Knowledge and Awareness of Mammography Screening Among Medical Students at Taif University, Saudi Arabia:

A Cross-Sectional Study

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Abstract:

Background: Breast cancer remains the most commonly diagnosed cancer and one of the leading causes of cancer-related mortality among women worldwide. Mammography is the cornerstone of early breast cancer detection and has been shown to substantially reduce disease-specific mortality. As future healthcare providers, medical students are expected to possess adequate knowledge of evidence-based breast cancer screening recommendations to effectively educate patients and promote screening uptake. This study aimed to assess the knowledge and awareness of mammography screening among medical students at Taif University, Saudi Arabia.

Methods: A cross-sectional study was conducted among 305 medical students at Taif University between August and October 2024. Data were collected using a validated, self-administered online questionnaire assessing sociodemographic characteristics, awareness of mammography screening, knowledge of breast cancer risk factors and symptoms, recommended screening practices, and sources of information. Descriptive and inferential statistical analyses were performed to examine factors associated with awareness.

Results: Overall, 73.8% of participants reported being aware of mammography screening. Awareness increased significantly with academic progression, ranging from 28.6% among first-year students to 97.1% among interns. Female students demonstrated significantly higher awareness than males (84.4% vs. 66.1%). Although 46.9% correctly identified 40 years as the recommended age to initiate screening, only 19.7% correctly recognized the recommended biennial screening interval. Nearly half of the participants (47.9%) incorrectly considered breast self-examination and clinical breast examination to be effective breast cancer screening modalities.

Conclusions: Although awareness of mammography screening was generally high, substantial deficiencies remain in students' knowledge of current evidence-based screening recommendations. These findings highlight the need to strengthen undergraduate medical curricula through guideline-based and practice-oriented education to improve future physicians' competency in breast cancer prevention and early detection.

Keywords: Breast cancer; Mammography; Screening; Knowledge; Awareness; Medical students; Saudi Arabia.

Introduction:

Breast cancer is the most frequently diagnosed malignancy among women and represents a major global public health challenge. Despite advances in screening, diagnosis, and treatment, it remains one of the leading causes of cancer-related mortality among women, particularly in low- and middle-income countries where delayed diagnosis and limited access to healthcare services remain significant concerns. According to recent global cancer estimates, breast cancer accounts for approximately one-quarter of all cancers diagnosed among

women worldwide and contributes substantially to cancer-related deaths [1,2].

Early detection is a fundamental component of breast cancer control, as diagnosis at an early stage is associated with improved survival, less aggressive treatment, and better quality of life. Mammography remains the primary imaging modality for population-based breast cancer screening and has demonstrated effectiveness in reducing breast cancer mortality through early detection [3]. The United States Preventive Services Task Force (USPSTF) currently recommends biennial mammography screening for women aged 40–74 years at average risk, while routine breast self-examination and clinical breast examination are not recommended as standalone screening strategies because of insufficient evidence of mortality reduction [4].

In Saudi Arabia, breast cancer is the most common malignancy among women, accounting for more than 30% of newly diagnosed female cancers [5]. Although mammography services are available through the national healthcare system, participation in screening programs remains suboptimal. Previous studies have identified several contributing factors, including insufficient awareness, misconceptions regarding screening recommendations, cultural barriers, and limited physician engagement in recommending mammography [6,7].

Recent projections indicate that the global burden of breast cancer will continue to increase substantially over the coming decades. A comprehensive analysis published in *Nature Medicine* in 2025 predicted a marked rise in new breast cancer cases and related deaths by 2050, with the greatest impact expected in low- and middle-income countries. These projections highlight the urgent need to strengthen early detection strategies and improve adherence to evidence-based screening recommendations among healthcare providers and the general population [18].

The World Health Organization (WHO) emphasizes that reducing breast cancer mortality requires strengthening health systems, improving access to early diagnosis, enhancing public awareness, and ensuring that healthcare professionals are adequately trained to provide evidence-based counseling regarding screening and prevention strategies [19].

Previous studies conducted in Saudi Arabia have demonstrated inadequate knowledge regarding breast cancer screening among university students and the general population [8–10]. Deficiencies in understanding the recommended age for screening initiation, screening intervals, and appropriate screening modalities may contribute to delayed diagnosis and reduced utilization of mammography services.

Medical students represent an important target group for breast cancer education because they will become future healthcare providers responsible for counseling patients, promoting preventive healthcare, and supporting evidence-based screening practices.

However, available evidence regarding medical students' knowledge of mammography screening in Saudi Arabia remains limited, particularly in the western region of the country.

Therefore, this study aimed to assess knowledge and awareness of mammography screening among medical students at Taif University, Saudi Arabia, and to identify potential knowledge gaps that may guide future educational interventions and curriculum development.

Materials and Methods:

2.1 Study Design and Setting:

A cross-sectional, questionnaire-based study was conducted between August and October 2024 among undergraduate medical students at the Faculty of Medicine, Taif University, Taif, Saudi Arabia. The study aimed to assess students' knowledge and awareness of mammography screening. The study was reported in accordance with the **Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines**.

2.2 Study Population and Eligibility Criteria:

The study population included undergraduate medical students enrolled at the Faculty of Medicine, Taif University, during the 2024 academic year. Students from all academic levels (first year to internship) were eligible to participate.

Students were included if they:

- were registered medical students at Taif University;
- were aged ≥18 years;
- provided voluntary informed consent; and
- completed the online questionnaire.

Students from other colleges, incomplete questionnaires, and participants who declined participation were excluded from the analysis.

2.3 Sample Size Calculation:

The required sample size was calculated using the **Raosoft® Sample Size Calculator** based on a total population of 1,471 medical students. Assuming a 95% confidence level, a 5% margin of error, and a 50% expected response distribution

(maximum variability), the minimum required sample size was estimated to be 305 participants.

The survey link was electronically distributed to eligible students through the official WhatsApp groups of each academic year. A total of 305 complete responses were obtained and included in the final analysis.

2.4 Study Instrument:

Data were collected using a structured, self-administered online questionnaire developed based on a review of the relevant literature and previously published questionnaires assessing breast cancer screening knowledge.

The questionnaire consisted of four sections:

Section 1: Sociodemographic characteristics:

- Age
- Gender
- Marital status
- Academic year
- Family history of breast cancer

Section 2: Awareness and knowledge of mammography screening:

- Previous awareness of mammography screening
- Recommended age to initiate screening
- Recommended screening interval
- Recommended screening modality
- Contraindications and potential adverse effects

Section 3: Knowledge of breast cancer:

- Warning signs and symptoms
- Established breast cancer risk factors

Section 4: Sources of information and educational needs:

- Sources of breast cancer-related information
- Preferred educational approaches
- Perceived need for additional education

The questionnaire was administered in English, as English is the official language of medical instruction at Taif University.

2.5 Validity and Reliability:

Before data collection, the questionnaire underwent assessment of **face validity and content validity** by three faculty members with expertise in public health and family medicine to ensure clarity, relevance, and comprehensiveness.

A pilot study involving 30 medical students was conducted to evaluate the readability, feasibility, and clarity of the questionnaire. Data obtained during the pilot phase were not included in the final analysis. Minor modifications were implemented based on participants' feedback.

The internal consistency of the questionnaire was acceptable, with a Cronbach's alpha coefficient of **0.81**.

