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Recall Rate of Opportunistic Screening Mammography in a University Referral Breast Center in Iran

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Abstract

Background: No information has been published on the effectiveness of digital non-diagnostic opportunistic screening mammography in Iran that is measured by recall rate as one of its indices.
Objectives: In this longitudinal study, we measured recall rate of non-diagnostic mammography at a tertiary referral university hospital and made a comparison with reported international data.
Methods: We examined 9395 digital mammograms performed in 2014 - 2015 from which, 2930 were the first-time and 6465 were subsequent mammography. The patients were referred to the university hospital by their clinicians during annual check-ups while none of them had any chief complaint. The mean age was 49 years. We calculated recall rate, sensitivity, specificity, and cancer detection rate.
Results: Breast cancer was diagnosed in 80 patients. Recall rates were 29% for the first-time and 22% for subsequent mammography, and the overall rate of cancer incidence was 8.5 per 1000 mammograms (80/9395) with specificity of 75.9%, sensitivity of 97.5%, PPV of 3.4%, and NPV of 99%.
Conclusions: The recall rate was much higher in this setting than the acceptable range reported in literature. However, the sensitivity and detection rate were higher; thus, the higher recall rate could be due to some differences in the patient population such as being at younger ages and higher risks.

Keywords: Recall Rate, Mammography, Breast Cancer, Screening, Detection Rate

1. Background

Mammography can be done for diagnosis after a chief complaint from the patient or just for check-up screening. The recall rate has been defined differently in previous studies. Some studies restrict the recall rate to the need for further imaging to make a final decision, while other studies include clinical examinations, further imaging, both or just biopsies. Obviously, the different definitions affect the recall rate. The recall rate in this study was defined as the frequency with which a radiologist needs additional imaging or repetition of imaging before a final recommendation or recalling the patient for biopsy.

The recall rate is commonly used as a measure in screening mammography practice in some countries (1). A low recall rate can be associated with decreased sensitivity and increased number of false-negative results, while a rate that is too high increases false-positive results, increased costs, patient anxiety, and overload job on staff (2-7). Reported recall rates range from less than 1% to about 15% (7). The recommended recall rate according to the American college of radiology and the U.S. Agency for health care policy and research is less than 10% (8, 9). European guidelines recommend a target recall rate of 5% (with an acceptable rate of less than 7% for the first screenings and less than 5% for subsequent screenings) (10, 11).

Multiple factors seem to have an impact on the recall rate, including patient population, radiologist, employed techniques, and systemic factors. Factors related to patient population are age (12), breast density (13), use of hormone replacement therapy (12), time interval since obtaining the previous mammogram (14, 15), family history (16), and previous benign biopsy results (16). Radiologist factors that have been proposed to affect recall rate include sex (17), fellowship training in mammography (18), years of work experience (17, 19), and affiliation to an academic medical center (20). Factors related to technique and types of mammography machine include the use of digital or analogue device, tomosynthesis (21, 22), 3D images (23), computer-aided detection rate and even, skill of the technologists (24). Systemic factors shown to affect recall rate include reading volume (25), double versus single reading (26), and computer-aided reading (27).

In this study, we determined the recall rate at a tertiary referral university hospital and compared the data with international data. Patients came to the hospital to do self-paid screening mammography after receiving information from media meant to inform the population or following referral by clinicians for mammography check-ups.

2. Methods

2.1. Design

In Iran, there is no governmental plan for mammography screening. Mass media are trying to teach people about the value of breast cancer screening, and general physicians, gynecologists, and surgeons refer women who are usually above 40 to imaging centers for screening mammography. We conducted a longitudinal study in an academic tertiary referral hospital to measure the recall rate of this type of non-diagnostic mammography. We included mammographies from patients who did not have any chief complaint or positive clinical examination.

Before doing the mammography, patients signed a written informed consent form. Mammography was performed using dedicated, fully digital Selenia Dimensions mammography system (Hologic Inc., Marlborough, USA) in the breast clinic of the cancer institute of Imam Khomeini hospital, where breast surgeons were also working. Craniocaudal and mediolateral oblique views of each breast were recorded. The data used in this study were collected from mammograms read by three breast imaging radiologists with 6 to 20 years of breast imaging experience between Jan 1, 2014, and Jan 1, 2015. Computer-assisted detection software was not used.

