Section: Community Medicine

Original Research Article

ASSESSMENT OF BREAST CANCER RISK AND SCREENING PRACTICES AMONG WOMEN: A CROSS-SECTIONAL STUDY USING A RISK CALCULATOR

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ABSTRACT

Background: Breast cancer remains a leading cause of morbidity and mortality among women worldwide. Early risk stratification and appropriate screening practices are crucial for timely detection and improved outcomes. This study aims to evaluate breast cancer risk profiles and assess screening practices among women in a defined population. **Material and Methods:** A cross-sectional study was conducted among 615 women aged 30-65 at tertiary care center from October 2023 to October 2024. Participants were assessed for breast cancer risk factors using Gail model. Data on demographic variables, family history, lifestyle factors, and screening behaviors were collected through structured interviews and questionnaires. The association between breast cancer risk category and screening behavior was assessed using Chi-square tests or Fisher's exact tests wherever applicable. A p-value less than 0.05 was considered statistically significant. **Result:** Among the 615 participants, 79.2% were classified as low risk, 15.4% moderate risk, and 5.4% high risk for breast cancer. Overall, 60.3% of women had heard of at least one screening method, and 33.5% had practiced any form of screening. Overall, 29.2% of low-risk, 45.3% of moderate-risk, and 63.6% of high-risk women had undergone at least one screening method ($p < 0.0001$), indicating a strong positive association between breast cancer risk level and screening uptake. **Conclusion:** The study highlights a substantial proportion of women at moderate to high risk for breast cancer with inadequate screening adherence. Enhanced public health initiatives focusing on risk awareness and improving access to screening services are essential to reduce breast cancer burden. Tailored interventions targeting high-risk groups could optimize early detection and outcomes.

INTRODUCTION

Breast cancer is the most common cancer among women globally, accounting for approximately 11.7% of all new cancer cases and 6.9% of cancer-related deaths in 2020, with an estimated 2.3 million new cases and 685,000 deaths worldwide.[1] In India, breast cancer has emerged as the leading malignancy in women, with an age-adjusted incidence rate of 25.8 per 100,000 women and a mortality rate of 12.7 per 100,000.[2] Urban areas such as Delhi, Mumbai, Bengaluru, and Chennai report significantly higher incidence rates (ranging from 40 to 50 per 100,000) compared to rural regions, indicating a possible urban-rural divide in risk profiles and detection practices.[3]

The increasing burden of breast cancer in India is compounded by late-stage diagnosis, with over 60% of cases presenting at Stage III or IV.[4] This delay is often due to poor awareness, socio-cultural barriers, and lack of structured screening programs. Early detection through risk stratification and timely screening is critical to improving survival, as localized breast cancer has a 5-year survival rate exceeding 90%, compared to less than 30% for metastatic disease.[5]

Risk stratification models, such as the Gail Model and Breast Cancer Risk Assessment Tool (BCRAT), have been developed to estimate an individual's absolute risk based on epidemiological and reproductive factors including age, age at menarche, age at first childbirth, family history, and history of benign breast disease.[6] However, in India, the use of these tools in clinical or community settings is

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minimal due to limited awareness among healthcare providers and the general public, as well as the lack of adaptation to Indian risk profiles.[7] This models, though originally developed using Western cohorts, can be valuable in identifying high-risk women in Indian populations when used with appropriate modifications.[8]

In terms of screening practices, population-based mammography screening is not routinely implemented in India. Opportunistic screening is often practiced, predominantly in urban private healthcare settings. Clinical Breast Examination (CBE) and Breast Self-Examination (BSE) remain the most widely practiced methods in community settings due to cost-effectiveness and ease of implementation.[9] A large randomized controlled trial in Mumbai demonstrated that biennial CBE by trained primary healthcare workers significantly downstaged breast cancer at diagnosis and improved survival in women aged 50 years and above.[10]

Despite these benefits, national data reveal low uptake of any form of breast cancer screening. According to the National Family Health Survey-5 (2019–2021), only 9.8% of women aged 30–49 years in India reported ever undergoing any breast examination, with even lower percentages in rural and tribal areas.[11] These statistics underscore the need to assess current screening practices, especially in underrepresented populations, and to implement risk-based screening approaches to optimize resource utilization.

