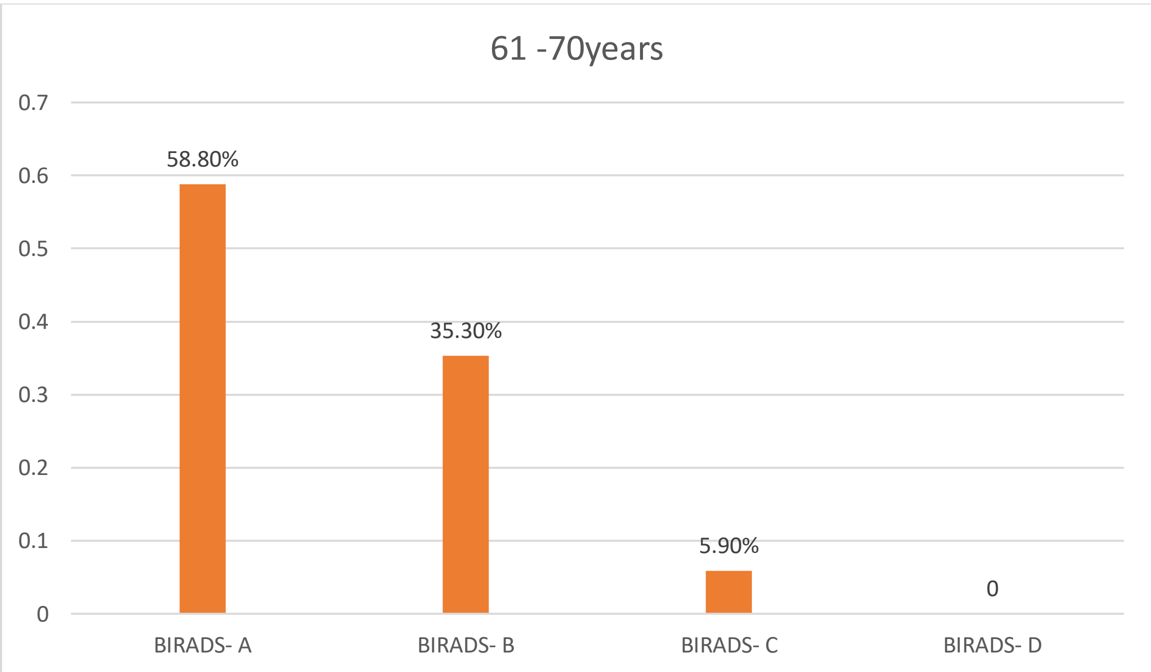

Chart 5: In the age group 61-70 years, the most common BIRADS A is the commonest pattern