2.6 Data Collection Procedure:

Data were collected electronically using **Google Forms®**. The survey link was distributed through official student WhatsApp groups after obtaining ethical approval. Participation was voluntary, and only one response per participant was accepted. No personally identifiable information was collected, ensuring participant anonymity and confidentiality throughout the study.

2.7 Ethical Considerations:

Ethical approval was obtained from the Research Ethics Committee of Taif University before commencement of the Electronic informed consent was obtained from all participants before completing the questionnaire.

Participation was voluntary, and participants were informed that they could withdraw at any time without any consequences. Confidentiality and anonymity of collected data were maintained throughout the study. The study was conducted in accordance with the ethical principles of the **Declaration of Helsinki**.

2.8 Statistical Analysis:

Data were exported from Google Forms®, checked for completeness, coded, and analyzed using **IBM SPSS Statistics version 26.0** (IBM Corp., Armonk, NY, USA).

Continuous variables were presented as mean ± standard deviation (SD), while categorical variables were summarized as frequencies and percentages.

Associations between categorical variables were assessed using the **Chi-square test** or **Fisher's exact test**, where appropriate. Statistical significance was considered at a two-sided **P-value <0.05**. All statistical tests were two-tailed.

3. Results:

3.1 Participants' Characteristics:

The table shows that the sample consisted of 305 students ranging from 18 to 26 years old. There was a slight predominance of male participants, 58%, and the participants were fairly evenly distributed across academic years, with slightly higher representation from 1st and 3rd years, 16% each, and slightly lower representation from interns, 11%.

Age	18-26	M (21.5), SD (2.006)
Gender	Male	177 (58%)
	Female	128 (42%)
Academic year	1st year	49 (16.1%)
	2nd year	47 (15.4%)
	3rd year	49 (16.1%)
	4th year	39 (12.8%)
	5th year	45 (14.8%)
	6th year	42 (13.8%)
	Intern	34 (11.1%)
Marital status	Married	2 (0.7%)
	Unmarried	303 (99.3%)
Family history of breast cancer	Yes	25 (8.2%)
	No	265 (86.9%)
	I don't know	15 (4.9%)

Table 1. Sociodemographic characteristics of the participants (n = 305)

A total of **305 medical students** completed the questionnaire and were included in the final analysis. Participants' ages ranged from 18 to 26 years, with a mean age of **21.5 ± 2.0 years**. Male students represented **58.0% (n=177)** of participants, whereas females accounted for **42.0% (n=128)**.

Participants were distributed across all academic years, with the highest proportions observed among first-year and third-year students (**16.1% each**), while interns represented **11.1%** of the sample. Nearly all participants were unmarried (**99.3%**), and **8.2%** reported a family history of breast cancer (Table 1).

The study included 305 undergraduate medical students, with ages ranging from 18 to 26 years and a mean age of 21.5 ± 2.0 years. Male participants represented a slightly higher proportion of the study population (58.0%), while females accounted for 42.0%. Participants were distributed across all academic years, with a relatively balanced representation from the first to sixth years and internship, ensuring inclusion of students at different stages of medical education.

The majority of participants were unmarried (99.3%), reflecting the young age distribution of the study population. A positive family history of breast cancer was reported by only 8.2% of participants, while 86.9% reported no family history. Overall, the demographic characteristics indicate that the sample represented a broad range of undergraduate medical students, allowing assessment of variations in mammography awareness and knowledge across different academic levels.

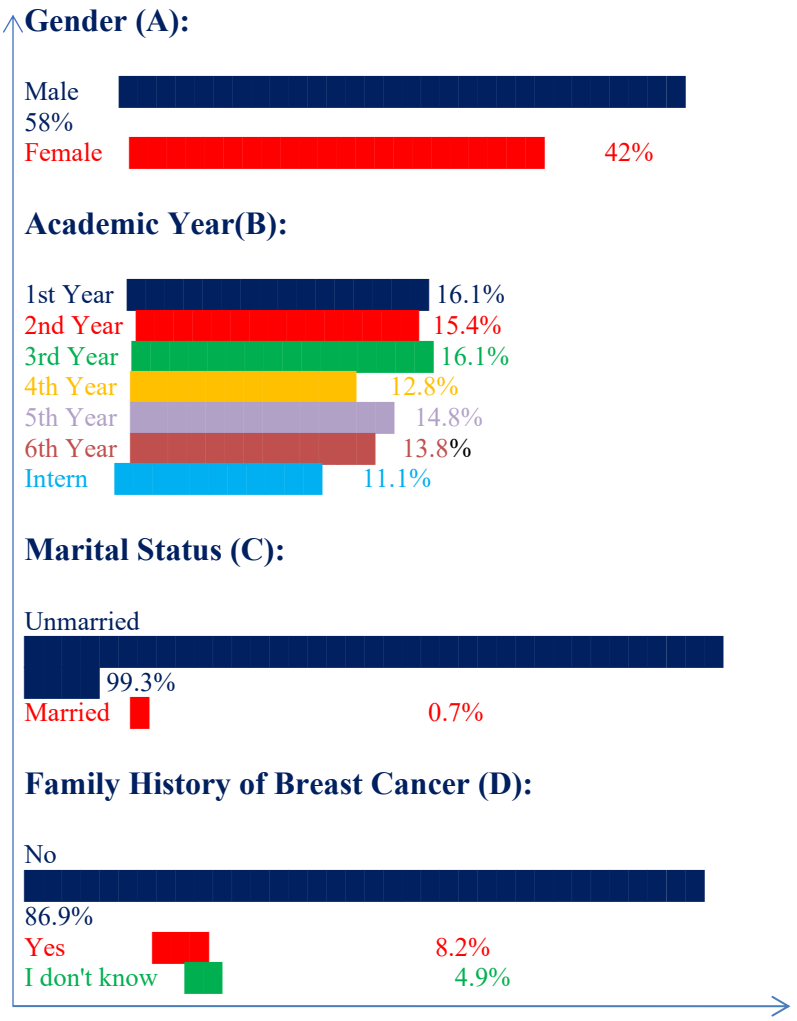


Figure 1. Sociodemographic characteristics of the study participants (n = 305).

The figure illustrates the distribution of participants according to gender, academic year, marital status, and family history of breast cancer and the figure shows the distribution of participants according to gender, academic year, marital status, and family history of breast cancer. Most participants were male (58.0%), while females represented 42.0%. The highest proportions of participants were in the first and third academic years (16.1% each), followed by the second year (15.4%), fifth year (14.8%), sixth year (13.8%), fourth year (12.8%), and

internship year (11.1%). Nearly all participants were unmarried (99.3%). Regarding family history of breast cancer, 86.9% reported no family history, 8.2% reported a positive family history, and 4.9% were unsure.

Male students constituted a slightly higher proportion than females (58.0% vs. 42.0%). Participants were relatively evenly distributed across academic years, with the highest representation from the first and third years (16.1% each). Almost all participants were unmarried (99.3%), and the majority (86.9%) reported no family history of breast cancer.

3.2 Awareness of Mammography Screening According to Academic Year:

Awareness of mammography screening increased significantly across academic years, ranging from **28.6% among first-year students** to **97.1% among interns** (Table 2).

