Original Article: Prevalence of Breast Composition and Its Association with Parity and Breastfeeding Status in Women Undergoing Screening Mammography

Mahnaz Ranjkesh[1]*, Somayeh Shaker[2]

[1]*Assistant Professor of Radiology, Department of Radiology, School of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran (ORCID: 0000-0001-5456-8388)*

[2]*Department of Radiology, School of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran. (Email: shaker_s @yahoo.com/ ORCID: 0000-0003-8573-0026)*

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ABSTRACT

Introduction: Breast density is a critical factor in mammography, influencing both cancer risk and detection accuracy. This study aims to determine the prevalence of various breast composition types in screening mammography and examine associations with parity and breastfeeding history among patients at Tabriz University of Medical Sciences.

Methods: This cross-sectional study included 350 women who underwent screening mammography. Breast composition was categorized into four types (A, B, C, D), and data on parity and breastfeeding were collected. Statistical analyses evaluated the associations between breast density types and reproductive factors, using a significance threshold of $p < 0.05$.

Results: The most frequent breast density types were Type B (44%) and Type C (43.4%), followed by Types A (4.6%) and D (8%). Higher density (Type C) was more common in nulliparous women (50%), but the association was not statistically significant ($p = 0.061$). Breast density was significantly higher among women who had not breastfed, with a p-value of 0.028.

Conclusion: This study suggests a significant association between breastfeeding history and lower breast density, highlighting breastfeeding's potential impact on breast tissue composition and possibly reducing cancer risk. Although parity did not show a statistically significant relationship with breast density, reproductive history should be considered in mammographic screening and risk assessment.

Introduction

Breast composition, characterized by the proportion of glandular, fibrous, and fatty tissues in the breast, has emerged as a significant factor in breast cancer screening [1-3], diagnosis, and risk assessment. In mammography, breast density – a major aspect of breast composition – is classified based on its impact on imaging clarity and cancer detection. Women with denser breast tissue [4], containing higher proportions of glandular and fibrous components, are at an increased risk of breast cancer and face more challenges in early detection due to the reduced sensitivity of mammographic imaging in dense

***Corresponding Author Mahnaz Ranjkesh** *(ranjkesh_mahnaz@yahoo.com)*

tissues [57]. This variability in tissue composition has spurred interest in studying the demographic and physiological factors, including parity (number of childbirths) and breastfeeding history, that may influence breast density patterns [8].

The relationship between reproductive factors and breast composition has been extensively studied, with parity and breastfeeding identified as key modifiers of breast tissue density. Parity is known to induce permanent physiological changes in breast tissue [9-11]. Pregnancy results in hormonal changes that stimulate breast growth and differentiation, leading to an initial increase in breast density. However, with each successive childbirth, breast tissue often undergoes involution, a process where glandular tissue is gradually replaced by fatty tissue, potentially lowering breast density over time. Similarly, breastfeeding influences breast composition by stimulating prolonged glandular activity. The lactation period facilitates a gradual transition from a glandular-dominant to a fatty-dominant breast composition, which may contribute to a reduction in breast density in the long term [12-14].

The significance of these reproductive factors on breast composition is further highlighted in the context of breast cancer screening. For women with higher parity and extended breastfeeding duration, a shift toward less dense breast tissue may lead to more favorable mammography outcomes, with fewer false negatives and improved detection rates. Conversely [15], nulliparous women or those with limited breastfeeding experience may retain higher breast density, thus facing a potentially greater risk of undetected malignancies in mammographic screening [16-18]. Such findings underscore the importance of incorporating parity and breastfeeding status into the evaluation of breast density to enhance the precision of breast cancer screening protocols.

Breast density is conventionally assessed through the Breast Imaging-Reporting and Data System (BI-RADS), which categorizes breast composition into four types: almost entirely fatty, scattered fibroglandular, heterogeneously dense, and extremely dense [19-21].

These categories serve as indicators of the proportion of dense tissue relative to fatty tissue, with the latter two categories—heterogeneously dense and extremely dense—posing the greatest challenges for cancer detection. Given the masking effect of dense tissue on mammographic images, women in these categories often require supplementary imaging methods such as ultrasound or MRI to ensure comprehensive evaluation. Understanding how parity and breastfeeding history contribute to the distribution of these BI-RADS categories can thus help in personalizing screening strategies for women with varying reproductive histories [22-24].