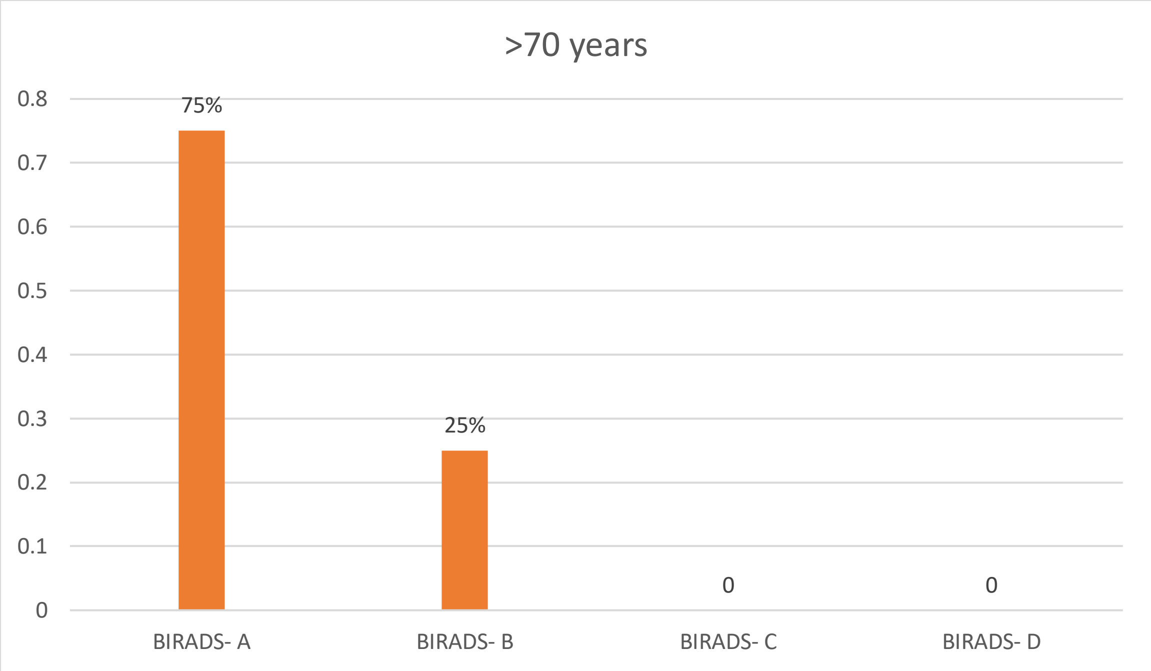

Chart 6: In the age group above 70 years, BIRADS A is the most common pattern

Chi-Square Tests

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	92.449[a]	12	<.001
Likelihood Ratio	99.384	12	<.001
N of Valid Cases	272		

a. 8 cells (40.0%) have expected count less than 5. The minimum expected count is .16.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.583	<.001
	Cramer's V	.337	<.001
	Contingency Coefficient	.504	<.001
N of Valid Cases		272	

To investigate the association between age (grouped into five categories: 35-40, 41-50, 51-60, 61-70, and 70+ years) and breast density, a chi-square test of independence was used. The findings indicated a statistically significant correlation between breast density and age group, X^2=92.2, p-value of <0.001. The effect size, as measured by Cramer's V, was 0.34, indicated a moderate association. Inspection of the crosstabulation table showed a relatively higher number of older women (>50years) had lower breast density compared to the younger age groups.

A logistic regression analysis was conducted to predict the value "low density BIRADS A and B" by examining the impact of women's age on final mammographic density. It showed that the model as a whole is significant (Chi2(1) = 60.91, p <.001, n = 268). The calculated odds ratio was 1.18. This showed that as the women's age increases, breast density decreases.

Similar to this, logistic regression analysis was used to predict the value "high density BIRADS C and D" by examining the impact of women's age on the final mammographic density. Again, the analysis showed that the model as a whole is significant (Chi2(1) = 60.91, p <.001, n = 268). The odds ratio was 0.85. This showed that as women's age increases, the probability of high breast density decreases.

5.4. Breast cancer

Thirty-three of the 272 women in our study had pathologically proven breast cancer (either biopsy or FNAC), representing a 12.1% rate.

Biopsy/FNAC confirmed breast cancer.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	239	87.9	87.9	87.9
	yes	33	12.1	12.1	100.0
	Total	272	100.0	100.0	

5.4.1. Breast cancer and breast density, and age

Breast density and breast cancer

Among the 33 breast cancer cases from our study, 18 of the cases, accounting for 54.5% had scattered fibroglandular density, 8 of the cases, accounting for 24.2% had a heterogeneously dense pattern, 4 of the cases accounting for 12.1% had almost entirely fatty pattern and 3 of the cases accouting for 9.1% have extremely dense pattern.

