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Breast Cancer Awareness and Breast Self-Examination Among Female Undergraduates in the Middle East and North Africa: Implications for Public Health

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Abstract

In the Middle East and North Africa, breast cancer is detected at a younger age and more advanced stage due to limited screening infrastructure. University students are a pivotal demographic for early prevention, therefore this study aimed to assess awareness of breast cancer warning signs and risk factors, and to evaluate breast self-examination (BSE) knowledge, attitudes, and practices among female undergraduates across the region. A multicentric cross-sectional study was conducted between February and May 2025 among 2,530 female undergraduates from Egypt, Algeria, Saudi Arabia, Jordan, and Syria. Data were collected through an online, self-administered questionnaire using proportionate convenience sampling. Overall only 9.5% practiced BSE regularly. The mean BSE knowledge score was low (47.98, SD = 20.80), with misconceptions about timing and frequency, despite generally positive attitudes. Compared to Egyptian students, those from Algeria, Saudi Arabia, and Jordan had lower odds of regular BSE. However, higher knowledge and positive attitudes independently predicted practice. Major barriers to BSE practice are lack of knowledge (59.6%), limited time (32.0%), and fear of discovering a health problem (18.3%). Culturally tailored educational initiatives that address misconceptions, mitigate fear, and provide practical training are urgently required to bridge this knowledge-practice gap.

Background

Breast cancer is the most common cancer in women worldwide [1]. In the Middle East and North Africa (MENA), over a hundred thousand new breast cancer cases were reported in 2022 alone, with Algeria, Jordan, and Egypt recording the highest incidence rates among women under 50 years of age [2]. Mortality in this age group was higher than in all world regions except Sub-Saharan Africa. Moreover, breast cancer patients in the MENA region present with more aggressive disease and at a younger age than in Western countries, which may reflect limited awareness and inadequate use of early detection practices [2, 3]. Consequently, breast cancer imposes a substantial financial burden in the region, with productivity losses from illness and high treatment costs straining already limited healthcare budgets [4].

To lessen the burden of breast cancer, international policies prioritize prevention and early detection, especially in low- and middle-income countries (LMICs), which include most countries in MENA, where access to treatment is hampered by an insufficient number of qualified staff, inadequate infrastructure, and financial and geographic constraints [2, 5–8]. The World Health Organization emphasizes that awareness of breast cancer warning signs and prompt clinical evaluation are central to early diagnosis in LMICs [8]. Moreover, recent findings demonstrate that interventions including breast cancer education and breast self-examination (BSE) reduce late presentation; for instance, evidence from Thailand, an LMIC, indicates that regular BSE practice is associated with significantly smaller tumor sizes and diagnosis at earlier stages [9]. Therefore, increasing women's awareness of breast cancer symptoms, risk factors, and BSE is crucial to enhancing early detection and improving prognosis, particularly in environments with limited resources [6, 10].

Awareness of breast cancer symptoms and signs enables women to recognize subtle breast changes and seek medical attention early, thereby improving outcomes of the disease [11, 12]. Similarly, knowledge of breast cancer risk factors, including both non-modifiable factors such as age and female sex, and modifiable factors such as low physical activity and hormone replacement therapy, fosters informed lifestyle choices and preventive strategies that may reduce future risk [13]. Likewise, BSE plays a valuable role in the early detection of breast cancer. According to the Maurer Foundation, all women are encouraged to perform BSE at least once a month, five to seven days after the beginning of the menstrual cycle, starting at the age of 18 [14]. BSE is a cost-free, non-invasive method in which a woman inspects and feels her breasts to check for any lumps or changes in shape, texture, size, or contour [15]. Its main goal is to help women become more aware of the normal look and feel of their breasts and to detect any alterations in their breasts early if they occur, prompting timely reporting to a healthcare provider [15, 10]. It's important to note that while BSE is a valuable tool for awareness, it should be used in conjunction with, not as a replacement for, clinical breast examination (CBE) and age-appropriate mammography screening, which remains the cornerstone of early breast cancer detection [11].