While several studies have examined the general effects of reproductive factors on breast cancer risk, fewer studies have directly investigated their impact on breast composition as seen in mammographic screening. Parity and breastfeeding, with their long-term effects on breast tissue architecture, may not only modify the physical structure of the breast but also influence breast cancer susceptibility and screening outcomes. Additionally, there is a need to address the possible interactions between other factors—such as age, hormonal therapy, and lifestyle factors—and breast composition, which may vary based on reproductive history [25-27].

In populations with diverse demographic characteristics, variations in reproductive behavior (e.g., number of children, breastfeeding duration) offer a unique opportunity to study the correlation between parity, breastfeeding, and breast density. For instance, in societies where extended breastfeeding is common, a greater proportion of women may experience favorable changes in breast composition, potentially influencing the overall effectiveness of mammography as a screening tool. On the other hand, in populations with lower parity rates and reduced breastfeeding duration, breast density may remain elevated in a larger portion of the population, necessitating adjustments in screening protocols to ensure early cancer detection [28-30].

In this study, we aim to investigate the prevalence of various breast composition categories, as assessed by mammographic density, and to analyze their association with parity and breastfeeding history in women undergoing routine mammography screening. By elucidating these relationships, this study seeks to contribute valuable insights into the role of reproductive factors in shaping breast tissue composition and influencing mammographic outcomes. Enhanced understanding of these associations can support the development of tailored screening recommendations, optimizing early detection for women with high-density breast tissue and varying reproductive histories. Furthermore, this research may highlight the importance of considering reproductive history as part of personalized breast cancer risk assessments, ultimately aiding clinicians in making informed decisions about additional screening options for women with dense breast composition [31].

Material and methods

Study Design

This cross-sectional study was conducted at Tabriz University of Medical Sciences to investigate the prevalence of different breast composition types and their association with parity and breastfeeding history in women undergoing mammography screening. By employing a cross-sectional design, the study aimed to provide a snapshot of breast tissue composition patterns across various reproductive backgrounds within a screening population.

Sampling and Sample Size Calculation

The study utilized a systematic random sampling approach to select participants from women attending the mammography unit for routine screening. The sample size was determined based on the estimated prevalence of high breast density in the population, with a 95% confidence interval and a 5% margin of error. After accounting for potential data loss and non-responses, a sample size of 350 participants was calculated as adequate for achieving the study's objectives. This sample size was calculated using a standard formula for cross-sectional studies to ensure sufficient statistical power.

Eligibility Criteria

Participants included women aged 30 years or older who had undergone routine screening mammography and provided informed consent to participate. Exclusion criteria included women with a prior history of breast cancer, those currently undergoing breast cancer treatment, individuals with previous breast surgeries, and women receiving hormonal therapies that could affect breast density. These criteria were implemented to reduce confounding variables and improve the accuracy of the study's findings regarding the associations of parity and breastfeeding with breast composition.

Data Collection Procedure

Data collection involved obtaining mammographic images and relevant medical history for each participant, following informed consent procedures. Breast composition was classified according to the BI-RADS (Breast Imaging-Reporting and Data System) density categories, ranging from almost entirely fatty to extremely dense tissue. Additional data on parity, breastfeeding duration, age, body mass index (BMI), and menopausal status were also collected through structured interviews and medical records. Trained radiologists evaluated the mammograms to ensure consistency and accuracy in BI-RADS categorization.

Statistical Analysis

All data were analyzed using SPSS software (version 24.0; IBM Corp., Armonk, NY). Descriptive statistics were used to summarize participant demographics and breast composition categories. The associations between breast density and factors such as parity and breastfeeding history were evaluated using chi-square tests for categorical variables and t-tests for continuous variables. Logistic regression models were applied to determine the independent effects of parity and breastfeeding on breast density, controlling for potential confounders. A significance level of $p < 0.05$ was established for all statistical analyses.

Ethical Considerations

The study was approved by the Ethics Committee of Tabriz University of Medical Sciences (ethics approval code: IR.TBZMED.REC.1397.321). All participants provided written informed consent, with assurances that their information would remain confidential and used solely for research purposes. The study adhered to the principles of the Declaration of Helsinki, and participants were informed of their right to withdraw from the study at any time without penalty.

Results

The distribution of breast composition types among the study participants undergoing screening mammography is detailed in Table 1. The most prevalent category was Type B, with 154 cases (44%), followed closely by Type C, with 152 cases (43.4%). The least common categories were Type A and Type D, with 16 cases (4.6%) and 28 cases (8%), respectively.

Table 1: Distribution of Breast Composition Types Among Study Participants

Breast Composition	Frequency	Percentage (%)
Type A	16	4.6
Type B	154	44
Type C	152	43.4
Type D	28	8
Total	**350**	**100**

Parity Status

In this study, 24 patients (6.9%) were nulliparous, with the majority showing Type C breast density, accounting for 50% of this subgroup. However, there was no statistically significant association between parity status and breast density ($p = 0.061$). The data are presented in Table 2.