This study was therefore undertaken with the dual objectives of assessing the risk of developing breast cancer among women using a validated breast cancer risk calculator, and of describing the prevalent breast cancer screening practices in a representative community population. The findings aim to identify gaps in risk awareness and screening uptake, thereby informing targeted interventions for early detection and prevention of breast cancer.

MATERIALS AND METHODS

Study Design and Setting

This was a community-based cross-sectional study conducted over a 12-month period from October 2023 to October 2024 under the department of Community Medicine, in a semi-urban area located in North India. The study site was selected due to its representative population comprising a mix of low- and middle-income households, with limited access to structured breast cancer screening services. The region is served by a primary health center and several sub-centers but lacks specialized oncology care, making it a suitable setting to study community-level screening behavior and risk profiles.

Study Population

The study population included women aged 30 to 65 years who were permanent residents of the study area for at least one year. Women with a known history of breast cancer, those currently undergoing cancer treatment, and those who refused to give written informed consent were excluded. Eligible participants were identified through door-to-door surveys conducted by trained female field investigators. Those meeting inclusion criteria were invited to participate after a detailed explanation of the study objectives.

Sample Size and Sampling Technique

The sample size was calculated using a single population proportion formula based on an assumed prevalence of breast cancer screening awareness at 10%, as reported in the NFHS-5 data. With a 95% confidence level and 2.5% absolute precision, the estimated sample size was 553. After accounting for a 10% non-response rate, the final sample size was increased to 615. A multistage random sampling technique was employed. In the first stage, five municipal wards were selected randomly out of 15 wards. In the second stage, systematic random sampling (every 5th household) was used to select households within each ward. One eligible woman from each household was enrolled using a simple random method in cases where multiple eligible women were present.

Data Collection Tool and Procedure

Data were collected using a pretested, semi-structured questionnaire developed in English and translated into the local language Hindi using standardized forward and backward translation techniques. The tool was pretested on 20 women in a similar community setting to refine question clarity and cultural appropriateness. The final questionnaire had three sections: sociodemographic and reproductive profile, risk stratification using the Gail Model, and breast cancer screening practices. Face-to-face interviews were conducted in the privacy of participants' homes by trained female investigators. Supervisory checks were conducted daily to ensure quality and consistency.

Risk Stratification Method

Individual risk of developing breast cancer was estimated using the National Cancer Institute's Breast Cancer Risk Assessment Tool (BCRAT), also known as the Gail Model.[12] This validated model incorporates key variables such as current age, age at menarche, age at first live birth, number of first-degree relatives with breast cancer, history of breast biopsies, and presence of atypical hyperplasia. The tool was administered in real time using an offline version adapted to local settings. Each participant's 5-year and lifetime breast cancer risk were computed. Based on the 5-year risk estimates, participants were categorized into three groups: low risk (<1.66%), moderate risk (1.66–3%), and high risk (>3%), as per standard clinical risk thresholds.

Assessment of Screening Practices

Participants were asked detailed questions regarding their awareness and practice of breast cancer screening methods including breast self-examination (BSE), clinical breast examination (CBE), and mammography. Information was collected on whether the participant had ever undergone each

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method, the frequency of screening, the age at which screening was initiated, and the source of screening referral or recommendation (self-initiated, family member, or healthcare provider). Additionally, perceived barriers to screening such as lack of awareness, cost, fear, embarrassment, or absence of symptoms were recorded.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using IBM SPSS Statistics version 25. Continuous variables such as age were summarized using means and standard deviations, while categorical variables like education level, risk category, and screening uptake were expressed as frequencies and percentages. The association between breast cancer risk category and screening behavior was assessed using Chi-square tests or Fisher's exact tests wherever applicable. A p-value less than 0.05 was considered statistically significant.

Ethical Considerations

Ethical clearance for the study was obtained from the Institutional Ethics Committee. Written informed consent was obtained from each participant after providing detailed information about the study objectives, procedures, and confidentiality safeguards. Participants were informed of their right to withdraw from the study at any time without any consequences. Privacy was maintained during interviews, and no personally identifiable information was recorded on data collection forms.

RESULTS

The mean age of the participants was 44.2 ± 8.6 years. Most women belonged to the 40–49 age group (38.4%), followed by 30–39 years (30.6%). Regarding education, 33% had completed secondary school, while 21.8% were illiterate. A majority were homemakers (74.3%), with 21.3% employed. The average monthly family income was ₹15,657 ± 6,326, with 45.9% earning between ₹10,001 and ₹20,000, 32.2% earning less than ₹10,000, and 21.9% earning more than ₹20,000 (Table 1).