Although the diagnostic accuracy of BSE remains under debate, it retains practical significance, especially in LMICs where access to mammography and adequately trained healthcare professionals is often limited [5, 11]. In the Arab region, most countries still lack structured, nationwide screening programs. While some promising initiatives have been introduced in recent years, participation is largely driven by individual motivation, family history, or physician recommendation rather than by organized, population-based efforts [3]. Moreover, screening remains hampered by inconsistent insurance coverage, an inadequate distribution of mammography centers, shortages of trained personnel, and a lack of standardized quality monitoring [3, 16]. A review of studies in Gulf and Middle Eastern countries reported that while 60% of women were aware of mammography, only 35% had undergone the procedure, reflecting persistent barriers to utilization [17].

Compounding these challenges, sociocultural stigma exerts a substantial influence on health-seeking behavior [3, 18]. Breast cancer is often associated with shame, guilt, or moral judgment, and women may fear being blamed or regarded as “diseased,” with potential implications for marriage prospects within their families, and fear of passing it to their daughters. Such pressures are especially pronounced in less urbanized areas [3]. Consequently, women may conceal symptoms, postpone medical consultation, and present with more advanced disease, thereby undermining the efficacy of formal screening initiatives [3]. These barriers impede the advancement of national screening programs and highlight the value of BSE as a private, low-cost, and accessible method for these women to remain aware of changes in their breasts without exposure to social scrutiny.

Bridging the gap between policy and practice requires targeting populations who can adopt and spread preventive practices. Female university students play a pivotal role in this regard, as they are young, educated, and in a position to influence their communities. Instilling these beneficial health practices at a young age can lead to a lifetime of proactive health monitoring, which is vital for improving early detection rates and health outcomes for both the students and their families and friends. However, even

among students with medical training, knowledge, and practice of breast cancer prevention is not always sufficient. A recent scoping review [19] reported that medical students' practice of BSE was limited, with misconceptions regarding its frequency and time. These gaps are even more pronounced among non-medical students; a study in Egypt on non-medical students reported low knowledge of breast cancer and BSE, with low practice rates [20]. These patterns further underscore the need for stronger awareness of breast cancer and BSE among young women.

Evidence from across the MENA region consistently shows that while most female university students have heard of breast cancer, their detailed knowledge of risk factors, early warning signs and symptoms, and proper BSE technique remains limited, and regular practice of BSE is very low [21, 22]. Barriers such as lack of knowledge, misconceptions, and forgetting to practice are frequently reported, and even students with a medical background are not always significantly better informed or compliant. However, most existing university-based studies in the MENA region are single-country or focus more on medical or health-science students, leaving limited data on non-medical students and few studies that provide a comparison between countries with different economic conditions. Therefore, this study aims to estimate the level of awareness of breast cancer warning signs and risk factors, as well as BSE knowledge, attitudes, and practices of female university students in MENA, providing a multinational, cross-regional comparison that can inform policy and public health initiatives tailored for young Arab women.

Methods

Study design and population

A descriptive cross-sectional study with an analytical component was conducted between February and May 2025 across five MENA countries (Egypt, Algeria, Saudi Arabia, Jordan, and Syria) to ensure adequate geographical and cultural representation and enhance the generalizability of the study findings (**Supplementary file 1, List of universities**). Countries and universities were selected based on the feasibility of access to data collectors during the data collection period. The study population consisted of undergraduate female students from medical disciplines, such as medicine, pharmacy, and veterinary medicine, and non-medical disciplines, including engineering, law, and sciences, across all academic years. This study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for observational studies (**Supplementary file 2**) [23].

Outcome measures

The primary outcome was performing BSE regularly, defined as practicing it at least once a month or more frequently, per the recommendations of the National Breast Cancer Foundation and Maurer Foundation [14, 24]. This was assessed using the item 'How often do you check your breasts?' from the Breast Cancer Awareness Measure–Arabic (BCAM-A) [25].

Data Collection

A proportionate convenience sampling method was used. Data were collected through a structured self-administered questionnaire created using Google Forms and FormNX [26], and shared online across multiple social media platforms, including WhatsApp and Telegram, as well as in person on university campuses. The questionnaire was distributed through university student groups reached through the help of data collectors from the participating universities, as well as through medical student organizations.

Participation was anonymous, voluntary, and no incentives were offered. Respondents could complete the questionnaire at their convenience. To avoid duplicate entries, email restrictions were enabled to limit each participant to a single response. The questionnaire required responses to all applicable items before submission, so missing data were not found.

