

EFFICACY OF DIGITAL MAMMOGRAPHY IN BREAST CANCER SCREENING: A PROSPECTIVE OBSERVATIONAL STUDY

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Abstract

Background: Breast cancer screening is a crucial component of early cancer detection. Digital mammography has been posited as a potentially more effective alternative to traditional mammography, but empirical data, especially from diverse populations, is necessary to support this claim. This study aimed to evaluate the efficacy of digital mammography in detecting breast cancer in a diverse demographic, comparing its detection rate with traditional mammography. It also sought to analyse the stages at which cancer was detected, false positives and negatives, and participant satisfaction. **Materials and Methods:** A prospective observational study was conducted with 100 participants undergoing digital mammography screening. The study focused on detection rates, false positives and negatives, cancer stages at detection, and compared these results with historical data on traditional mammography. Additional parameters such as participant age, ethnicity, family history, recall rates, and satisfaction were also assessed. **Result:** Detection Rate: The study achieved a 15% breast cancer detection rate among the screened participants. False Positives/Negatives: A false positive rate of 10% and a false negative rate of 2% were observed. Cancer Stage at Detection: Breast cancer was detected as follows: Stage 0 (3 cases), Stage I (7 cases), Stage II (4 cases), Stage III (1 case), and Stage IV (0 cases). Comparative Analysis: Digital mammography showed a 3% higher detection rate than traditional mammography (15% vs. 12%). Additional Parameters: The average age at detection was 55 years. Ethnic breakdown revealed Indo-Aryan (45%), Dravidian (35%), Austroasiatic (15%), and Tibeto-Burman (5%). 40% had a family history of breast cancer. The recall rate for additional imaging was 20%, and participant satisfaction rate was 85%. **Conclusion:** Digital mammography demonstrated a higher detection rate for breast cancer compared to traditional methods in this Indian population study. The findings support its use, especially considering the high participant satisfaction and efficacy in early-stage cancer detection.

INTRODUCTION

Breast cancer remains one of the most prevalent cancers among women worldwide, posing significant health challenges.^[1] Early detection of breast cancer is crucial as it significantly increases the chances of successful treatment and survival. Mammography, the process of using low-energy X-rays to examine the human breast, has been a cornerstone in breast cancer screening for decades.^[2,3] Traditional film-based mammography, while effective, has certain limitations, particularly in detecting tumours in dense breast tissues. With the advent of digital technology, digital mammography has emerged as a promising alternative, offering clearer images and greater accuracy.^[4]

Digital mammography, also known as full-field digital mammography (FFDM), converts X-ray signals captured by the mammography machine into digital images.^[5] This technological advancement allows for enhanced image storage, manipulation, and transmission.^[6] Studies have shown that digital mammography is more effective than traditional mammography in certain groups, especially in younger women and those with denser breast tissues. Additionally, it allows for better contrast between dense and non-dense tissues, potentially improving the detection of small tumours.^[7]

Despite these advances, the adoption of digital mammography across various demographics and geographical regions has been uneven. In developing countries and regions with diverse populations, such

as Chhattisgarh, India, the implementation and efficacy of digital mammography in breast cancer screening are not well documented. This gap in knowledge is significant, given the varying breast density and cancer presentation among different ethnic groups. Furthermore, the detection rates, false positives, and patient satisfaction in these populations have not been thoroughly explored in the context of digital mammography.

Breast cancer epidemiology in India presents unique challenges. The incidence of breast cancer in Indian women is rising, and it tends to occur at a younger age compared to Western populations. Moreover, cultural factors, healthcare accessibility, and awareness play crucial roles in breast cancer screening uptake. The Indian population's diverse ethnic composition, including Indo-Aryan, Dravidian, Austroasiatic, and Tibeto-Burman groups, provides a unique opportunity to study the effectiveness of digital mammography in a heterogeneous cohort. Such a study is essential not only for India but also for providing insights relevant to other regions with similar demographic profiles.

The potential of digital mammography to reduce recall rates and false positives is another aspect worth investigating. High recall rates, often associated with traditional mammography, can lead to unnecessary anxiety, additional tests, and increased healthcare costs. In contrast, digital mammography could offer more accurate readings, reducing the need for subsequent screenings and biopsies. Understanding this aspect is crucial for healthcare systems that aim to optimize cancer screening programs while being mindful of resource allocation and patient well-being. The aim of this study is to evaluate the efficacy of digital mammography in the early detection of breast cancer in a diverse Indian population from Chhattisgarh. The objectives are to compare the detection rate of digital mammography with traditional mammography, analyse the stages of cancer detected, assess the rates of false positives and false negatives, and evaluate participant satisfaction. This study seeks to provide valuable insights into the effectiveness of digital mammography in diverse populations, contributing to the global body of knowledge on breast cancer screening and potentially influencing screening practices in similar demographic settings.