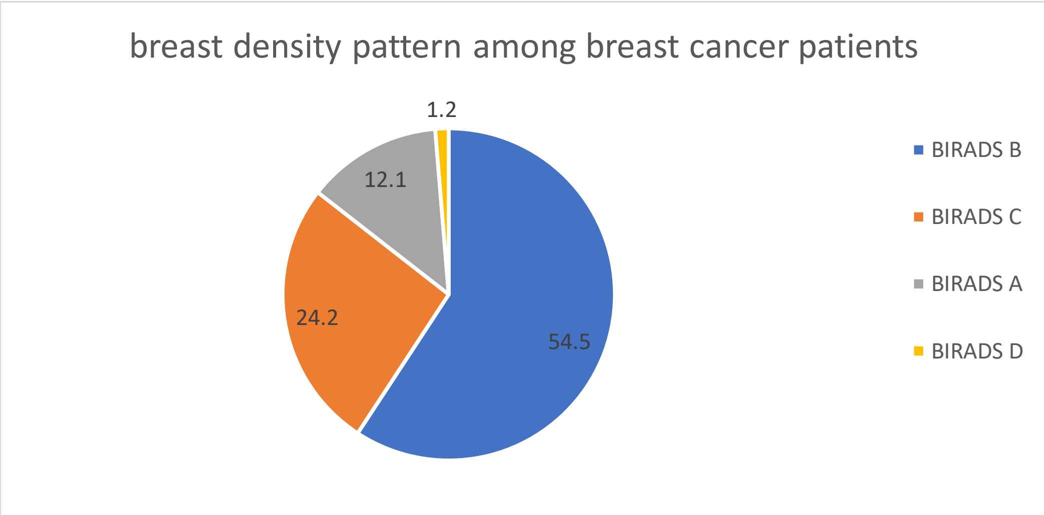

Figure 1: Pie chart showing breast density pattern among women diagnosed with breast cancer

When we see the proportion of breast cancer in each BIRADS category based on the number in each of the four groups, the highest was in BIRADS C- (heterogeneously dense breast), around 33.3%, followed by BIRADS D (extremely dense breast), around 27.3%, the third was BIRADS B-scattered fibroglandular density, around 13.6% and lastly BIRADS A (almost entirely fatty), around 6%.

Breast cancer and age

Among 33 cases of pathologically confirmed breast cancer, 14 cases accounting for 42.4% were within the age range of 41-50years, 8 cases accounting for 24.2 were within 35-40 years, 6 cases accounting for 18.2% were within in 61-70years, and 5 cases accounting for 15% were within 51-60years.

Family history of breast cancer

Among the 272 cases included in the study, 3 cases, accounting for 1.1% had a family history of breast cancer.

Age, family history of cancer, and final mammography density were all examined in relation to self-history of breast cancer in order to predict the value "yes" using logistic regression analysis. It showed that the model as a whole is not significant ($Chi^2(3) = 4.09$, p .252, n = 272). P-value for all variables was high above 0.05.

All these findings, which showed no statistical significance (high p value >0.05), a wide level of variability in the confidence level could be due to our small sample size.

7. Discussion

Breast density can be assessed by different methods, including both qualitative and quantitative methods. Currently, the most widely used method is qualitative assessment based on mammographic distribution and proportion of fibroglandular tissue (connective tissue stroma and glandular tissue) and fat into four categories based on the BIRADS category 5^{th} edition developed by ACR, to classify mammographic breast density. These are BIRADS-A, almost entirely fatty; BIRADS-B, scattered fibroglandular; BIRADS-C, heterogeneously dense; and BIRADS-D, extremely dense groups. (23, 24). Our study's objectives were to evaluate Ethiopian women's breast density patterns, their relationships to age, and their correlations to breast cancer.

Mammographic images of women above 35 years from two teaching hospitals were taken, including both screening and diagnostic images. Images were downloaded from PACS, and sociodemographic data (age, family history of breast cancer) were taken from the electronic-based system by the principal investigator. Based on the ACR BIRADS category in our study, the most common category we found was BIRADS-B, accounting for 48.5%, 132 out of 272 cases. Followed by BIRADS A, accounting for 23.9%, 65 out of 272 cases. BIRADS D is the least common, accounting for 4%, 11 out of 272 cases. BIRADS C accounted for 23.5%, 64 out of 272 cases. Low-density breast, which is defined as BIRADS A and B, accounted for 72.4%, 197 out of 272 cases. High-density breast, which is defined as BIRADS C and D, accounted for 27.5%, 75 out of 272 cases. In the Ethiopian setup up there is no baseline study to compare. In a study done in Israel to assess mammographic breast density among Ethiopian immigrants, it was found that they had significantly lower breast density compared to their age-matched Israeli-born women. BIRADS C and D accounted for 32.5% among Ethiopians, compared to 76.8% in Israel (25). In our study, we found BIRADS C and D in 27.5%.

