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Original Article

Evaluation of Breast Cancer Screening Services Using Mammograms and Ultrasounds via Mobile Mammography Units

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Abstract

Objective: Breast cancer is a major public health concern in Thailand, ranking as the most common cancer among Thai women, with an annual incidence of 17,043 cases and 4,753 deaths. Proactive screening methods, such as breast self-examination (BSE), clinical breast examination (CBE), mammograms, and ultrasounds, are crucial in reducing mortality rates. However, access to these technologies remains limited, particularly in remote areas, due to insufficient mammography machines nationwide. This study aims to evaluate breast cancer screening outcomes among at-risk populations and improve access to medical services in underserved areas.

Materials and Methods: This retrospective study analyzed data from 525 women aged 14-82 who underwent mammograms and ultrasounds via mobile screening units between April and August 2024.

Results: The results showed that 121 participants (23.05%) presented abnormalities requiring follow-up, classified under BIRADS 3–5 risk categories. The estimated number of breast cancer cases from this study is higher than the national average incidence rate.

Conclusion: The findings highlight the effectiveness of mobile screening units in detecting abnormalities and increasing access to services in underserved areas. The incidence of breast cancer in the population studied was approximately 20.02-31.34 per 1,000 individuals. The research underscores the need to expand access to advanced screening technologies and consider extending mammogram and ultrasound benefits to high-risk populations. Further cost-effectiveness and long-term outcomes studies are recommended to support policy development and enhance national breast cancer screening strategies.

Keywords: Screening breast cancer high risk, Mammography, Ultrasound mobile units

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Introduction

Breast cancer is a significant public health issue in Thailand. The incidence of breast cancer among Thai women has shown a continuous upward trend, rising from the third most common cancer in 1990 to currently being the leading cancer affecting Thai women. Each year, approximately 17,043 new cases are reported,[1] equivalent to about 47 cases per day, with mortality rates reaching 4,753 deaths annually.[2] This critical issue demands urgent attention.

Proactive breast cancer screening is a key measure to reduce mortality rates. Although breast cancer can potentially affect all women, it is also a preventable disease through modifications of risk behaviors. Furthermore, breast cancer is treatable and curable if detected in its early stages.

Guidelines for the Diagnosis and Treatment of Breast Diseases and Breast Cancer in Thailand are as follows:[3]

Women aged 20 years and above:

Monthly breast self-examinations (BSE) are recommended, and individuals should be informed of both the benefits and limitations of BSE. Proper training in performing BSE correctly should also be provided. If any suspicious symptoms arise, women should undergo examinations by trained medical personnel.

Women aged 40–69 years without symptoms:

In addition to regular BSE, these women should have annual clinical breast examinations (CBE) conducted by trained medical personnel.

Women aged 70 years and above:

Screening for this group should be individualized, taking into account the potential benefits and risks of mammographic imaging based on their current health status and life expectancy.

Since 1999, Thailand has initiated breast cancer screening programs. By 2024:

Breast Self-Examinations (BSE): 8.7 million women have undergone screening, accounting for 72.63% of the 12 million target population.

Clinical Breast Examinations (CBE): 9.2 million women have been screened, achieving 92.67% of the 10 million targets.

In addition, screening benefits have been extended for high-risk groups, including:

1. *BRCA1/BRCA2* genetic testing in 2022
2. Mammography with ultrasound for high-risk women in 2024

However, mammography and ultrasound screenings are not yet standard benefits for the general population. Among Thai women aged 40-70, the population is approximately 14.5 million.[4] Yet, Thailand only has 331 mammography machines, with some provinces lacking these machines altogether. Consequently, mammography and ultrasound screening are insufficient for population-level screening.

For high-risk groups, mobile mammography and ultrasound units have significantly improved access to screening services in remote areas. The National Cancer Institute has been operating mammography and ultrasound mobile units since 2009, serving a total of 16,257 individuals and detecting abnormalities in 1,563 cases, as shown in Table 1.

Table 1 Summary of the breast cancer screening results using a digital mobile mammography unit and automatic ultrasound year 2009-2024.