Mammogram reports were categorized using the fifth edition of the breast imaging reporting and data system (BI-RADS) from the American college of radiology. All examinations with BI-RADS scores of 0 (additional imaging required), 4 (suspicious finding), and 5 (highly suspicious finding) were regarded as recall patients.

For 12 months, the patients were followed up and in the case of biopsies, an expert pathologist examined breast tissue specimens of core needle biopsies from patients with BI-RADS 4 or 5.

2.2. Subject

After exclusion of 11 cases with missing data, we included 9395 screening mammograms from women without any chief complaint or positive clinical breast examination, representing 3135 mammograms per radiologist.

2.3. Data Acquisition

Using MS Office Excel (Microsoft, Redmond, USA) during medical records review, we gathered data pertaining age, mammography session (first or subsequent), mammographic findings (breast mass, asymmetry, distortion, and micro-calcification), histopathological type of breast lesion (benign, atypia, in situ, and invasive), BI-RADS score, and “recall” mammograms.

2.4. Data Analysis

Dividing the number of “recall” mammograms by the number of screening mammograms gave us the recall rate. We assessed the sensitivity, specificity, negative predictive value (NPV), and positive predictive value (PPV) of recall mammograms for detection of in situ or invasive breast carcinoma within the follow-up period. Histopathological diagnosis (biopsy) was the gold standard. We defined cancer detection rate as the number of cancers (in situ or invasive) with positive initial interpretation (true positive recall mammogram) per 1000 screening mammograms. The cancer detection rate was also defined as the number of cancers with positive initial interpretation (recall) among 1000 screening mammograms (TP/TP + FN + FP + TN). We used descriptive statistics, including frequency distribution, mean, and standard deviation, to report the findings. Kappa measurement was calculated to assess the agreement between three radiologists on reporting mammograms (recall rates). ANOVA and independent t test was used to compare age factor between the categories. To compare the recall rate in categorical variables, we used chi square and Fisher’s exact tests. Type I error was considered 0.05. All analyses were conducted using SPSS v.22 (IBM Corp., Armonk, USA).

2.5. Ethical Considerations

All identity revealing information is preserved. Researchers imposed no harms on the patients. Researchers in this project are committed to the principles of the declaration of Helsinki and declare no conflicts of interests.

3. Results

The age ranged 25 to 78 years with the mean ($\pm$ standard deviation) of 49.84 ($\pm$ 9.19) years. Table 1 represents the frequency distribution and age of patients in BI-RADS categories. Patients in BI-RADS category 4 (suspicious findings, n = 180) were the youngest (44.06 ± 6.40 years), and the mean age significantly differed among categories (P value < 0.001). The recall rate in total, in the first mammograms (n = 2930), and in subsequent mammograms (n = 6465) were 24.7%, 29%, and 22%, respectively. "Recall" patients (n = 2320) were younger than patients not recalled (n = 7075) (48.00 ± 8.27 versus 50.44 ± 9.39 years, independent t test statistic = 11.901, P value < 0.001), and the recall rate significantly decreased per age decade (P value < 0.001, Table 2).

The agreement between radiologists (A, B, and C) in classifying "recall" mammograms was strong (A and B: kappa = 0.7, A and C: kappa = 0.7, B and C: kappa = 0.8).

Total 80 patients (34.8% of 230 biopsies) had breast cancer (10 in situ and 70 invasive breast cancer, table3), and cancer detection rate was 8.5 per 1000 mammograms (80/9395) with specificity: 75.9%, sensitivity: 97.5%, and PPV: 3.4%. Table 4 represents the contingencies.

As represented in Table 5, micro-calcification was 48.5% prevalent and came with lower recall rate (21.1% versus 28.1%, P value < 0.001). Mass was detected in 16.0% of mammograms. Recall rate was higher in the presence of mass (49.3% versus 20.0%, P value < 0.001). Distortion was 2.4% prevalent in mammograms and recall rate was higher in patients with distorted lesions (34.8% versus 24.4%, P value < 0.001). Asymmetric lesions were detected in 32.9% of mammograms. Recall rate for asymmetric lesions was higher (48.1% versus 13.2%, P value < 0.001).