Table 2 Awareness among students by academic year

		Academic year:							
		1st year	2nd year	3rd year	4th year	5th year	6th year	Intern	Total
Have you heard about mammogram screening?	Yes	Count	14	30	35	34	39	40	33	225
		%	28.6%	63.8%	71.4 %	87.2 %	86.7 %	95.2 %	97.1%	
	No	Count	35	17	14	5	6	2	1	80
		%	71.4%	36.2%	28.6 %	12.8 %	13.3 %	4.8%	2.9%	

Table 2 shows that 71% of first year students doesn't know about mammogram screening in contrast to Interns which is 2.9%.

The Chi-square test is significant (p-value <0.05) and indicates a strong association between the level of medical education and knowledge about mammogram screening.

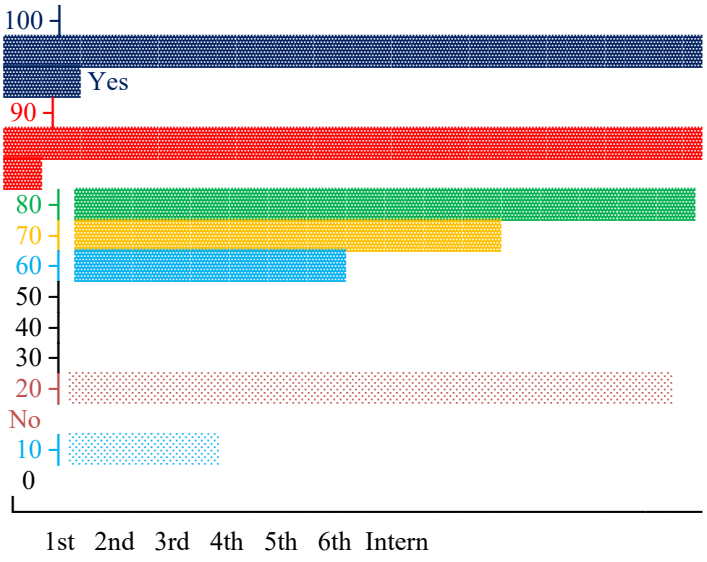
The proportion of students who had heard about mammography screening was **63.8%, 71.4%, 87.2%, 86.7%, and 95.2%** among second-, third-, fourth-, fifth-, and sixth-year students, respectively.

The association between academic year and mammography awareness was statistically significant (**χ^2 test, P <0.001**).

Awareness of mammography screening demonstrated a significant progressive increase across academic years (Table 2). Only **28.6%** of first-year medical students reported having heard about mammography screening, compared with **97.1%** among interns. Awareness increased consistently from the early preclinical years to the advanced clinical years, reaching more than 85% among students from the fourth year onward.

The association between academic year and awareness of mammography screening was statistically significant (**χ^2 test, P < 0.001**), indicating that progression through medical education was strongly associated with improved awareness. This finding suggests that exposure to clinical sciences and preventive medicine education during later stages of the curriculum may contribute substantially to students' understanding of breast cancer screening.

However, the relatively low awareness among early-year students highlights the importance of introducing basic concepts of cancer prevention and screening guidelines earlier within the medical curriculum to ensure progressive acquisition of preventive healthcare knowledge throughout medical training.



Yes (%) 28.6 63.8 71.4 87.2 86.7 95.2 97.1
No (%) 71.4 36.2 28.6 12.8 13.3 4.8 2.9

Figure 2. Awareness of Mammography Screening by Academic Year

Figure 2 demonstrates a progressive increase in awareness of mammography screening with advancing academic year. The proportion of students who had previously heard about mammography screening increased from 28.6% among first-year students to 63.8% in the second year, 71.4% in the third year, 87.2% in the fourth year, 86.7% in the fifth year, 95.2% in the sixth year, and 97.1% among interns. Conversely, the percentage of students who had not heard about mammography screening declined steadily from 71.4% in the first year to 2.9% among interns. These findings suggest that awareness of mammography screening improves progressively throughout medical education, likely reflecting increased exposure to medical curricula and clinical training.

Figure **2** shows the distribution of students' awareness of mammography screening across academic years. The percentage of students who reported previous awareness increased progressively from **28.6%** among first-year students to **97.1%** among interns, whereas the proportion of students who had not

previously heard about mammography screening decreased from **71.4%** to **2.9%** over the same academic progression.

3.3 Gender Differences in Mammography Awareness:

Female students demonstrated significantly higher awareness of mammography screening compared with male students (**84.4% vs. 66.1%, respectively; P <0.001**) (Table 3).

Lack of awareness was more common among male participants (**33.9%**) compared with female participants (**15.6%**).

Table 3 Awareness of Mammogram by Gender

		Male	Female	Total
Have you heard about mammogram?	Yes	117(66.1%)	108(84.4%)	225
	No	60(34%)	20(15.6%)	80
Total		177	128	305

Table 3 shows a higher percentage of females 84% were aware of mammograms compared to males 66%.
The Chi-square test is significant (p-value <0.05), indicating Females are more likely to have heard about mammograms compared to males.

Table 3 demonstrates a significant difference in awareness of mammography screening between male and female medical students. Female participants showed a higher level of awareness compared with male participants (**84.4% vs. 66.1%, respectively**). Conversely, lack of awareness was more frequently reported among male students (**34.0%**) compared with female students (**15.6%**).

The association between gender and awareness of mammography screening was statistically significant (**χ^2 test, P < 0.001**), suggesting that female students were more likely to have previous knowledge of mammography screening than their male counterparts.

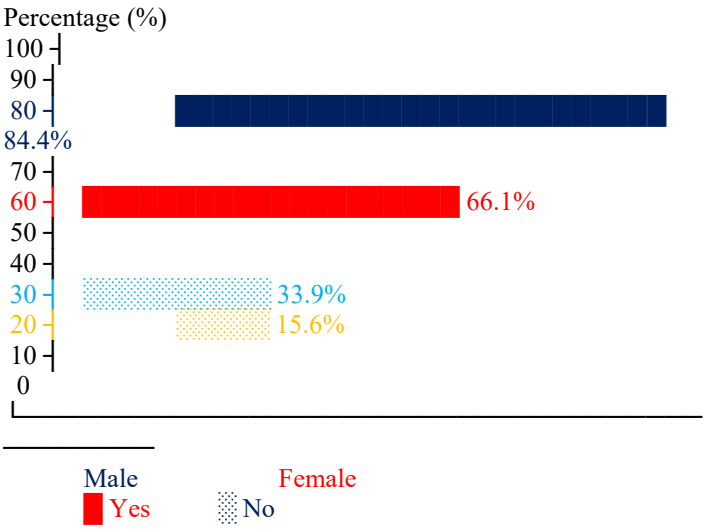


Figure 3 The level of awareness of mammography

Figure 3 illustrates the level of awareness of mammography screening according to gender among the study participants. Female students showed a higher proportion of previous awareness of mammography screening compared with male students (**84.4% vs. 66.1%**, respectively). Conversely, the proportion of students who had not previously heard about mammography screening was higher among males than females (**33.9% vs. 15.6%**). These findings indicate a higher level of awareness among female students regarding mammography screening.

Figure 3 presents the distribution of mammography screening awareness by gender. Among the participants, awareness was reported by **84.4% of female students** and **66.1% of male students**, while lack of previous awareness was reported by **15.6% of females** and **33.9% of males**.