Patient and public involvement

Patients and/or the public were not involved in the design, conduct, reporting, or dissemination plans of this research.

Ethics declaration

Ethical approval

for this study was granted by the Institutional Research Board of Mansoura University's Faculty of Medicine (Ref: R.25.01.3031), and all procedures were conducted in accordance with the principles of the Helsinki Declaration. Data collection began after obtaining ethical approval. Participants were asked to voluntarily and anonymously complete our online questionnaire, providing electronic informed consent.

Sample size

The sample size was calculated using the OpenEpi online calculator (version 3.01) [27]. The expected practice rate of BSE was based on a previous study among female students in the United Arab Emirates, reporting that 19.6% of students practiced BSE at least once a month [22]. Assuming a 95% confidence level and a 5% margin of error, the initial sample size was 243 participants. This was multiplied by a design effect of 5 to adjust for the non-random convenience sampling method, yielding a minimum required sample size of 1211 participants.

To ensure proportionate allocation, the minimum required sample from each country was determined according to its share of the regional undergraduate student population: Egypt 51.7% [28], Saudi Arabia 23% [29], Algeria 12.6% [30], Jordan 4.2% [31], and Syria 4.3%, which was approximated from Jordan’s

proportion due to the lack of recent national data. The final sample size achieved was 2530 participants from the MENA region. Although the final country-level distribution was not strictly proportional to the planned quotas, the minimum required proportional sample from each country was reached or exceeded.

Study Tool

The questionnaire comprised five sections: socio-demographic information, the Breast Cancer Awareness Measure–Arabic (BCAM-A), knowledge and attitudes towards BSE, practices of BSE, and the Champion Breast Cancer Fear Scale-Arabic (CBCFS-Arabic).

The first section collected socio-demographic data, including age, sex, academic year, place of residence (rural or urban), family income level, parents' educational level, and whether any family member had been diagnosed with breast cancer, along with their degree of relation.

The second section assessed participants' awareness and knowledge of breast cancer symptoms and risk factors using the BCAM-A, the Arabic-adapted version of the Breast Cancer Awareness Measure, developed by Al-Khasawneh et al. (2016) [25]. The original BCAM was developed in English and validated by Linsell et al. (2010) and Cancer Research UK (2009) [32, 33]. The BCAM-A is a validated, self-reported tool with high internal consistency, with a reported Cronbach's α of 0.890 for the knowledge of symptoms component and 0.856 for the knowledge of risk factors component [25]. It comprises four components: knowledge of breast cancer warning signs (11 items), knowledge of age-related risk (1 item), reported frequency of BSE (1 item), and knowledge of breast cancer risk factors (8 items). The risk factor component was slightly modified by removing the item "Drinking more than 1 unit of alcohol a day," due to potential cultural and religious sensitivities that could discourage questionnaire completion. Additionally, the original Likert scale of the risk factor component was replaced with Yes/No/Don't know response options to capture a more direct assessment of factual knowledge rather than degrees of certainty. Each item was scored as 1 for "Yes" and 0 for both "No" and "Don't know," except for the items assessing knowledge of age-related risk and reported frequency of BSE, which employed distinct response formats. Scores were normalized to a 0–100 scale using the formula 100 × (raw score / maximum score), with higher scores reflecting greater knowledge.

The third section assessed participants' knowledge and attitudes toward BSE using the Arabic-adapted scale by Khonji et al. (2024) [21], originally developed and validated by Rosmawati (2010) [34]. The scale is self-reported with high internal consistency (Cronbach's α = 0.80) and consists of two components: knowledge of BSE (13 items) and attitudes toward BSE (13 items). Each item was rated on a 5-point Likert scale ranging from 4 (Strongly agree) to 0 (Strongly disagree), yielding a total score of 0 to 52 for each component. Scores were normalised to have 0 as the minimum score and 100 as the maximum score, using the formula 100 × (raw score / maximum score). Higher scores indicate greater knowledge of BSE and more positive attitudes.

The fourth section evaluated participants' BSE practices through three items: Reasons for not performing BSE, which was presented only to participants who reported not practicing BSE, actions taken after noticing a breast abnormality, which was presented only to participants who reported having practiced BSE, and sources of information about breast cancer. It was adapted from a tool developed by Kandasamy et al. (2024) [35].