Table 1: Sociodemographic Profile of Study Participants (n = 615)

Variable	Frequency (n)/Mean ± SD	%
Age (years)	44.2 ± 8.6	-
Age group (years)		
• 30–39	188	30.6
• 40–49	236	38.4
• 50–59	129	21
• ≥60	62	10.1
Educational status		
• Illiterate	134	21.8
• Primary school	176	28.6
• Secondary school	203	33
• Graduate and above	102	16.6
Occupation		
• Homemaker	457	74.3
• Employed	131	21.3
• Others	27	4.4
Monthly family income (INR)	15,657 ± 6,326	-
Monthly family income (INR)		
• <10,000	198	32.2
• 10,001–20,000	282	45.9
• >20,000	135	21.9

The mean age at menarche was 12.9 ± 1.4 years, with 20.7% experiencing menarche before the age of 12. The average age at first childbirth was 24.1 ± 3.8 years, and 84.7% had their first childbirth before the age of 30. The mean parity was 2.7 ± 1.1; nearly half of the women (48.9%) had three or more children, while 4.4% were nulliparous. A large majority (93.7%) had a history of breastfeeding. Oral contraceptive use was reported by 26.7% of participants. A history of breast biopsy was present in 2.1%, 5.9% had a first-degree relative with breast cancer, and 1% had biopsy-proven atypical hyperplasia (Table 2).

Table 2: Reproductive and Family History of Participants

Variable	Frequency (n)/Mean ± SD	%
Age at menarche (years)	12.9 ± 1.4	-
Age at menarche <12 years	127	20.7
Age at first childbirth (years)	24.1 ± 3.8	-
Age at first childbirth <30 years	521	84.7
Parity	2.7 ± 1.1	-
Parity		
• Nulliparous (0)	27	4.4
• 1–2	287	46.7
• ≥3	301	48.9
Breastfeeding history	576	93.7

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Oral contraceptive use	164	26.7
History of breast biopsy	13	2.1
First-degree relative with breast cancer	36	5.9
Biopsy-proven atypical hyperplasia	6	1

Based on the breast cancer risk calculator, 79.2% of women were categorized as low risk (<1.66%) with a mean 5-year risk of 0.91 ± 0.38%. Moderate risk (1.66–3%) was observed in 15.4% of participants, with a mean risk of 2.14 ± 0.41%, while 5.4% were classified as high risk (>3%) with a mean risk of 4.32 ± 0.89%. The overall mean 5-year risk in the study population was 1.14 ± 0.72%, and the mean estimated lifetime risk up to age 90 was 10.6 ± 4.1% (Table 3).

Table 3: Risk Stratification Based on Breast Cancer Risk Calculator (BCRAT)

Risk Category (5-year risk %)	Frequency	%	Risk (Mean ± SD)
Low risk (<1.66%)	487	79.2	0.91 ± 0.38%
Moderate risk (1.66–3%)	95	15.4	2.14 ± 0.41%
High risk (>3%)	33	5.4	4.32 ± 0.89%
Overall mean 5-year risk	—	—	1.14 ± 0.72%
Lifetime risk (to age 90)	—	—	10.6 ± 4.1%

Among the participants, 53.3% had heard of breast self-examination (BSE), and 28.8% reported ever performing it, with an average frequency of 3.2 ± 1.7 times per year. Awareness of clinical breast examination (CBE) was reported by 36.7%, and 15.6% had undergone it, averaging 0.8 ± 0.6 times annually. Mammography was the least known (23.7%) and practiced (7.0%), with a mean annual frequency of 0.3 ± 0.2. Overall, 60.3% of women had heard of at least one screening method, and 33.5% had practiced any form of screening. The most common sources of information were TV/media (35.4%), followed by doctors or health workers (19.0%) and friends or relatives (11.7%) (Table 4).