3.4 Knowledge and Awareness of Mammography Screening:

Table 4 Awareness and knowledge of mammogram screening

	Variable	Frequency	%
Have you heard about mammogram screening?	Yes	225	73.8
	No	80	26.2
At what age is it recommended to start mammogram screening according to USPTF?	20	17	5.6
	30	30	9.8
	40	143	46.9
	50	20	6.6
	I don't know	95	31.1
How often women should do mammogram screening according to USPTF?	Every ten years	12	3.9
	Every five years	42	13.8
	Every two years	60	19.7
	Every year	84	27.5
	I don't know	107	35.1
Do you think mammogram screening is the best method of breast cancer screening at the recommended age?	Yes	191	62.6
	No	19	6.2
	I don't know	95	31.1
What other screening modalities have you heard about?	BCE	54	17.7
	CBE	42	13.8
	BCE and CBE	133	43.6
	None	76	24.9
Do you think Clinical Breast Examination and Breast Self-Examination are effective modalities of screening?	Yes	146	47.9
	No	70	23
	I don't know	89	29.2
Is any of the following an adverse effect of mammogram screening?	Risk of radiation	119	28.7
	Pain	63	15.2
	False positive or negative	112	27
	No adverse effects	12	2.9
	I don't know	109	26.3
Is any of the following a contraindication to mammogram screening?	Very young age	110	27.3
	Sign or symptoms of cancer	49	12.2
	Pregnancy	116	28.8
	None	24	6
	I don't know	104	25.8

Overall, **73.8%** of participants reported previous awareness of mammography screening (Table 4).

Regarding evidence-based screening recommendations, fewer than half (**46.9%**) correctly identified **40 years** as the recommended age to initiate mammography screening according to USPSTF recommendations, while **31.1%** reported that they did not know the correct age.

Knowledge regarding screening frequency was limited; only **19.7%** correctly identified biennial mammography as the recommended interval, whereas **35.1%** were unaware of the correct frequency.

Approximately two-thirds of participants (**62.6%**) recognized mammography as the recommended screening modality at the appropriate age. However, misconceptions remained, with **47.9%** believing that clinical breast examination (CBE) and breast self-examination (BSE) are effective screening methods.

Radiation exposure (**28.7%**) and false-positive or false-negative results (**27.0%**) were the most frequently recognized potential adverse effects of mammography, while approximately one-quarter of participants were uncertain.

Pregnancy (**28.8%**) and very young age (**27.3%**) were the most frequently identified contraindications.

This difference may reflect the greater personal relevance of breast cancer screening for female students; however, improving awareness among male medical students remains important, as future physicians of both genders will be involved in patient education, counseling, and promotion of evidence-based breast cancer screening practices.Table 4 shows that among the respondents, the majority, 47%, identified 40 years as the recommended age to start mammogram screening, while the most common response was "I don't know" 35% on the frequency of screening. Additionally, 48% of respondents believe Clinical Breast Examination and Breast Self-Examination are effective screening modalities.

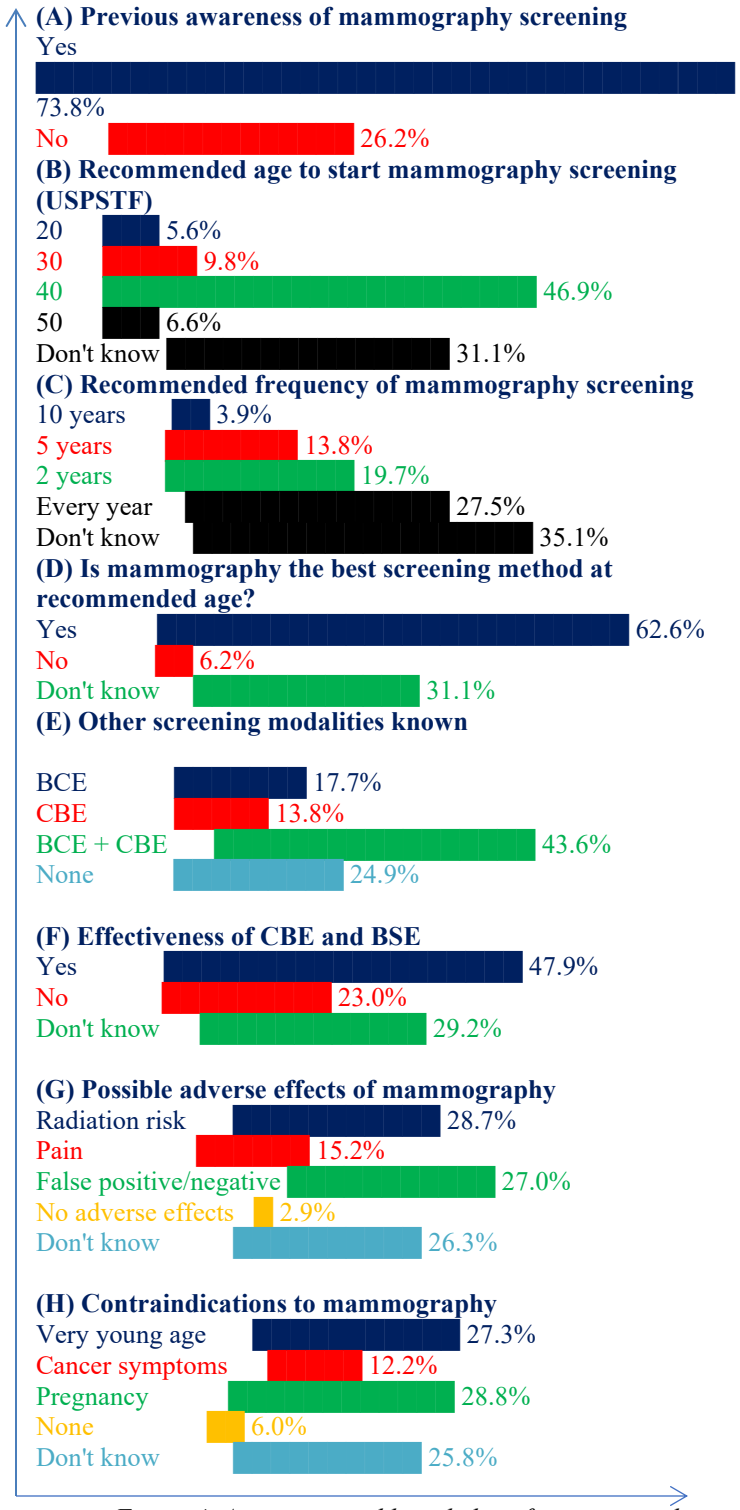


Figure 4. Awareness and knowledge of mammography screening among medical students (n = 305)

Figure 4 summarizes the awareness and knowledge of mammography screening among medical students. Most participants reported previous awareness of mammography screening (73.8%). Regarding knowledge of the recommended age to initiate mammography screening according to USPSTF recommendations, 46.9% correctly identified the age of 40 years, while 31.1% reported that they did not know.

Concerning the recommended screening interval, only 27.5% correctly selected annual screening, whereas 35.1% lacked knowledge about the appropriate frequency. More than half of the participants (62.6%) considered mammography the best screening method at the recommended age. Regarding other breast cancer screening modalities, 43.6% had heard of both breast self-examination (BSE) and clinical breast examination (CBE). However, knowledge gaps were observed concerning the effectiveness of BSE/CBE and potential adverse effects and contraindications of mammography screening.

Figure 4 illustrates the distribution of awareness and knowledge related to mammography screening among the participants. Although 73.8% of students had previously heard about mammography screening, variations were observed in their knowledge of recommended screening age, frequency, effectiveness, adverse effects, and contraindications. The most commonly identified correct response regarding the recommended starting age was 40 years (46.9%), while uncertainty was particularly evident regarding screening intervals (35.1% reported not knowing).