In another analytical cross-sectional prospective study done in Egypt among asymptomatic women above the age of 40 years who came for screening, BIRADS-B -B was the most common density pattern, accounting for 52.1%, followed by BIRADS C accounting for 24.1%, BIRADS A accounting for 21.6% and BIRADS D accounting for 2.2% (23). BIRADS B to be the most common and BIRADS D to be the least common were similar in both studies. But there is a discrepancy regarding BIRADS C and A.

In yet another African study in Nigeria among women sent for either screening or diagnostic mammography, the density pattern was classified into three: fibroglandular, fat-replaced, and dense breast. 319 women were taken, among these 62 were sent for screening and 257 for diagnostic mammography. Fibroglandular density was the most common pattern, accounting for 50.5%, similar to our study. Fatty replaced accounted for 48%, which is higher than our in which almost entirely fatty acids account for 23.9% (25). Another Nigerian study done in 2015, among women sent for screening mammography, BIRADS A was the most common pattern, accounting for 39.64%, followed by BIRADS B, accounting for 34.2%, BIRADS C, accounting for 16% and BIRADS D, accounting for 9.9% (13). This is contrary to many studies in Caucasian studies. In comparison to our study, it's similar in that the predominant density pattern is low density, around 73.9%; in our study, it accounted for 72.4%. But the commonest finding in our study is BIRADS B in comparison to the BIRADS A in their study. (13). This could be attributed to the difference in women's ages.

In another study in sub-Saharan Africa, done in Uganda among women above 30 years sent for breast imaging, BIRADS C and D accounted for 25%, which was significantly lower than other studies done in Western countries. (2). But this seemed comparable to our study, in which BIRADS C and D accounted for 27.5%. This could be due to the race, lifestyle, parity, and contraceptive usage, and requires further study.

In another cross-sectional descriptive study done in Malaysia, which revised mammographic data, BIRADS B was the most common density pattern, accounting for 56.1%, followed by BIRADS C, accounting for 30.7%. BIRADS A density pattern was the least common, with 5.9%. In comparison to this, in our study, the proportion of low-density pattern was higher, around 72.4% compared to their finding of 62% (12).

A cross-sectional study done in Iraq among 750 women from routine screening, dense breast (BIRADS C and D), accounted for 54.3%. Our study showed dense breast pattern to be much less common, only 27.6%. Additionally, they demonstrated a strong correlation with age, body mass index, premenopausal status, family history of breast cancer, and no breastfeeding history. In our study, a significant association with age was seen; other parameters were not assessed due to the unavailability of data. (18).

In a large meta-analysis done in the USA, to assess mammographic breast density and association with BMI, 43% had dense breasts. Dense breast showed an inverse relation with both age and BMI. Although the dense breast prevalence is much lower in our study, the relation of breast density with age has also shown an inverse relation with breast density. (4).

In our study age range was 36 to 77 years; from this, most women were between 41-60 years of age, accounting for 67.3%.

In our result, women's age and breast density showed a significant association with a calculated chi-square test of 92.2, p-value of <0.001. Logistic regression calculated between age and the two final mammographic density categories showed that with increasing age, the probability of low-density breast increased, with a calculated odds ratio of 1.18, p value <0.001, and with a confidence interval of 11.2-12.5% (CI of 95%). This finding is concordant with many other studies, which also showed an inverse relation between age and breast density. (4, 12, 18, 23).

In many different studies, women's age and breast density showed an inverse relation. This is due to the changes in the breast with aging, the fibroglandular tissue involutes, and the fat increases. (12).