Table 4: Awareness and Practice of Breast Cancer Screening Methods (n = 615)

Variables	Heard of It	Ever Performed	Frequency of Practice (per year)
	Frequency (%)		(Mean ± SD)
Screening Methods			
Breast Self-Examination	328 (53.3%)	177 (28.8%)	3.2 ± 1.7
Clinical Breast Examination	226 (36.7%)	96 (15.6%)	0.8 ± 0.6
Mammography	146 (23.7%)	43 (7.0%)	0.3 ± 0.2
Any Method	371 (60.3%)	206 (33.5%)	—
Source of information			
• TV/Media	218 (35.4%)	—	—
• Doctor/Health Worker	117 (19.0%)	—	—
• Friends/Relatives	72 (11.7%)	—	—

The most commonly reported barrier to breast cancer screening was the absence of symptoms or perceived need (67.4%), followed by lack of awareness (60.3%) and fear of diagnosis (18%). Other barriers included inaccessibility of healthcare services (9.6%), embarrassment or stigma (6.4%), cost-related concerns (5.5%), cultural or religious factors (4.1%), and lack of female health staff (2.5%) (Table 5).

Table 5: Barriers to Breast Cancer Screening (n = 438 who never screened)

Reported Barrier	Frequency	%
Lack of awareness	264	60.3
Fear of diagnosis	79	18
Embarrassment or stigma	28	6.4
Cost-related concerns	24	5.5
No symptoms or perceived need	295	67.4
Inaccessibility of healthcare services	42	9.6
Cultural/religious barriers	18	4.1
Lack of female health staff	11	2.5

Screening practices varied significantly across risk categories. Breast self-examination (BSE) was performed by 25.5% of women in the low-risk group, compared to 40.0% in the moderate-risk and 45.5% in the high-risk group ($p = 0.0016$). Clinical breast examination (CBE) was reported by 12.5%, 23.2%, and 39.4% in the low-, moderate-, and high-risk groups respectively ($p < 0.0001$). Mammography use was substantially higher in the high-risk group (45.5%) compared to moderate (12.6%) and low-risk participants (3.3%) ($p < 0.0001$). Overall, 29.2% of low-risk, 45.3% of moderate-risk, and 63.6% of high-risk women had undergone at least one screening method ($p < 0.0001$), indicating a strong positive association between breast cancer risk level and screening uptake (Table 6).

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Table 6: Association Between Risk Category and Screening Practice (n = 615)

Screening Method	Low Risk (n = 487)	Moderate Risk (n = 95)	High Risk (n = 33)	p-value
	Frequency (%)			
BSE				
Performed	124 (25.5%)	38 (40.0%)	15 (45.5%)	0.0016
Not performed	363 (74.5%)	57 (60.0%)	18 (54.5%)	
CBE				
Performed	61 (12.5%)	22 (23.2%)	13 (39.4%)	<0.0001
Not performed	426 (87.5%)	73 (76.8%)	20 (60.6%)	
Mammography				
Performed	16 (3.3%)	12 (12.6%)	15 (45.5%)	<0.0001
Not performed	471 (96.7%)	83 (87.4%)	18 (54.5%)	
Any screening method				
Performed (n=206)	142 (29.2%)	43 (45.3%)	21 (63.6%)	< 0.0001
Not performed (n=409)	345 (70.8%)	52 (54.7%)	12 (36.4%)	

DISCUSSION

This cross-sectional study aimed to assess breast cancer risk among women using the Gail model and to evaluate their awareness and practice of breast cancer screening in a semi-urban Indian setting. The findings provide important insights into risk profiles, prevailing screening behaviors, and the sociocultural factors influencing preventive health practices.

The majority of the participants were between 40–49 years of age, with a mean age of 44.2 ± 8.6 years. This distribution is consistent with national data suggesting that breast cancer incidence begins to rise significantly in women above 40 years, underscoring the importance of early risk assessment and targeted screening.[11] Most participants were homemakers (74.3%) and belonged to lower-middle-income households (mean income: ₹15,657 ± ₹6,326), which mirrors the demographic profiles reported in NFHS-5 and highlights the potential financial barriers to accessing healthcare services.[13] Educational attainment varied, with 21.8% being illiterate and only 16.6% having completed graduation, a factor shown in several studies to significantly influence health literacy and screening uptake.[14]

From a reproductive and clinical risk perspective, the mean age at menarche was 12.9 ± 1.4 years, and 20.7% had early menarche (<12 years), which is a recognized risk factor for breast cancer due to a longer window of estrogen exposure.[15] The average parity was 2.7 ± 1.1, and 93.7% of women had a history of breastfeeding—both of which are protective against breast cancer.[16] A history of oral contraceptive use was reported by 26.7% of women, which aligns with study by Namasivayam et al.[17] Although the prevalence of high-risk clinical indicators was low (5.9% had a first-degree relative with breast cancer, and only 2.1% reported prior breast biopsy), these factors are critical when calculating individualized risk using the Gail model.