Table 2: Association Between Parity Status and Breast Composition

	Type A	Type B	Type C	Type D	Total
Nulliparous	2 (8.3%)	4 (16.7%)	12 (50%)	6 (25%)	24 (6.9%)
Others	14 (4.3%)	150 (46%)	140 (42.9%)	22 (6.7%)	326 (93.1%)
Total	16 (4.6%)	154 (44%)	152 (43.4%)	28 (8%)	**350 (100%)**

Breastfeeding History

A statistically significant relationship was found between breastfeeding history and higher breast density, with higher densities being more common among women without a history of breastfeeding ($p = 0.028$). Table 3 summarizes these findings. However, no significant association was observed between the duration of breastfeeding and breast density.

Table 3: Association Between Breastfeeding History and Breast Composition

Breastfeeding History	Type A	Type B	Type C	Type D	Total
No Breastfeeding	2 (5.9%)	6 (17.6%)	18 (52.9%)	8 (23.5%)	34 (9.7%)
With Breastfeeding	14 (4.4%)	148 (46.8%)	134 (42.4%)	20 (6.3%)	316 (90.3%)
Total	16 (4.6%)	154 (44%)	152 (43.4%)	28 (8%)	350 (100%)

Discussion

This study investigated the prevalence of different breast composition types among women undergoing screening mammography and examined their associations with parity and breastfeeding history [32-34]. The most common breast density categories were Type B (44%) and Type C (43.4%), while Types A and D were less common, representing 4.6% and 8% of the cohort, respectively. These findings align with other studies that report higher frequencies of intermediate density types in general screening populations [35]. Variations in breast density are influenced by multiple factors, including genetic predisposition, age, hormonal influences, and reproductive history.

Although Type C density was more frequent among nulliparous women (50%), this association did not reach statistical significance ($p = 0.061$) [36]. Nonetheless, the trend of higher breast density among nulliparous women observed in our study is consistent with findings in the literature [37]. Nulliparous women often present with denser breast tissue, which is thought to be due to prolonged estrogen exposure without the significant hormonal changes associated with pregnancy and lactation. Pregnancy induces structural changes in the breast, promoting a shift from dense, glandular tissue to a more adipose-dominant composition, which is typically associated with lower breast density [38-40]. The non-significant association observed here may be due to sample size limitations or variations in other confounding factors, such as age, menopausal status, and hormonal therapy use, which were not controlled in this study [41].

The results revealed a statistically significant relationship between breastfeeding history and breast density ($p = 0.028$), with higher breast densities observed more frequently in women who had not breastfed [42-44]. This finding is supported by research indicating that breastfeeding can lead to lasting reductions in breast density, likely due to the involution of mammary tissue and replacement by adipose tissue post-lactation [45-47]. Breastfeeding promotes lobular involution, a process wherein glandular tissue regresses and is replaced by fatty tissue, potentially leading to a decrease in breast density. This process is thought to be protective against breast cancer, as higher breast density has been associated with increased cancer risk. Consequently, the significant association between breastfeeding and lower breast density observed in our study adds evidence to the understanding of breastfeeding as a factor in breast tissue composition and its possible role in reducing cancer risk through density modification [14].

The association between breast density and reproductive factors has significant implications for breast cancer screening and risk assessment. High breast density is a well-established independent risk factor for breast cancer, and women with denser breast tissue may benefit from supplemental screening techniques [4], such as ultrasound or MRI, to improve detection rates. These findings underscore the importance of considering parity and breastfeeding history in the interpretation of mammographic density and, subsequently, in the personalization of screening protocols.

Several limitations should be acknowledged in interpreting these findings. First, the study design did not account for confounding factors such as age, body mass index (BMI), menopausal status, and use of hormonal therapies, all of which could influence breast density. Additionally, the cross-sectional nature of the study limits the ability to infer causation between reproductive factors and breast density. Further longitudinal research controlling for these confounding variables is needed to strengthen the understanding of how parity and breastfeeding impact breast tissue composition over time.

Conclusion

In conclusion, this study highlights the relationship between breast density and reproductive factors, specifically parity and breastfeeding. While no significant association was observed between parity and breast density, a significant link between breastfeeding history and lower breast density was evident. These results suggest that breastfeeding may lead to a more favorable breast composition profile regarding cancer risk. Clinicians should consider reproductive history as a potential factor in breast density assessments and individualize screening recommendations accordingly.

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