MATERIALS AND METHODS

This prospective observational study was conducted at B.R.L.S.A.B.V.M. Medical College, situated in Pendri, Rajnandgaon, Chhattisgarh, India. The study spanned a one-year period, from June 2022 to May 2023, and was designed to evaluate the efficacy of digital mammography in breast cancer screening.

Participant Recruitment and Selection Criteria: The study enrolled a total of 100 participants through a combination of voluntary participation and referrals from local healthcare providers. Inclusion criteria for

the study were women aged 40 to 70 years, with no prior diagnosis of breast cancer. Participants with a history of breast surgery or radiation therapy to the chest were excluded from the study to avoid confounding factors. The recruitment strategy aimed to ensure a diverse representation in terms of ethnicity and medical history, reflecting the demographic composition of Chhattisgarh.

Screening Procedure

All participants underwent breast cancer screening using digital mammography. The mammograms were performed by trained radiologic technologists and interpreted by board-certified radiologists with expertise in breast imaging. The radiologists were blinded to the participants' medical histories and demographic details to ensure impartiality in interpretation. Standard mammography protocols were followed, and each mammogram was classified according to the Breast Imaging Reporting and Data System (BI-RADS) classification.

Data Collection

Data collected from each participant included demographic information (age, ethnicity), medical history (family history of breast cancer), and mammography results. The mammography findings were categorized into breast cancer detected, false positives (where cancer was indicated but not confirmed by biopsy), and false negatives (where mammography failed to detect cancer later confirmed by other methods). The stage of breast cancer at detection was also recorded.

Comparative Analysis

For comparative analysis, the detection rate of digital mammography was compared with historical data on the detection rate of traditional mammography. This historical data was sourced from previous studies and health records from similar demographic settings.

Ethical Considerations

The study was approved by the Institutional ethics committee of B.R.L.S.A.B.V.M. Medical College, Rajnandgaon, Chhattisgarh. All participants provided informed consent before enrollment, and confidentiality of participant data was strictly maintained throughout the study. Ethical guidelines for human research, as outlined by the Indian Council of Medical Research (ICMR), were adhered to rigorously.

Statistical Analysis

Statistical analysis was performed to calculate the detection rate, false positive rate, false negative rate, and participant satisfaction rate. Comparative analysis was conducted using appropriate statistical tests to determine the significance of differences between digital and traditional mammography. All analyses were performed using statistical software, and a p-value of less than 0.05 was considered statistically significant.

RESULTS

Detection Rate

Total Screened: Our study involved the screening of 100 participants using digital mammography, encompassing a diverse demographic.

Breast Cancer Detected: Of these participants, 15 were diagnosed with breast cancer, as confirmed through digital mammography.

Detection Rate: Consequently, the detection rate for breast cancer in our study, using digital mammography, was established at 15%.

False Positives and Negatives

False Positives: Our findings indicated 10 cases where digital mammography suggested the presence of breast cancer, but these diagnoses were not corroborated by subsequent biopsy, resulting in a false positive rate of 10%.

False Negatives: In contrast, 2 cases were identified where digital mammography initially failed to detect existing breast cancer, which was later confirmed through alternative diagnostic methods, leading to a false negative rate of 2%.

Stage at Detection

The distribution of cancer stages at the time of detection through digital mammography in our study was as follows:

Stage 0 (Non-Invasive): Detected in 3 cases.

Stage I: Detected in 7 cases.

Stage II: Detected in 4 cases.

Stage III: Detected in 1 case.

Stage IV: There were no cases detected at this stage. Comparative Analysis with Traditional Mammography

Digital Mammography Detection Rate: The detection rate using digital mammography in our study was recorded at 15%.

Traditional Mammography Detection Rate: In comparison, based on historical data, traditional mammography has a detection rate of 12%.

Advantage: This data indicates that digital mammography showed a 3% higher detection rate compared to traditional mammography.

Additional Parameters

Average Age at Detection: The average age of the participants at the time of cancer detection was found to be 55 years.

Ethnicity Breakdown of Detected Cases: The ethnic composition of the participants with detected cases was Indo-Aryan (45%), Dravidian (35%), Austroasiatic (Adivasi Tribes) (15%), and Tibeto-Burman (5%).

Family History of Breast Cancer: Notably, 40% of the participants diagnosed with breast cancer had a family history of the disease.

Recall Rate for Additional Imaging: The recall rate for additional imaging after the initial screening was 20%.

Participant Satisfaction Rate: Based on the post-screening survey, the participant satisfaction rate regarding the digital mammography process was 85%.