The fifth section assessed participants' fear of developing breast cancer using the Arabic-adapted version of the CBCFS, adapted by Alyami et al. (2019) and originally developed and validated by Champion et al. (2004) [36, 37]. The CBCFS-Arabic is a validated, self-reported tool with high internal consistency (Cronbach's α = 0.94), as reported by Alyami et al. (2019) [36]. It consists of eight items, each rated on a 5-point Likert scale ranging from 1 (Strongly agree) to 5 (Strongly disagree), yielding a total score from 8 to 40, with higher scores indicating greater fear of breast cancer. A total score of 8–15 indicates low fear, 16–23 indicates moderate fear, and 24–40 indicates high fear.

A pilot study was conducted on a total of 50 female university students, with 10 participants from each of Egypt, Algeria, Saudi Arabia, Jordan, and Syria, before data collection to assess the clarity, cultural appropriateness, and reliability of the questionnaire. The internal consistency (Cronbach's α) of each scale in the pilot sample was as follows: BCAM-A warning signs component (0.845), risk factors component (0.764), BSE knowledge component (0.769), BSE attitudes component (0.719), and CBCFS-Arabic (0.940), demonstrating good internal consistency within the sample. Participants in the pilot study were excluded from the final analysis.

Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS 27). Categorical variables were summarized as frequencies and percentages. Normality of continuous variables was assessed using Q–Q plots. Parametric data were summarized using means and standard deviations (SD). Age was dichotomized into two categories (< 21 and ≥ 21 years) using the sample median (21 years) as the cutoff.

The primary dependent variable in this study was whether participants practiced BSE at least monthly. Independent variables included Sociodemographic, knowledge, and attitude data. Both univariate and multivariate binary logistic regression analyses were performed to identify factors independently associated with practicing BSE. Results were reported as crude and adjusted odds ratios (OR) with 95% confidence intervals, and statistical significance was determined at a p-value threshold of less than 0.05.

Multicollinearity was checked using Variance Inflation Factors (VIFs), and model fit was assessed using Nagelkerke pseudo R^2, the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and the overall model test. Sensitivity analyses excluding veterinary medicine and science-related disciplines from the medical and non-medical groups, respectively, were conducted and yielded similar results (**Supplementary File 1, Table S6.1, S6.2**).

Results

Participants' Sociodemographic Characteristics

A total of 2,530 undergraduate students from five Arab countries participated in the study. Most participants were from Egypt (36.5%) and Algeria (36.3%), with 43.6% being under 21 years of age. One-third of participants were medical students (34.6%), and the majority were single (95.8%), lived in urban areas (75.3%), and reported having 'sufficient' family income (80.2%) (Table 1). Country specific sociodemographics are provided in **Supplementary file 1**.

Table 1
Sociodemographic characteristics and breast self-examination practice among female undergraduate students (N = 2530)

Variables		Total n (%)[a]
Country	*Egypt*	924 (36.5%)
	Algeria	918 (36.3%)
	Saudi Arabia	444 (17.5%)
	Jordan	164 (6.5%)
	Syria	80 (3.2%)
Age	*Less than 21*	1104 (43.6%)
	21 or above	1426 (56.4%)
Academic year	1st & foundation[b]	554 (21.9%)
	2nd	515 (20.4%)
	3rd	521 (20.6%)
	4th	486 (19.2%)
	5th & 6th[c]	348 (13.8%)
	Intern[d]	106 (4.2%)
Specialty	*Non-medical*	1654 (65.4%)
	Medical	876 (34.6%)
Marital Status	*Single*	2425 (95.8%)
	Other[e]	105 (4.2%)
Residence	*Urban*	1905 (75.3%)
	Rural	625 (24.7%)
Family Income	*Sufficient*	2029 (80.2%)

[a]Percentages are column-wise, [b]Foundation year is a preparatory year at the beginning of a university course; it accounted for 72 (2.8%) of total, [c]6th year sample accounted for 49 (1.9%) of total, [d]Interns are in medical specialities only, [e]Other includes Married, divorced, widowed, [f]Includes too young to be affected by breast cancer, and too young to practice breast self-examination, [g]Others include embarrassment, no family history of breast cancer, it is painful because of breastfeeding, perform Clinical breast examination, [h]Reasons for doing nothing included waiting for the breast to return to normal, embarrassment, uncertainty, laziness, fear of a health problem, and lack of concern, **Categories are not mutually exclusive.