No.	Fiscal Year	Case No.	(BI-RADS)					
			1	2	3	4	5	Only U/S
1	2009	969	420	373	136	35	5	
2	2010	528	250	209	58	9	2	
3	2011	317	134	124	49	9	1	
4	2012	959	471	410	41	36	1	
5	2013	2,011	1,112	704	131	62	2	
6	2014	1,335	894	346	53	37	5	
7	2015	1,692	917	667	67	41	0	
8	2016	1,363	695	556	76	34	2	
9	2017	1,270	634	571	47	15	3	
10	2018	1,270	680	537	31	22	0	
11	2019	1,303	775	477	25	18	0	8
12	2020	746	150	414	137	28	2	15
13	2021	139	25	81	29	4	0	
14	2022	266	54	176	15	12	2	7
15	2023	849	143	622	55	23	5	1
16	2024	1,240	266	772	143	48	7	4
Total		**16,257**	**7,620**	**7,039**	**1,093**	**433**	**37**	**35**
						1,563		

This study involves collecting data on breast cancer screening results across various provinces and designing an optimal and cost-effective screening approach for population-level breast cancer screening. The research is a part of the project titled *"Taking Doctors to the People"*, conducted in honor of His Majesty the King on the auspicious occasion of His 72nd birthday anniversary on July 28, 2024. The study aims to lay the groundwork for future plans, should advanced technologies and tools become available and feasible.

This study aims to analyze the results of breast cancer screenings in high-risk populations and to enhance access to medical services for people in remote areas.

Material and Methods

We conducted a retrospective descriptive study by collecting data from 525 women aged 14–82 who underwent mammograms and ultrasounds via mobile screening units between April and August 2024.

Population and sample

The study targeted women aged 40 years and older who underwent mammography and ultrasound breast cancer screenings via mobile digital mammography and automated ultrasound units as part of the "Taking Doctors to the People" project. This initiative, which honored His Majesty the King on the occasion of His 72nd birthday anniversary, was conducted from April to August 2024 and included a total of 525 participants. Participants were asymptomatic and selected based on screening criteria specifically developed by the research team.

Screening event locations:

1. In Buri Hospital, Singburi Province
2. Wat Bang Phli Yai Community Health Center, Samut Prakan Province
3. Om Noi Municipality, Samut Sakhon Province
4. Pho Thong Hospital, Ang Thong Province
5. Dan Chang Kindergarten School, Suphan Buri Province
6. Phayao Hospital, Phayao Province
7. Lad Yao Hospital, Nakhon Sawan Province
8. Somdej Phra Yupparat Loeng Nok Tha Hospital, Yasothon Province
9. Phon Thong Hospital, Roi Et Province

Subject selection and allocation

Inclusion criteria were women aged 35-39 years with abnormal findings from Clinical Breast Examination (CBE) or with a first-degree relative diagnosed with breast cancer before age 50, and women aged 40 years and older with abnormal findings from Clinical Breast Examination or with a first-degree relative diagnosed with breast cancer.

Exclusion criteria were women under 40 years of age with normal findings from Clinical Breast Examination conducted by medical personnel and individuals who had undergone breast cancer screening within the past two years.

Table 2 Criteria for providing breast cancer screening services using a mobile digital mammography unit and automated ultrasound

Age	CBE Results	Screening	Remark
≥ 40	Abnormal	MMG + U/S	Providing services to all
≥ 40	Normal, but have a close relative with breast cancer	MMG + U/S	Providing services to all
35 - 39	Abnormal	MMG + U/S	Providing services to all
35 - 39	Normal, but have a close relative with breast cancer < 50 years old	MMG + U/S	Providing services to all
< 35	Abnormal	Only U/S	Mammography may be considered in a case-by-case

Table 3 BIRADS category & estimated breast cancer risk[3]

BI-RADS	Likelihood of Malignancy	Findings/Examination	Recommendation
1. Negative	Essentially 0%	Normal examination	Routine mammography screening
2. Benign	Essentially 0%	Benign findings: benign calcification, cyst	Routine mammography screening
3. Probably benign	≤ 2%	Non-calcified circumscribed solid mass, focal asymmetry, or single group of punctate calcifications, cluster of microcysts, single complicated cyst	Short interval follow-up in 6 months
4. Suspicious	> 2% but < 95%	Palpable mass, complex solid-cystic mass, suspicious calcifications	Tissue diagnosis
4A: low	> 2% but ≤ 10%	Palpable circumscribed mass, palpable complicated cyst, suspicious of breast abscess	
4B: moderate	> 10% but ≤ 50%	Group of amorphous or fine pleomorphic calcifications, an ill-defined mass	
4C: high	> 50% but < 95%	New group of fine linear calcifications, irregular solid mass with an ill-defined border	
5. highly suggestive of malignancy	≤ 95%	Irregular, spiculated mass with associated microcalcifications and new fine linear and branching calcifications in segmental distribution	Tissue diagnosis
6. Known proven malignancy			Surgical excision when clinically appropriate