Risk stratification using the modified Gail model revealed that 79.2% of women were at low 5-year risk (<1.66%), 15.4% at moderate risk (1.66–3.0%), and 5.4% at high risk (>3.0%), with an overall mean 5-year risk of 1.14 ± 0.72% and a lifetime risk of 10.6 ± 4.1%. These proportions are broadly consistent with findings from Indian studies such as those by Thomas et al., and Faizan et al., which reported 80–85% of women in low-risk categories using the Gail model.[18,19] However, in contrast to study by Bener et al., from Western populations where higher proportions fall into moderate and high-risk categories due to different lifestyle and genetic risk profiles,[20] our findings reflect the comparatively lower risk burden in Indian women—potentially due to protective reproductive behaviors and lower prevalence of obesity and alcohol use.

Despite more than half the participants having heard of at least one screening method (60.3%), only 33.5% had ever performed any form of screening, indicating a substantial gap between awareness and practice. Breast self-examination (BSE) was the most recognized (53.3%) and practiced method (28.8%, frequency: 3.2 ± 1.7 times/year), followed by clinical breast examination (CBE, 15.6%) and mammography (7.0%). Similar trends were reported by Tiwari et al., in Central India, where 53% had heard of BSE, but only 20% practiced it.[21] Another study by Mohan et al., found mammography awareness to be below 10%, mirroring our findings.[22] These results reflect the limited penetration of formal screening programs in India and the reliance on opportunistic and self-driven screening.

The source of information about breast screening was predominantly through mass media (35.4%), followed by healthcare providers (19%) and peers (11.7%). This underscores the potential of both media campaigns and community health worker outreach in increasing screening literacy.[9] A study from Mumbai by Prusty et al., found that structured education through ASHAs significantly improved BSE and CBE practices.[23]

Barriers to screening were multifactorial and deeply rooted in both structural and psychosocial domains. The most cited reasons for non-participation were absence of symptoms or perceived need (67.4%) and lack of awareness (60.3%). These findings are consistent with the Health Belief Model, which posits that perceived susceptibility and perceived severity are key motivators for preventive health actions.[24]. Similar barriers were highlighted by Mahalakshmi et al., who reported that 70% of women believed

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screening was unnecessary without symptoms.[25] Fear of diagnosis (18%) and stigma (6.4%) also emerged as important deterrents, reflecting persistent cultural taboos and fatalistic attitudes toward cancer. Notably, cost-related concerns (5.5%) and inaccessibility of services (9.6%) continue to hinder screening, especially in resource-limited areas—a trend consistent with studies by Kathrikolly et al., and Weerarathna et al.[26,27]

Stratification of screening practices by risk category showed a significant positive association between calculated risk and likelihood of screening. Among high-risk women, 63.6% had undergone some form of screening, compared to 45.3% in the moderate-risk and 29.2% in the low-risk groups ($p < 0.0001$). This trend was most pronounced for mammography, performed by 45.5% of high-risk women compared to just 3.3% in the low-risk group. These findings suggest that either individual risk perception or selective counseling may have guided higher-risk individuals to screen more frequently. A similar risk-practice correlation was observed in studies by Austin et al., and Riganti et al., where higher-risk women were significantly more likely to report mammography use.[28,29] However, despite this positive gradient, screening rates remain suboptimal across all categories, especially given that guidelines from the American Cancer Society and the Breast Health Global Initiative recommend annual CBE and biannual mammography for women above 40 years or at elevated risk.[30]

CONCLUSION

Overall, the study highlights a paradox—while most participants were objectively at low risk, subjective awareness and actual screening practices were limited even among those at high risk. This underscores the need for integrated community-based risk assessment tools and the expansion of structured breast cancer screening programs in India. Empowering frontline health workers to deliver targeted education and risk-based referrals, enhancing accessibility to CBE and mammography at primary health centers, and addressing sociocultural barriers through culturally sensitive health promotion strategies will be essential steps forward.

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