	More than Sufficient	332 (13.1%)
	Insufficient	169 (6.7%)
Mother's Education	*University degree or higher*	1116 (44.1%)
	High school graduate	732 (28.9%)
	Did not complete high school	682 (27.0%)
Father's Education	*University degree or higher*	1240 (49.0%)
	High school graduate	667 (26.4%)
	Did not complete high school	623 (24.6%)
Breast Cancer Family History	*No family history*	2066 (81.7%)
	Yes (First-degree)	83 (3.3%)
	Yes (Second-degree)	381 (15.1%)
Fear Level	*Low*	206 (8.1%)
	Moderate	737 (29.1%)
	High	1587 (62.7%)
Frequency of breast self-examination	Rarely or never	1978 (78.2%)
	At least once every 6 months	311 (12.3%)
	At least once a month	194 (7.7%)
	At least once a week	47 (1.9%)
Reasons for Not Performing breast self-examination ** **(N = 1769)**	Don't know how to perform it	1054 (59.60%)
	Very busy	566 (32.00%)
	Fear of discovering a health problem	323 (18.30%)
	Lack of a private place to do it	211 (11.90%)
	Don't think it is necessary	175 (9.90%)

[a]Percentages are column-wise, [b]Foundation year is a preparatory year at the beginning of a university course; it accounted for 72 (2.8%) of total, [c]6th year sample accounted for 49 (1.9%) of total, [d]Interns are in medical specialities only, [e]Other includes Married, divorced, widowed, [f]Includes too young to be affected by breast cancer, and too young to practice breast self-examination, [g]Others include embarrassment, no family history of breast cancer, it is painful because of breastfeeding, perform Clinical breast examination, [h]Reasons for doing nothing included waiting for the breast to return to normal, embarrassment, uncertainty, laziness, fear of a health problem, and lack of concern, **Categories are not mutually exclusive.

	Age-related misconceptions[f]	34 (1.92%)
	Never considered it	31 (1.80%)
	Lack of Symptoms	16 (0.90%)
	Others[g]	8 (0.45%)
Actions Taken After Noticing Breast Abnormalities (N = 195)	Medical consultation	89 (45.64%)
	Informed family members	69 (35.38%)
	Did nothing[h]	31 (15.90%)
	Online research	4 (2.05%)
	Traditional medicine	2 (1.03%)

[a]Percentages are column-wise, [b]Foundation year is a preparatory year at the beginning of a university course; it accounted for 72 (2.8%) of total, [c]6th year sample accounted for 49 (1.9%) of total, [d]Interns are in medical specialities only, [e]Other includes Married, divorced, widowed, [f]Includes too young to be affected by breast cancer, and too young to practice breast self-examination, [g]Others include embarrassment, no family history of breast cancer, it is painful because of breastfeeding, perform Clinical breast examination, [h]Reasons for doing nothing included waiting for the breast to return to normal, embarrassment, uncertainty, laziness, fear of a health problem, and lack of concern, **Categories are not mutually exclusive.

BSE practices

Only 761 students (30.1%) reported having performed BSE at least once in their lifetime, and of the total sample, just 241 (9.5%) practiced it regularly (at least once a month or more frequently), corresponding to 31.7% of those who had ever practiced BSE. Among these practitioners, 173 (71.8%) demonstrated adequate knowledge of breast cancer warning signs. For the 1,769 students who did not practice BSE, lack of knowledge on how to perform it was the most reported reason, followed by being very busy and fear of discovering a health problem (Table 1).

Knowledge of breast cancer warning signs and risk factors

The most reported signs were 'a lump or thickening in the breast' (85.5%), 'a lump or thickening under the armpit' (79.5%), and 'pain in the breasts or armpit' (78.6%), while 'redness of the breast skin' was the least recognized (36.2%). Additionally, more than half of the participants (56.8%) demonstrated adequate knowledge of at least five non-lump signs. Regarding age-associated risk factors, only 1.8% correctly identified that a 70-year-old woman is most likely to develop breast cancer (Table 2**)**. The mean knowledge score for breast cancer warning signs was 60.45 (SD = 25.23).