Of significance (all P values < 0.001), micro-calcification was weakly correlated with age (Pearson's correlation coefficient = 0.139), asymmetry (-0.229), mass (-0.179), and BI-RADS score (0.196). Table 6 shows multivariate logistic model for prediction of "recall" (Nagelkerke R^2 = 0.631, Chi-square = 5196.457, dF = 6, P value < 0.001). Mammographic detection of mass was the strongest predictor of "recall" (OR = 11.467, 95% CI: 9.464 - 13.894). Notably and opposing to univariate analysis (Table 7), micro-calcification showed an increased probability of "recall" (OR = 2.347, 95% CI: 2.018 - 2.731), adjusted for age, distortion, asymmetry, mass, and BI-RADS score in multivariate logistic regression.

4. Discussion

In this study, mass was detected in 16.0% of mammograms, and recall rate was higher in the presence of mass (49.3% versus 20.0%, P value < 0.001). Mammographic detection of mass was the strongest predictor of "recall" (OR = 11.467, 95% CI: 9.464 - 13.894). One of our recalled patients with mass is depicted in Figure 1.

The recall rates for non-diagnostic check-up mammograms were 29% for the first-time mammograms and 22% for subsequent mammograms, which are high in comparison with the range of 5% - 20% reported in the United States (28-34) but more similar to an Asian study (35). The sensitivity was also higher in this study than most previous studies (2, 35). Various optimum recall rates have been suggested in literature. Yankaskas et al. (2) proposed a recall rate between 4.9% and 5.5% and showed a plateau in the association between sensitivity and recall rate above this range. In contrast, Gur et al. (30) found that increases in recall rates beyond 10% still increased the detection rate. Schell et al. (36) performed a cost-benefit analysis to determine an optimal recall rate and recommended average recall rates of 10.0% and 6.7% for the first mammograms and subsequent mammograms, respectively. Recently, Grabler suggested that a recall rate less than 10% may be too low (37).

Possible reasons for the increased recall rate in this center include higher percentage of patients with prior surgery or biopsy at the hospital site, complicated mammograms that are difficult to interpret, and higher-risk patients. Unfortunately, we did not have access to this information, but these factors are likely for this type of center (as a tertiary referral university hospital). Future local research could be helpful to confirm this issue. Carney et al. showed that the recall rate increases among higher-risk patients (16). In addition, the mean age of patients was significantly lower compared to other reports (2). This factor may also have contributed to the higher recall rates, as younger age has been associated with higher recall rates (2, 36). It is possible that a higher recall rate is mandatory for some populations to maintain an appropriate cancer detection rate, and the local patient population has to be considered in the measurement.

Our study had several limitations. First of all, the number of patients included in the study was not large enough, and it would be better to include more patients in future studies. Due to the retrospective nature and limitations of the information gathering systems used in this study, no data were available for race, family, or personal history of breast cancer, and prior surgery or biopsy. Another important limitation is that we analyzed recall rates from only three radiologists, all of whom were university professors experienced in breast imaging and working in the same center. The majority of mammograms in Iran are interpreted by general radiologists as a small percentage of their overall workload. These points make it difficult to generalize the conclusions of this study to the general practice in Iran. Some centers in other parts of the world decreased their recall rate by double readings of mammography reports (38, 39), tomography, and three-dimensional mammography (21), or by using computer-aided detection

Table 1. Age of Women Based on BI-RADS Categories of Screening Mammography

BI-RADS Category	Frequency, No. (%)	Age, Mean ± SD	ANOVA	
			F statistic	P value
0[a]	2060 (21.9)	48.24 ± 8.19	78.249	< 0.001
1	1570 (16.7)	47.78 ± 8.94		
2	4885 (52.0)	51.36 ± 9.49		
3	590 (6.3)	49.05 ± 7.38		
4[a]	180 (1.9)	44.06 ± 6.40		
5[a]	80 (0.9)	50.63 ± 10.95		
6	30 (0.3)	66.33 ± 9.97		
Total	9395 (100)	49.84 ± 9.19	-	-

Abbreviations: ANOVA, Analysis of Variance; BI-RADS, Breast Imaging Reporting And Data System; SD, Standard Deviation.
[a] "Recall" patients.