3.5 Knowledge of Breast Cancer Symptoms:

Table 5 Knowledge about Breast cancer symptoms

	Variable	Frequency	%
Breast lump	Yes	213	69.8
	No	15	4.9
	I don't know	77	25.2
Nipple discharge	Yes	174	57
	No	36	11.8
	I don't know	95	31.1
Changes in the nipple shape	Yes	184	60.3
	No	33	10.8
	I don't know	88	28.9
Size changes	Yes	205	67.2
	No	24	7.9
	I don't know	76	24.9
Heaviness or pain in the armpit	Yes	181	59.3
	No	25	8.2
	I don't know	99	32.5
Skin changes	Yes	180	59
	No	27	8.9
	I don't know	98	32.1

Table 5 shows that a high percentage of respondents, 70%, identified breast lump as a potential sign of breast cancer, while 12% Identified nipple discharge as not a symptom.

Participants demonstrated a moderate level of knowledge regarding the clinical manifestations of breast cancer (Table 5). A breast lump was the most commonly recognized symptom, identified by **69.8%** of students, followed by breast size changes (**67.2%**) and changes in nipple shape (**60.3%**).

Awareness of other important warning signs was comparatively lower, including axillary heaviness or pain (**59.3%**), skin changes (**59.0%**), and nipple discharge (**57.0%**). Notably, a considerable proportion of students reported uncertainty regarding several symptoms, particularly nipple discharge (**31.1%**), axillary symptoms (**32.5%**), and skin changes (**32.1%**).

Participants demonstrated moderate knowledge of breast cancer symptoms (Table 5). Breast lump was the most frequently recognized symptom (**69.8%**), followed by breast size changes (**67.2%**), nipple shape changes (**60.3%**), axillary heaviness or pain (**59.3%**), skin changes (**59.0%**), and nipple discharge (**57.0%**).

However, between one-quarter and one-third of participants reported uncertainty regarding several breast cancer manifestations.

These findings indicate that although many students recognized the most typical presentation of breast cancer, knowledge of less obvious but clinically important warning signs remains insufficient. Strengthening undergraduate medical education regarding the full spectrum of breast cancer symptoms may improve future physicians' ability to provide effective patient counseling and promote early detection.

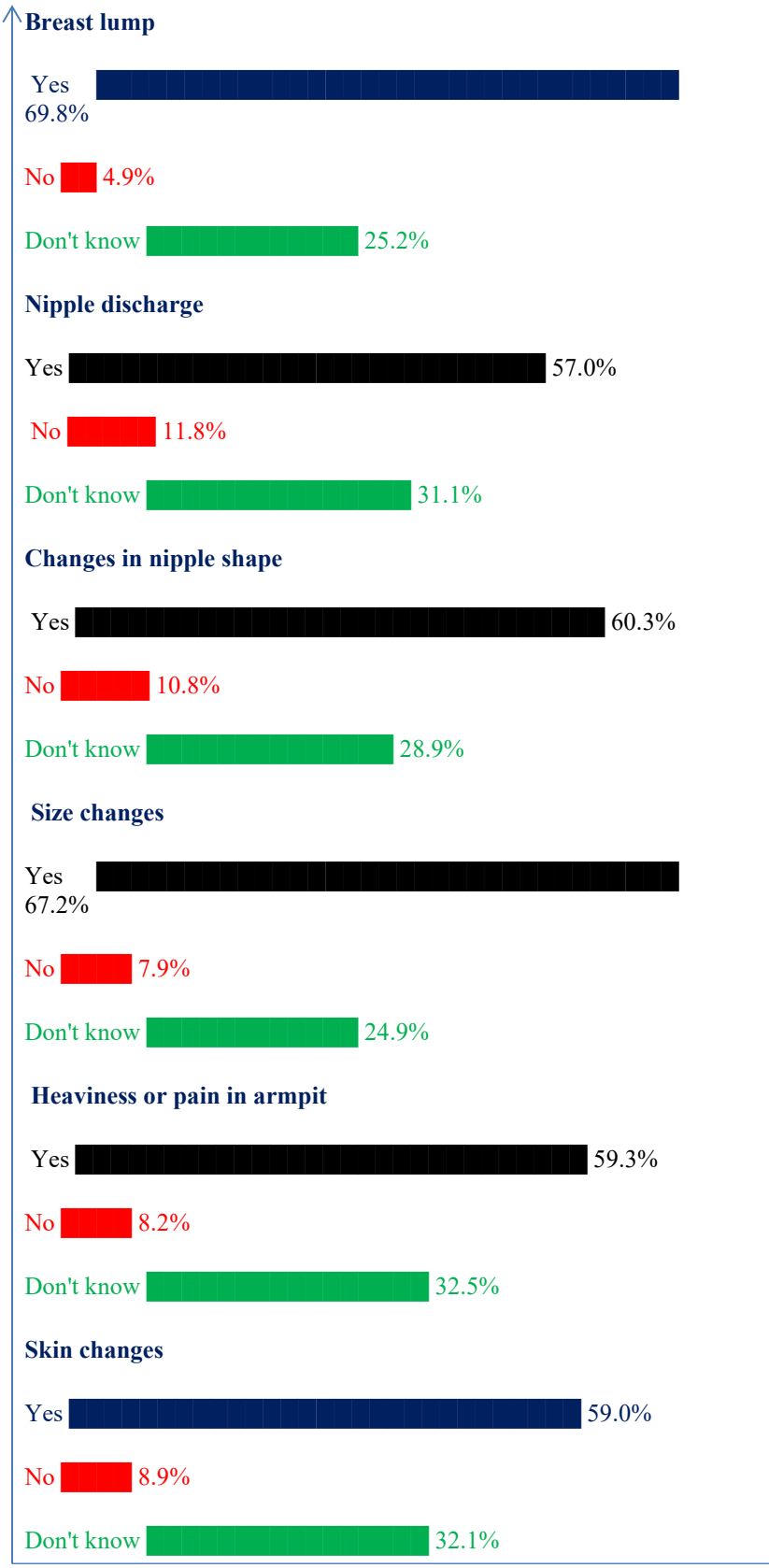


Figure 5. Knowledge of breast cancer symptoms among medical students (n = 305)

Figure 5. Knowledge of breast cancer symptoms among medical students (n = 305). The figure presents participants' recognition of common breast cancer symptoms, including breast lump, nipple discharge, nipple shape changes, breast size changes, axillary heaviness or pain, and skin changes. Breast lump was the most commonly recognized symptom (**69.8%**), followed by breast size changes (**67.2%**). However, a considerable proportion of students reported uncertainty regarding several symptoms, particularly axillary heaviness or pain (**32.5%**) and nipple discharge (**31.1%**).

Figure 5 demonstrates the level of knowledge regarding breast cancer symptoms among the participants. A breast lump was the most frequently recognized symptom (**69.8%**), followed by changes in breast size (**67.2%**) and changes in nipple shape (**60.3%**). Recognition of nipple discharge, axillary heaviness or pain, and skin changes was lower, ranging from **57.0% to 59.3%**. Notably, approximately one-quarter to one-third of participants were uncertain about several symptoms, indicating persistent gaps in symptom awareness.