Breast cancer prevalence in our study was 12.1%, but it may not represent the true prevalence, as the mammographic data were taken from both screening and diagnostic studies, which might give a falsely high prevalence. An Egyptian study done among women above the age of 40 years who came for screening mammography, with a sample size of 814, showed a breast cancer prevalence of 10.3% (23). The sample size is much larger than ours, and the mammographic images were only from screening.

The prevalence of breast cancer in BIRADS A was 6%, BIRADS B 13.6%, BIRADS C 33.3% and BIRADS D 27.3%. Logistic regression was calculated and showed the coefficient of the variable dense breast is b = 0.73, which is positive. This implies that the likelihood of breast cancer rises with breast density. With a 95% confidence level of 0.3–41.9, the odds ratio of 2.08 indicates that the likelihood of breast cancer increases by 2.08 times for patients with dense breast density. But according to the p-value of.095 this influence is not statistically significant. This finding is likely due to the small sample size. But other multiple studies with much higher sample sizes than ours have shown a significant correlation between increasing breast density and increased breast cancer incidence. (9, 23, 26, 27).

To investigate the relationship between age, family history of cancer, and final mammographic density and breast cancer, logistic regression analysis was used. It showed that the model as a whole was not significant ($Chi^2(3) = 4.09$, p .252, n = 272). The p-values for age, family history of breast cancer, and dense breast were 0.88, 0.3, and 0.095, respectively.

All these findings, which showed no statistically significant p value (high p value >0.05), and a wide level of variability in the confidence level, could be due to the small sample size. But in many other studies, there were strong correlations between increasing age, high breast density, and family history of breast cancer with increased incidence of breast cancer. (3, 23, 26).

High breast density is an established risk factor for breast cancer; the mechanism is not clearly understood. One possible stated way is that abundant glandular tissue may persist into menopause, but in contradiction to this, breast cancer increases with age. Another stated theory is the Pike model of breast aging, which states that the primary factor influencing tissue density may not be a patient's chronological age but rather the accumulated genetic damage to the breast epithelium. High density on mammography will obscure lesions and delay early detection. (15, 28).

A retrospective study done in Massachusetts, USA, to assess breast density distribution among different racial groups, including white, African Americans, and Asian Americans, did not show differences among the different races after age and BMI adjustments.(29). In multiple studies, BMI and age of women showed a significant inverse association. (4, 15, 19). In our study, we were unable to assess BMI, parity, and hormonal use on breast density.

9. Limitations of the study

Both screening and diagnostic mammography were taken, as there is no organized screening program, which would likely have an impact on the true prevalence of breast cancer.

The small sample size and sampling approach would not be representative as it was taken from on two hospitals.

Other confounding variables for breast density, like parity, OCP use, and BMI, were not included as the study was conducted at a single point in time from recorded data. (7, 16)

We recommended a prospective study with a larger sample size and with the inclusion of other confounding factors like BMI, number of children, duration of breastfeeding, and history of contraceptive use to better assess the pattern of breast density, its confounding factors, and correlation with risk of breast cancer. We also recommend to use screening mammographic data, as using both diagnostic and screening mammograms would affect the true prevalence of breast cancer.

10. Conclusion

In this baseline mammographic breast density pattern in Ethiopia, the most prevalent category was BIRADS B, followed by BIRADS A, together accounting for 72.4%. Women's age showed a significant inverse correlation with decreasing breast density. Breast cancer prevalence was 12.1%, but due to the inclusion of both diagnostic and screening mammography, it may not represent the true prevalence. Although breast cancer showed a relation with increasing age, dense breast, and family history of breast cancer, it was statistically significant with a high p-value (>0.05): it is by no means conclusive owing to the small sample size, we therefore recommend future population studies with larger sample size and a wider geophraphic coverage at a national level. Due to the lower breast density identified in our study, mammographic screening would be more sensitive. In contrast, for dense breasts, additional supplementary imaging modalities like ultrasound and MRI may be required.

We recommend a prospective study with a larger sample size and with the inclusion of other confounding factors like BMI, number of children, duration of breastfeeding, and history of contraceptive use to assess better the pattern of breast density, its confounding factors, and association with risk of breast cancer.

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