Table 2. Recall Rates in Different Age Groups of Women Undergoing Screening Mammography

Age Group, y	Count, No. (%)	Recall		Chi-Square	
		Frequency	Recall rate, %	Statistic	P value
< 40	880 (9.4)	270	30.7	137.710	< 0.001
40 - 49	4090 (43.5)	1180	28.9		
50-59	2955 (31.5)	640	21.7		
60 - 69	1140 (12.1)	190	16.7		
≥ 70	330 (3.5)	40	12.1		
Total	9395 (100)	2320	24.7	-	-

Table 3. Frequency Distributions of Different Types of Breast Lesions in 230 Biopsies from 9395 Women Undergoing Screening Mammography

Type of Breast Lesion	Frequency	Overall Percentage
Benign	100	1.1
Atypia	40	0.5
In situ BC	10	0.1
Invasive BC	70	0.7
Total biopsies	230	2.4

Abbreviation: BC, Breast Cancer.

Table 4. Contingency for for Recall Mammograms and Histopathological Diagnosis of Breast Cancer (230 Biopsies) in 9395 Women Undergoing Screening Mammography[a]

Variables	Cancer[b]	No Cancer	Total
Recall	80	2240	2320
No recall	2	7073	7075
Total	82	9313	9395

[a] Specificity, 75.9%; Sensitivity, 97.5%; PPV, 3.4%; NPV, 99%.
[b] Considering in situ and invasive.

software (40). These are potential future options for improving the national mammography report system.

In conclusion, this study showed a high recall rate in our center, which could be due to different patient population. Improving the mammography reading system may decrease this rate in the future.

Footnotes

Authors' Contribution: study concept and design, Afsaneh Alikhassi; acquisition of data, Afsaneh Alikhassi, Maryam Rahmani and Nasrin Ahmadinejad; data gathering and statistical analysis, Sona Akbari, Farzin Roozafzai; interpretation of data, Afsaneh Alikhassi; drafting of the manuscript, Afsaneh Alikhassi; critical revision of the manuscript for important intellectual content, Maryam Rahmani, Nasrin Ahmadinejad and Zahra Alikhassy

Table 5. Description and Analysis of "Recall Rates" in Different Screening Mammographic Findings

Mammographic Findings	Category	Frequency No. %	Recall		Chi-Square	
			Frequency	Recall rate, %	Statistic	P value
Micro-calcification	Yes	4555 (48.5)	960	21.1	62.247	< 0.001
	No	4840 (51.5)	1360	28.1		
Mass	Yes	1500 (16.0)	740	49.3	582.738	< 0.001
	No	7895 (84.0)	1580	20.0		
Distortion	Yes	230 (2.4)	80	34.8	12.904	< 0.001
	No	9165 (97.6)	2240	24.4		
Asymmetry	Yes	3095 (32.9)	1490	48.1	1364.628	< 0.001
	No	6300 (67.1)	830	13.2		
Total		9395 (100)	2320	24.7	-	-

Table 6. Multivariate Logistic Regressions with "Recall" Mammogram as Outcome Variable

Predictors	Beta	OR (95% CI)	P Value
Age	-0.020	0.980 (0.972 - 0.988)	< 0.001
BIRADS	-1.710	0.181 (0.167 - 0.196)	< 0.001
Mass	2.440	11.467 (9.464 - 13.894)	< 0.001
Asymmetry	2.086	8.052 (6.912 - 9.380)	< 0.001
Distortion	2.081	8.016 (5.292 - 12.142)	< 0.001
Micro-calcification	0.853	2.347 (2.018 - 2.731)	< 0.001
Intercept	-7.217	0.001	< 0.001

Table 7. Univariate Logistic Regressions with "Recall" Mammogram as Outcome Variable

Predictor	Beta	OR (95% CI)	P Value
Asymmetry	1.811	6.118 (5.528 - 6.772)	< 0.001
Mass	1.359	3.892 (3.468 - 4.367)	< 0.001
Distortion	0.500	1.649 (1.252 - 2.172)	< 0.001
BIRADS score	-1.867	0.155 (0.144 - 0.166)	< 0.001
Micro-calcification	-0.381	0.683 (0.621 - 0.751)	< 0.001
Age (years)	-0.030	0.970 (0.965 - 0.975)	< 0.001
Age decade	-0.307	0.736 (0.698 - 0.776)	< 0.001

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Conflict of Interests: The authors declare that there is no conflict of interest regarding the publication of this paper.