3.6 Knowledge of Breast Cancer Risk Factors:

Table 6 Knowledge about BC risk factors

	Variable	Frequency	%
Old age	Yes	194	63.6
	No	21	6.9
	I don't know	90	29.5
Family history of BC	Yes	239	78.4
	No	10	3.3
	I don't know	56	18.4
Exposure to radiation	Yes	220	72.1
	No	17	5.6
	I don't know	68	22.3
Use of contraceptive pills	Yes	156	51.1
	No	37	12.1
	I don't know	112	36.7
Overweight and obesity	Yes	124	40.7
	No	42	13.8
	I don't know	139	45.6
Smoking	Yes	188	61.6
	No	30	9.8
	I don't know	87	28.5
Early menarche	Yes	131	43.0
	No	40	13.1
	I don't know	134	43.9
Late menopause	Yes	124	40.7
	No	45	14.8
	I don't know	136	44.6

Table 6 shows a high percentage of respondents; 78% identified family history as a risk factor for breast cancer, while only 41% identified Late menopause and overweight and obesity as a risk factor.

Participants demonstrated variable levels of knowledge regarding breast cancer risk factors (Table 6). Family history of breast cancer was the most frequently recognized risk factor, identified by **78.4%** of students, followed by exposure to radiation (**72.1%**), advanced age (**63.6%**), and smoking (**61.6%**).

In contrast, awareness of several hormonal and lifestyle-related risk factors was comparatively limited. Only **51.1%** of participants recognized the use of contraceptive pills as a potential risk factor, while fewer students identified early menarche (**43.0%**), overweight and obesity (**40.7%**), and late menopause (**40.7%**) as associated risk factors.

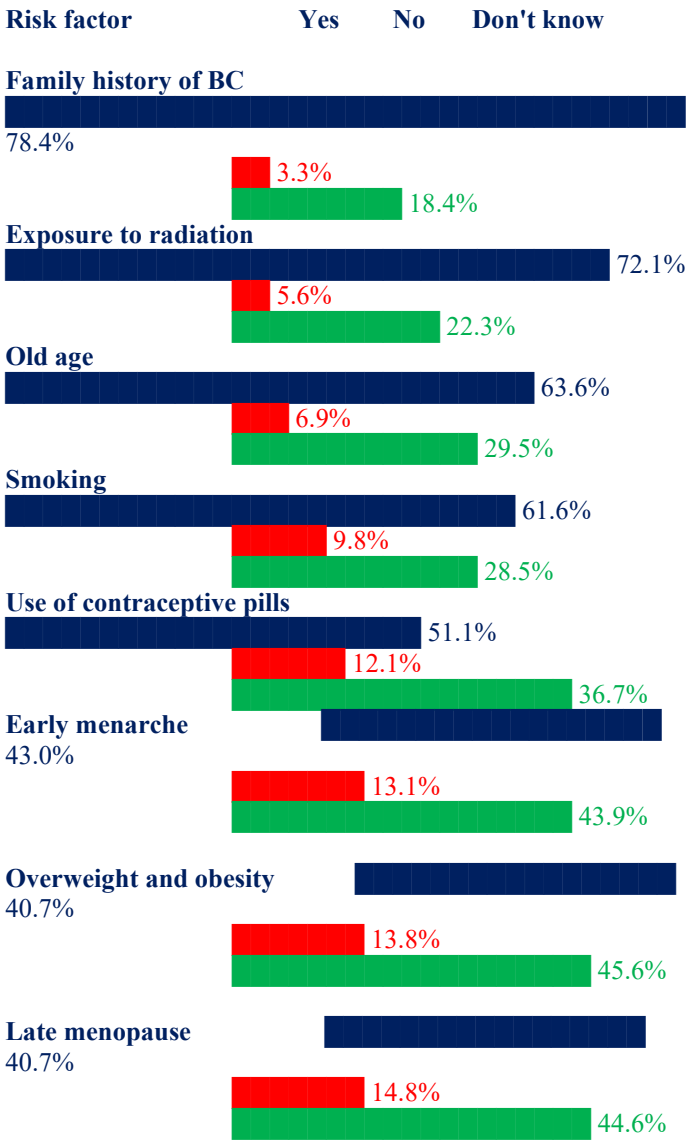


Figure 6. Knowledge of breast cancer risk factors among medical students (n = 305)

The figure illustrates participants' recognition of established breast cancer risk factors. Family history of breast cancer was the most frequently recognized risk factor (**78.4%**), followed by exposure to radiation (**72.1%**), older age (**63.6%**), and smoking (**61.6%**). Lower levels of awareness were observed for hormonal and reproductive factors, including contraceptive pill use (**51.1%**), early menarche (**43.0%**), overweight/obesity (**40.7%**), and late menopause (**40.7%**). A considerable proportion of participants reported uncertainty regarding several risk factors, particularly overweight/obesity (**45.6%**) and late menopause (**44.6%**).

Figure 6 demonstrates the level of knowledge regarding breast cancer risk factors among the participants. Family history of breast cancer was the most recognized risk factor (**78.4%**), whereas reproductive and lifestyle-related factors showed lower recognition rates. Nearly half of the students were uncertain about the association of overweight/obesity and late menopause with breast cancer risk, indicating areas where further educational interventions may be needed.

Knowledge of breast cancer risk factors varied among participants (Table 6). Family history of breast cancer was the most commonly recognized risk factor (**78.4%**), followed by radiation exposure (**72.1%**), advanced age (**63.6%**), and smoking (**61.6%**).

Awareness of hormonal and lifestyle-related risk factors was comparatively lower. Only **51.1%** identified oral contraceptive use, **43.0%** recognized early menarche, and **40.7%** correctly identified overweight/obesity and late menopause as breast cancer risk factors.

A substantial proportion of students reported uncertainty regarding some established risk factors, particularly overweight and obesity (**45.6%**), late menopause (**44.6%**), and early menarche (**43.9%**). These findings suggest that while students are familiar with major hereditary and environmental risk factors, knowledge regarding reproductive and lifestyle-related factors remains insufficient.

Improving education on the comprehensive spectrum of breast cancer risk factors within the undergraduate medical curriculum may enhance future physicians' ability to provide effective risk assessment, counseling, and preventive healthcare recommendations.

3.7 Sources of Information and Educational Needs:

Table 7 Source of information and preferred method of learning

	Variable	Frequency	%
Where did you learn about mammogram screening?	Lectures	179	30.9%
	TV	40	6.9%
	Internet	109	18.8%
	Social media	126	21.8%
	Hospital	76	13.1%
	None	49	8.5%
Do you feel the need for more Information about mammogram screening?	Yes	243	79.7
	No	62	20.3
What do you think would improve your knowledge of breast cancer screening?	More comprehensive lectures or seminars	144	24.2%
	Increased clinical exposure	175	29.5%
	Case-based learning	154	25.9%
	Online courses	121	20.4%

Table 7 shows that 31% chose lectures as their source of Information, 80% of respondents feel the need for more information about mammograms, and 30% chose increased clinical exposure as the method for more knowledge.

Lectures were the most commonly reported source of information regarding mammography screening among medical students (**30.9%**), followed by social media (**21.8%**) and the Internet (**18.8%**). Hospital-based learning contributed to information acquisition for **13.1%** of participants, whereas only **8.5%** reported having no previous source of information about mammography screening.

The majority of students (**79.7%**) expressed a need for additional information regarding mammography screening, indicating perceived gaps in their current knowledge despite their medical education background.