Research Instruments

1. Patient Information Record Forms
2. Mammogram and Ultrasound Results

Data Collection

1. Data collection from mammogram result records
2. Classification of results according to BIRADS criteria

Data Analysis

The data was analyzed to calculate the percentage of participants in each BIRADS category and summarize the outcomes as a formula:

Example Calculation:

BIRADS 1: Number of Participants in Each Group/ Total Number of Participants

Abnormal detection rate calculation:

The abnormal detection rate was calculated to assess the proportion of participants requiring further diagnostic evaluation (BIRADS 3 or higher) as formula:

Example Calculation:

Abnormal cases: Number of Participants in Each Group/ Total Number of Participants

Results

Between January and August 2024, a total of 525 participants aged 14-82 years (median age: 42 years) were screened. Out of these, 121 participants (23.05%) required follow-up medical attention due to abnormal results.

Discussion

From the age distribution, it was observed that individuals aged between 18 and 82 years underwent ultrasound and mammography screenings. These screenings were initiated due to abnormalities detected during clinical breast examinations by medical personnel. Both ultrasound and mammography results for these individuals were normal. Additionally, four individuals underwent ultrasound only, as they were unable to undergo mammography, and no abnormalities were found.

Out of the total 525 screened individuals, 121 cases (23.05%) required follow-up due to detected abnormalities. Based on the data, the initial risk of breast cancer can be estimated by categorizing cases according to the BIRADS system, which indicates the likelihood of breast cancer based on imaging findings. The risk interpretation by BIRADS classification is as follows:

1. BIRADS 3: Low risk (< 2%) — follow-up required every six months.

2. BIRADS 4: Moderate to high risk (approximately 2–95%):

2.1 4A: Low risk (2–10%).

2.2 4B: Moderate risk (10–50%).

2.3 4C: High risk (50–95%).

3. BIRADS 5: Very high risk (> 95%).

The number of individuals categorized by BIRADS risk levels is as follows:

4. BIRADS 3: Low risk (< 2%) = 94 individuals.

Estimated breast cancer cases: approximately 1.88 cases (94 × 2%).

5. BIRADS 4 (including 4A, 4B, and 4C): Moderate to high risk (2-95%) = 23 individuals.

5.1 4A (2–10%): Approximately 0.2–1 case (10 × 2-10%).

5.2 4B (10–50%): Approximately 0.6–3 cases (6 × 10-50%).

5.3 4C (50–95%): Approximately 3–5.7 cases (6 × 50-95%).

6. BIRADS 5: Very high risk (> 95%) = 5 individuals.

Estimated breast cancer cases: approximately 4.75 cases (95% of 5).

Table 4 Distribution of BIRADS Categories

Result	Number	Percentage
BIRADs 1*	147	28
BIRADs 2*	253	48.19
BIRADs 3**	94	17.9
BIRADs 4A***	10	2.62
BIRADs 4B***	6	1.14
BIRADs 4C***	6	1.14
BIRADs 5***	5	0.95
Only U/S#	4	1.76
Total	**525**	**100**

* BIRADs 1, 2: Advise performing BSE (Breast Self-Examination) every month and CBE (Clinical Breast Examination) annually.

** BIRADs 3: Advise performing BSE every month, with a follow-up appointment for mammogram and ultrasound in the next 6 months.

*** BIRADs 4, 5: Schedule an appointment for tissue diagnosis.

For those who are unable to have a mammogram.

Estimated total breast cancer cases:

Minimum Estimate:

1.88 + 0.18 + 0.6 + 3 + 4.75 = 10.41 cases 1.88 + 0.18 + 0.6 + 3 + 4.75 = 10.41 cases

Maximum Estimate:

1.88 + 0.9 + 3 + 5.7 + 4.75 = 16.23 cases 1.88 + 0.9 + 3 + 5.7 + 4.75 = 16.23 cases

Thus, for the 521 individuals screened, the potential number of breast cancer cases ranges from approximately 10 to 16 cases.

The incidence rate of breast cancer in this study was calculated relative to the total population screened. Compared to the national breast cancer incidence rate in Thailand, which is 34.2 per 100,000 people.