Table 1: Detection Rate Overview

| Parameter | Value |
|------------------------|------------------|
| Total Screened | 100 participants |
| Breast Cancer Detected | 15 cases |
| Detection Rate | 15% |

Table 2: False Positives and Negatives

| Type | Number of Cases | Rate |
|-----------------|-----------------|------|
| False Positives | 10 cases | 10% |
| False Negatives | 2 cases | 2% |

Table 3: Stage at Detection

| Cancer Stage | Number of Cases |
|------------------------|-----------------|
| Stage 0 (Non-Invasive) | 3 cases |
| Stage I | 7 cases |
| Stage II | 4 cases |
| Stage III | 1 case |
| Stage IV | 0 cases |

Table 4: Comparative Analysis with Traditional Mammography

| Parameter | Digital Mammography | Traditional Mammography |
|-----------------------------------|---------------------|-------------------------|
| Detection Rate | 15% | 12% |
| Advantage (Higher Detection Rate) | 3% | - |

Table 5: Demographics and Additional Parameters

| Parameter | Value |
|----------------------------------|----------|
| Average Age at Detection | 55 years |
| Ethnicity Breakdown | |
| - Indo-Aryan | 45% |
| - Dravidian | 35% |
| - Austroasiatic (Adivasi Tribes) | 15% |
| - Tibeto-Burman | 5% |

| | |
|------------------------------------|--------------------------------------|
| Family History of Breast Cancer | 40% (among detected cases) |
| Recall Rate for Additional Imaging | 20% |
| Participant Satisfaction Rate | 85% (based on post-screening survey) |

DISCUSSION

The findings of our study underscore the efficacy of digital mammography in breast cancer screening within the diverse population of Chhattisgarh, India, aligning with existing research that suggests digital mammography's superiority in imaging quality, particularly for women with dense breast tissues (Giampietro et al,^[1] 2020; Greenberg et al,^[11] 2014). Our reported breast cancer detection rate of 15% using digital mammography exceeds the 12% rate typically associated with traditional mammography (Coldman et al,^[2] 2014), highlighting the potential of digital mammography in improving cancer detection rates.

The 10% false positive rate and 2% false negative rate observed in our study are notable. While the false positive rate is a matter of concern due to the risk of unnecessary biopsies and psychological distress (Powell et al,^[12] 2017), it is consistent with other findings in mammography screenings (Cochon et al,^[5] 2020). The relatively low false negative rate, indicative of a reduced likelihood of missed diagnoses, is crucial for effective breast cancer prognosis and is in line with findings by Conant et al (2016).^[3]

Our study's ability to detect cancer predominantly in Stage 0 and Stage I is significant for successful treatment outcomes and is supported by previous research emphasizing the importance of early detection (Hofvind et al,^[7,8] 2019; Romero Martín et al,^[13] 2018). This efficacy in early-stage detection could be particularly beneficial in regions like India, where breast cancer incidence tends to occur at a younger age compared to Western populations (Singla et al,^[15] 2018).

The comparative analysis of our study indicating a 3% higher detection rate with digital mammography compared to traditional mammography (Giess et al,^[4] 2017) suggests its suitability as a screening tool, especially in diverse populations similar to ours. However, these results should be interpreted with the understanding that they are context-specific and might vary with different population dynamics (Houssami et al 2019).^[8,9]

The average age of cancer detection in our study was 55 years, resonating with global trends in breast cancer incidence (Chikarmane et al,^[6] 2021). The ethnic breakdown of detected cases offers a valuable perspective on breast cancer epidemiology in a diverse context like India, highlighting the necessity for screening approaches tailored to different ethnic susceptibilities (Aase et al,^[14] 2019).

The high participant satisfaction rate (85%) in our study indicates the acceptability of digital mammography among participants, a crucial factor for the success of public health initiatives (Houssami et al,^[8,9] 2017). Such high satisfaction rates are likely

to encourage regular participation in breast cancer screening programs.

Despite these promising findings, our study is not without limitations. The sample size of 100 participants, though adequate for preliminary analysis, limits the generalizability of our results (Skaane et al,^[10] 2013). Additionally, the one-year duration of our study constrains the assessment of long-term outcomes, necessitating future studies with larger cohorts and extended follow-up periods.

CONCLUSION

Our study highlights the potential advantages of digital mammography over traditional mammography in breast cancer screening. The higher detection rate, ability to detect cancer at earlier stages, and high participant satisfaction rate make a compelling case for the adoption of digital mammography, particularly in diverse populations like that of Chhattisgarh, India. However, continuous evaluation and research are necessary to optimize breast cancer screening strategies in different demographic and regional settings.

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