Regarding preferred approaches to improve breast cancer screening knowledge, increased clinical exposure was the most frequently selected method (**29.5%**), followed by case-based learning (**25.9%**), comprehensive lectures or seminars (**24.2%**), and online courses (**20.4%**).

Lectures were the most commonly reported source of mammography-related information (**30.9%**), followed by social media (**21.8%**), the Internet (**18.8%**), and hospital-based learning (**13.1%**) (Table 7).

The majority of participants (**79.7%**) expressed a need for additional education regarding mammography screening. Increased clinical exposure was the preferred educational strategy (**29.5%**), followed by case-based learning (**25.9%**), comprehensive lectures and seminars (**24.2%**), and web-based learning resources (**20.4%**).

These findings suggest that students favor more practical and clinically oriented learning strategies rather than relying solely on theoretical teaching. Integrating structured clinical exposure, case-based discussions, and interactive educational activities into the medical curriculum may enhance students' competency in breast cancer screening counseling and preventive healthcare practices.

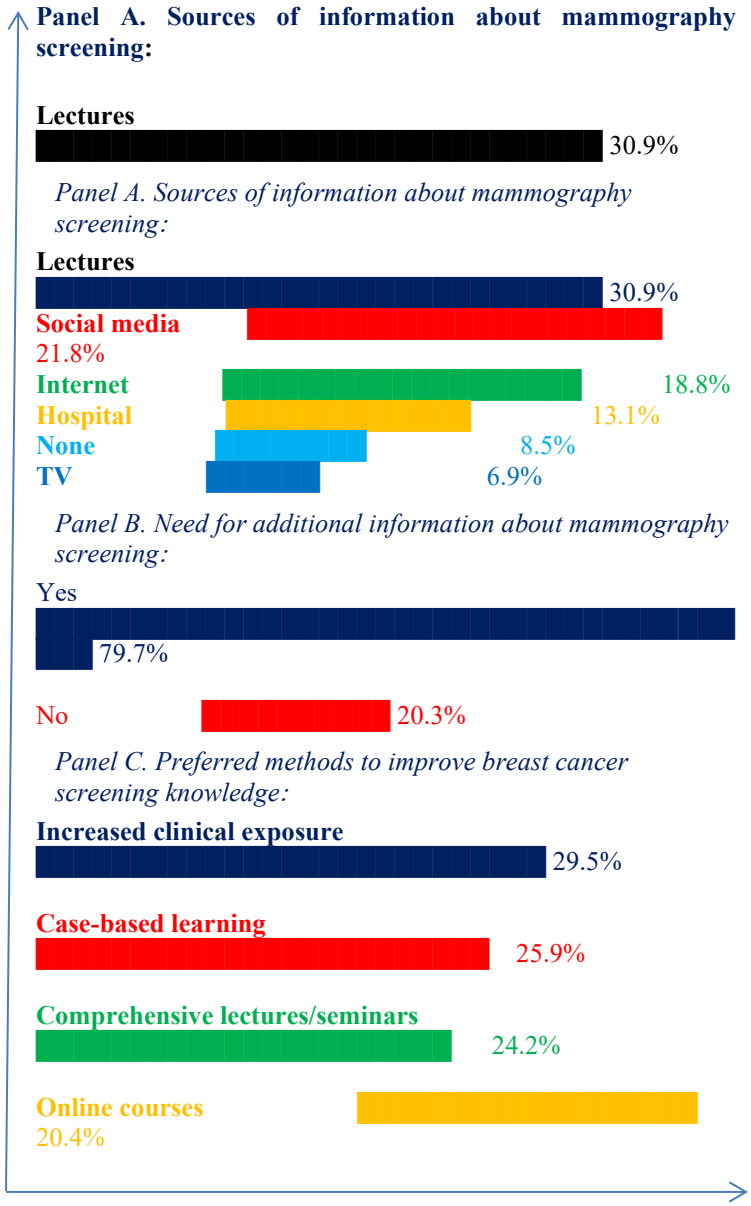


Figure 7. Sources of information and preferred learning methods regarding mammography and breast cancer screening among medical students (n = 305)

Figure 7. Sources of information and preferred learning methods regarding mammography and breast cancer screening among medical students (n = 305). The figure illustrates the main sources of mammography screening information, students' perceived need for additional information, and preferred educational approaches to improve breast cancer screening knowledge. Lectures were the most frequently reported source of information (**30.9%**), followed by social media (**21.8%**) and the internet (**18.8%**). The majority of students (**79.7%**) expressed a need for further information about mammography screening. Increased clinical exposure (**29.5%**) was the most preferred strategy for improving knowledge, followed by case-based learning (**25.9%**) and comprehensive lectures or seminars (**24.2%**).

4. Discussion:

This study provides important insights into the level of knowledge and awareness of mammography screening among medical students at Taif University, Saudi Arabia. As future healthcare providers, medical students have an essential role in breast cancer prevention through patient education, risk assessment, and promotion of evidence-based screening practices. Therefore, evaluating their knowledge of mammography screening is important for identifying educational gaps and informing curriculum development.

In the present study, 73.8% of participants reported previous awareness of mammography screening. Although this indicates a relatively favorable level of general awareness, approximately one-quarter of future physicians had not previously heard about mammography screening, highlighting the persistence of knowledge gaps. The observed awareness level is comparable with findings from studies among medical students in other developing countries, while higher than levels reported among non-medical university students and the general population. This difference may reflect the positive influence of medical education and exposure to health-related information on breast cancer awareness [18–19].

A major finding of this study was the significant association between academic level and awareness of mammography screening. Awareness increased markedly from 28.6% among first-year students to 97.1% among interns. This finding suggests that progression through medical training is associated with improved awareness of preventive healthcare practices. Similar trends have been reported among medical students in the Middle East and Africa, where senior students generally demonstrated higher knowledge levels than junior students, likely due to increased exposure to clinical subjects and preventive medicine concepts [11,12]. However, the presence of knowledge gaps even

among senior students indicates that breast cancer screening guidelines may require greater emphasis throughout undergraduate medical education.

Female students demonstrated significantly higher awareness of mammography screening compared with male students (84.4% vs. 66.1%). Similar gender differences have been reported in previous studies involving healthcare students, with female participants often demonstrating higher levels of breast cancer-related knowledge [23,24]. This difference may be related to greater personal relevance of breast cancer among female students and increased exposure to breast cancer awareness activities. Nevertheless, improving knowledge among both male and female medical students remains essential because physicians of all genders contribute to patient counseling and preventive healthcare delivery.

Despite the relatively high overall awareness, detailed knowledge of evidence-based mammography screening recommendations was insufficient. Less than half of participants (46.9%) correctly identified 40 years as the recommended age to initiate screening, and only 19.7% correctly recognized the recommended biennial screening interval. These findings are clinically important because physician knowledge contributes to the quality of preventive counseling and screening recommendations provided to patients. Current USPSTF recommendations support biennial mammography screening for women aged 40–74 years at average risk, emphasizing the importance of integrating updated screening guidelines into undergraduate medical education [13].

Another important finding was the misconception regarding breast self-examination (BSE) and clinical breast examination (CBE), with 47.9% of students considering these methods effective screening modalities. Similar misconceptions have been reported among healthcare students in different countries [26,27]. This may reflect confusion between breast awareness, clinical assessment, and population-based screening strategies. Current evidence-based guidelines emphasize mammography as the primary screening modality for average-risk women, while routine BSE and CBE are not recommended as independent screening approaches due to insufficient evidence of mortality reduction [14,15].