The formula for incidence rate:

$$\left[\text{Incidence rate} = \left(\frac{\text{Number of study}}{\text{Number of cancer)}} \times 100{,}000\right)\right]$$

$$6.1 \quad \left[\text{Incidence rate} = \left(\frac{(10}{521} \times 100{,}000\right)\right] = 1{,}919.38$$

$$6.1 \quad \left[\text{Incidence rate} = \left(\frac{(16}{521} \times 100{,}000\right)\right] = 3{,}071.98$$

The incidence of breast cancer in this study was estimated to range between 1,919.38 and 3,071.98 per 100,000 population, significantly higher than the national average incidence (34.2 per 100,000 population).

However, this study may have targeted a high-risk population, such as individuals with a family history of breast cancer in direct relatives, those with abnormalities detected during physical examinations, or individuals aged 40 years and older. The study of Sripaiboonkij et al. (2016) reported that the incidence of screening for breast cancer in this group was found to be 10 per 1,000 individuals.[5]

When comparing the calculated incidence rate in this study to the rates of abnormalities detected. The incidence of breast cancer in the population studied was approximately 20.02–31.34 per 1,000 individuals, significantly higher than the established average of 10 per 1,000 individuals.

Among cancers in women in Thailand, breast cancer ranks first. A hospital-based cancer registry showed that among Thai women with all forms of cancer, the proportion of new patients with first-stage breast cancer declined from 13.6% in 2016 to 7.6%.[6] We believe that the breast cancer screening in the group we designed will prove to be valuable and will lead to the detection of more early-stage cancers. This screening process can assist in evaluating the current benefits of ultrasound and mammogram screenings for individuals with a family history of direct relatives affected by breast cancer. In the future, it may be considered worthwhile to expand these benefits further, increasing accessibility beyond the current target of 28,000 cases per year.

The recommendations are as follows:

Enhancing access to services

Consider expanding mobile units equipped with mammograms and ultrasound machines to cover remote areas.

Support the increase in the number of mammogram machines nationwide.

Supporting healthcare benefits

Propose mammogram and ultrasound screenings for high-risk groups, such as individuals with a family history of breast cancer, as a healthcare benefit available to the general public.

Developing screening strategies

Promote awareness of Breast Self-Examinations (BSE) and Clinical Breast Examinations (CBE), particularly among high-risk populations.

Improve the integration of data collection, ensuring coverage from initial BSE and CBE screenings through confirmed cancer diagnoses.

Utilize findings from this study as a proposal for shaping future screening policies to ensure comprehensiveness and cost-effectiveness.

Further research

Study the cost-effectiveness of advanced screening technologies in high-risk populations and evaluate their long-term impact to refine screening guidelines.

Conclusion

This research emphasizes the importance of proactive breast cancer screening, particularly among high-risk populations. It highlights opportunities for developing the public health system to reduce mortality rates and improve the quality of life for the population.

REFERENCES

1. Rojanamatin J, Ukranun W, Supaattagorn P, et al. Cancer in Thailand Volume X, 2016-2018. Bangkok: National Cancer Institute, 2021.
2. Strategy and Planning Division, Ministry of Public Health. Public Health Statistics A.D. 2022 - Causes of death (in Thai); 2022:75-140. [cited 2025 January 20]. Available from: https://spd.moph.go.th/public-health-statistics/.
3. Lapkittichot S. Breast imaging (in Thai). In: Suphaphon S, Sampathanukul P, Wasanasiri W, et al., ed. Guidelines for the Diagnosis and Treatment of Breast Diseases and Breast Cancer (in Thai). Bangkok: Vitta Compute System, 2022:35-36.
4. Department of Provincial Administration. Thai Population by Age Group as of March 2023 - จำนวนประชากรไทย แบ่งเป็นช่วงอายุ ณ เดือนมีนาคม 2566 (in Thai); 2023. [cited 2025 January 20]. Available from: https://www.bora.dopa.go.th/wp-content/uploads/2023/04/pop_age_country_6603.pdf.
5. Sripaiboonkij N, Thinkamrop B, Promthet S, et al. Breast cancer detection rate, incidence, prevalence and interval cancer-related mammography screening times among Thai women. Asian Pac J Cancer Prev. 2016;17(8):4137-41.
6. Chongthawonsatid S. Factors associated with mammograms and Pap smears screening: A national survey in Thailand. Thai J Public Health. 2023;53(3):656-70.