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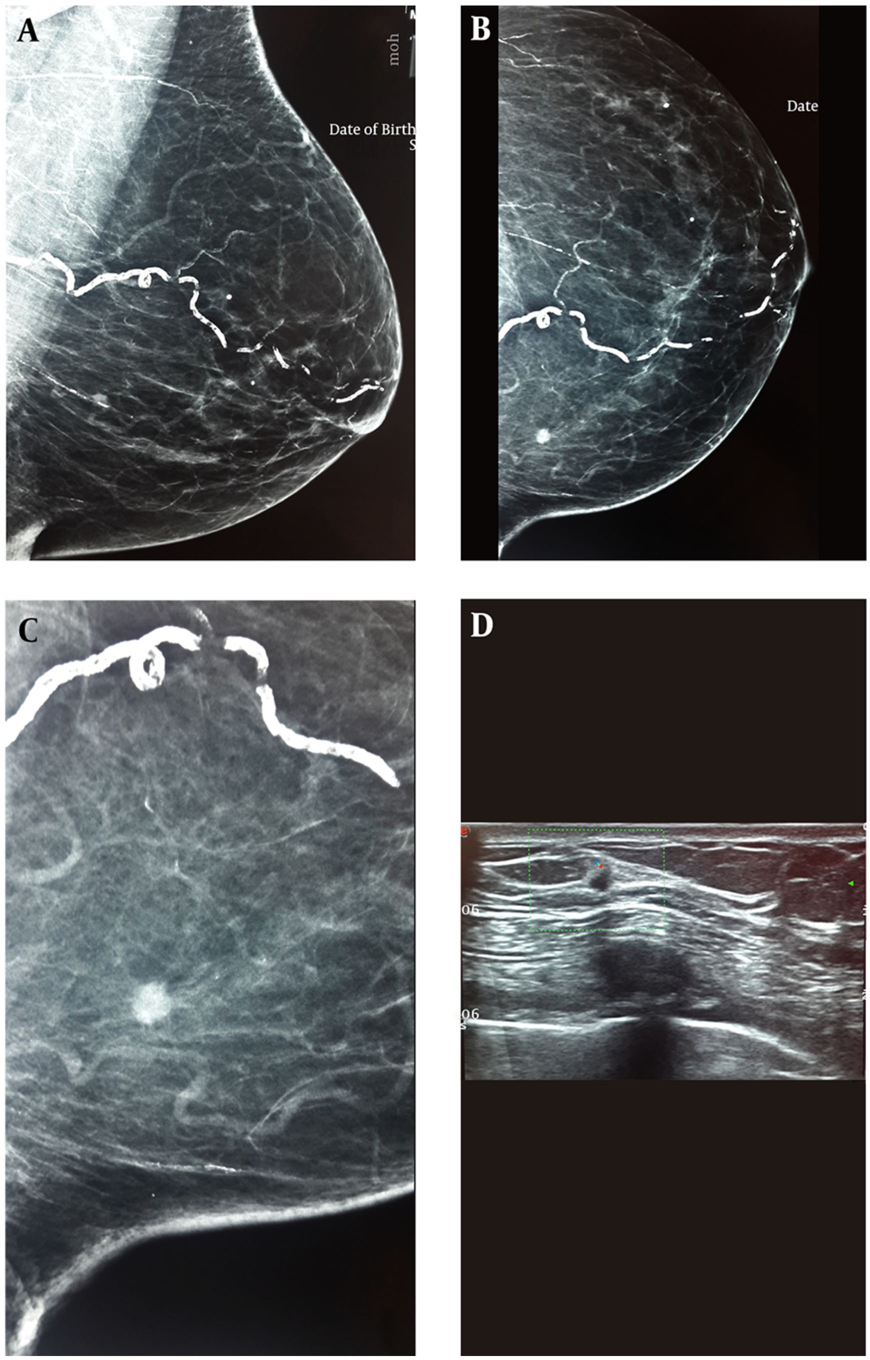
Figure 1. A 44 Year Old Lady Without Any Chief Complaint Who Referred for Mammary Screening



A, full digital mammography in MLO view shows a small dense mass in lower part of left breast; B, the same mass in CC view is in the inner part; C, in focal compression magnification view, it has speculated border; D, in target sonography, the mass was found which made biopsy and wire localization possible; it was proven to be an invasive ductal carcinoma.

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