Participants demonstrated moderate knowledge regarding breast cancer symptoms. A breast lump was the most frequently recognized warning sign (69.8%); however, awareness of other important symptoms, including nipple discharge, skin changes, and axillary symptoms, was comparatively lower. Similarly, although family history (78.4%) and radiation exposure (72.1%) were commonly identified as risk factors, recognition of lifestyle and reproductive factors such as obesity, early menarche, and late menopause was limited. These findings are consistent with previous studies indicating that medical students often recognize hereditary risk factors more readily than hormonal and lifestyle-related determinants of breast cancer [29,30]. Given the increasing prevalence of obesity and other modifiable risk factors in Saudi Arabia, strengthening education regarding comprehensive breast cancer risk assessment should be considered an important component of preventive medicine training.

Regarding sources of information, lectures were the most commonly reported source of mammography-related knowledge, followed by social media and internet-based resources. Despite being medical students, 79.7% expressed a need for additional education regarding mammography screening. Increased clinical exposure was the most preferred educational strategy, followed by case-based learning and comprehensive lectures. These findings suggest that students value practical and clinically oriented learning approaches in addition to traditional theoretical teaching. Incorporating structured breast cancer screening workshops, clinical case discussions, and guideline-based teaching may enhance students' confidence and preparedness for future patient counseling [16,17].

Overall, the findings highlight the importance of strengthening preventive medicine education within undergraduate medical curricula. Improving medical students' competency in breast cancer screening is consistent with international and national priorities, including the World Health Organization Global Breast Cancer Initiative and Saudi Vision 2030, which emphasize early diagnosis, improved screening participation, and enhanced healthcare workforce capacity [18,19].

The findings of the present study should be considered in the context of the increasing global burden of breast cancer and the urgent need to strengthen early detection strategies worldwide. Recent global cancer estimates indicate that breast cancer remains the most frequently diagnosed malignancy among women and continues to be a major contributor to cancer-related mortality, with a disproportionate impact in low- and middle-income countries due to delayed diagnosis and unequal access to screening services. Recent projections suggest a substantial future increase in breast cancer incidence and mortality, emphasizing the importance of improving population awareness, strengthening screening programs, and ensuring adequate preparation of healthcare professionals. In this context, medical students represent a critical component of cancer prevention strategies, as their future role will include patient education, risk communication, and promotion of evidence-based screening practices[20,21,22].

Although awareness of mammography screening was relatively high among participants in the current study, important deficiencies were identified regarding specific screening recommendations, including the recommended age of initiation and screening frequency. Similar knowledge gaps among medical students have been reported internationally, suggesting that awareness alone does not necessarily translate into adequate

understanding of evidence-based screening guidelines. Recent developments in breast cancer screening emphasize the importance of risk-based approaches, shared decision-making, and continuous updating of healthcare professionals' knowledge as recommendations evolve. Therefore, undergraduate medical curricula should incorporate structured teaching on current screening guidelines, including the benefits, limitations, and potential harms associated with mammography screening[23,24,25].

The finding that nearly 80% of participants expressed a need for additional education and preferred increased clinical exposure highlights the importance of adopting modern educational strategies in medical schools. Recent medical education literature supports the integration of active learning approaches, including case-based learning, simulation, clinical exposure, and competency-based preventive medicine training, to improve knowledge retention and clinical confidence. Such approaches may be particularly valuable for cancer screening education, where physicians must not only understand guidelines but also communicate effectively with patients and address misconceptions. Strengthening undergraduate medical education in breast cancer prevention is consistent with international cancer control strategies and national healthcare priorities, including Saudi Arabia's efforts to improve early cancer detection and preventive healthcare services[26,27,28,29].

The findings of the present study should be interpreted within the context of the increasing global burden of breast cancer and the growing emphasis on early detection strategies. Recent global reports indicate that breast cancer remains the most commonly diagnosed cancer among women and continues to represent a major cause of cancer-related mortality, particularly in low- and middle-income countries where delayed diagnosis and limited screening participation remain important challenges. The World Health Organization (WHO) Global Breast Cancer Initiative emphasizes that improving early detection requires not only accessible screening programs but also strengthening healthcare workforce capacity through appropriate training and education. Therefore, the observed improvement in mammography awareness with advancing academic years in our study highlights the critical role of undergraduate medical education in preparing future physicians to support evidence-based breast cancer prevention strategies.

Despite the relatively high proportion of students who had heard about mammography screening (73.8%), our findings revealed considerable gaps in detailed knowledge regarding screening recommendations, particularly the recommended initiation age and screening interval. This finding is clinically relevant because healthcare providers' knowledge and confidence in cancer screening guidelines directly influence their ability to counsel patients and improve screening uptake. Recent discussions in breast cancer screening have highlighted the increasing complexity of screening recommendations, including risk-based approaches, shared decision-making, and balancing the benefits of early detection against potential harms such as false-positive results and unnecessary investigations. These evolving recommendations emphasize the importance of integrating updated guideline-based breast cancer screening education into medical curricula to ensure that graduating physicians possess the skills required for effective patient counseling.

The high proportion of students expressing a need for additional education (79.7%) and their preference for increased clinical exposure suggest that traditional lecture-based teaching alone may not be sufficient to achieve competency in breast cancer screening counseling. Contemporary medical education models increasingly support experiential learning approaches, including clinical rotations, case-based discussions, simulation activities, and structured preventive medicine training. Such approaches may enhance students' ability to translate theoretical knowledge into clinical practice and communicate effectively with patients regarding screening decisions. This educational direction is particularly relevant for Saudi Arabia, where improving cancer prevention and early diagnosis represents an important component of national healthcare priorities. Strengthening the competency of future physicians in breast cancer screening may contribute to increasing public awareness, improving screening participation, and supporting the objectives of international initiatives such as the WHO Global Breast Cancer Initiative.

Strengths and Limitations:

This study has several strengths. It included medical students from all academic years, allowing assessment of knowledge and awareness across different stages of undergraduate medical education. Additionally, the study evaluated multiple dimensions of breast cancer screening knowledge, including mammography awareness, screening recommendations, symptoms, risk factors, and educational needs, providing comprehensive information for curriculum improvement.

However, several limitations should be considered. First, the cross-sectional design limits the ability to establish causal relationships between academic progression and knowledge level. Second, the study was conducted at a single medical school, which may restrict the generalizability of findings to other Saudi universities. Third, the use of a self-administered online questionnaire may have introduced recall and social desirability bias. Finally, voluntary participation may have resulted in response bias, as students with greater interest in breast cancer prevention may have been more likely to participate. Future multicenter studies involving medical schools from different regions of Saudi Arabia are recommended to validate these findings and assess the impact of targeted educational interventions.

Conclusion:

Although awareness of mammography screening among medical students at Taif University was relatively high, important gaps remain regarding evidence-based screening recommendations, particularly the appropriate age to initiate screening, screening intervals, and the distinction between mammography and other breast examination approaches. These findings highlight the need to strengthen undergraduate medical education through updated guideline-based teaching, case-based learning, and increased clinical exposure. Enhancing medical students' knowledge and counseling skills regarding breast cancer screening will better prepare future physicians to promote early detection and contribute to reducing breast cancer morbidity and mortality.

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