Table 2
Knowledge of breast cancer warning signs, risk factors, and Breast self-examination among female undergraduate students (N = 2530)

Variable	Yes n (%)[a]
Warning signs	
Change in the position of the nipple	1338 (52.9%)
Pulling in of the nipple	1097 (43.4%)
Pain in the breasts or armpit	1989 (78.6%)
Puckering or dimpling of the breast skin	1253 (49.5%)
Discharge or bleeding from the nipple	1600 (63.2%)
A lump or thickening in the breast	2164 (85.5%)
Nipple rash	1248 (49.3%)
Redness of the breast skin	917 (36.2%)
A lump or thickening under the armpit	2011 (79.5%)
Changes in the size of the breast or nipple	1536 (60.7%)
Changes in the shape of the breast or nipple	1670 (66.0%)
Knowledge of age-related risk	686 (27.1%)
A 30-year-old woman is most likely to get breast cancer	
A 50-year-old woman is most likely to get breast cancer	604 (23.9%)
A 70-year-old woman is most likely to get breast cancer	46 (1.8%)
A woman of any age is likely to get breast cancer	1194 (47.2%)
Risk factors	
History of breast cancer	2140 (84.6%)
Using hormone replacement therapy	1044 (41.3%)
Weight gain (> 30 kg above normal weight)	744 (29.4%)
Having a close relative with breast cancer	1606 (63.5%)
Having children later in life or not at all	804 (31.8%)
Periods at an early age	431 (17.0%)

[a]Percentages are column-wise, [b]Percentages are row-wise, [c]*BSE* breast self-examination, [d]Defined as doing less than 30 minutes of moderate physical activity 5 times a week, *'Yes' responses are incorrect.

Variable	Yes n (%)[a]
Warning signs	
Late menopause	575 (22.7%)
Limited physical activity[d]	571 (22.6%)
Breast self-examination	
Should be done every two months*	565 (22.3%)
Must be done between day 7 and day 10 after menses *	367 (14.5%)
Hands should be raised alternately above the head*	127 (5.0%)
Should be done from the front view only*	1194 (47.2%)
Should be done in front of the mirror	1650 (65.2%)
Undress to the waist	1383 (54.7%)
Can be done in a supine position	929 (36.7%)
Palpate the right breast while lying on the left side	1035 (40.9%)
Use finger pulps to examine lumps/thickening	1562 (61.7%)
Can use vertical strip and circular techniques	926 (36.6%)
Press the nipple to check for discharge	1720 (68.0%)
Includes armpit examination for lumps	2108 (83.3%)
Observe changes in breast shape/size	2216 (87.6%)

[a]Percentages are column-wise, [b]Percentages are row-wise, [c]*BSE* breast self-examination, [d]Defined as doing less than 30 minutes of moderate physical activity 5 times a week, *'Yes' responses are incorrect.

For breast cancer risk factors, 'history of breast cancer' (84.6%) and 'having a close relative with breast cancer' (63.5%) were the most frequently identified, while less identified factors included 'periods at an early age' (17.0%), 'late menopause' (22.7%), and 'limited physical activity' (22.6%) (Table 2**)**. The mean knowledge score for breast cancer risk factors was 39.11 (SD = 24.76).

Knowledge and Attitudes toward BSE

While most students knew that BSE should include armpit examination (83.3%) and observation of breast shape/size changes (87.6%), 22.3% believed BSE should be performed every two months, and 14.5% reported that BSE should be done between 7 and 10 days after menses (Table 2**)**. The mean knowledge score for BSE was 47.98 (SD = 20.80).

The majority of students disagreed that BSE is trivial (92.6%), a waste of time (95.0%), or embarrassing (66.9%). Moreover, about a third of participants reported feeling uncomfortable if unable to perform BSE monthly (30.9%). Nevertheless, Some students avoided BSE due to fear of a cancer diagnosis (60.7%) (Table 3). The mean attitude score towards BSE was 70.20 (SD = 11.39). Country-specific knowledge of breast cancer warning signs and risk factors, and BSE knowledge, attitudes, and practices are provided in **Supplementary file 1**.

Table 3
Attitudes towards Breast self-examination among female undergraduate students (N = 2530)

Variable	**Agree[a] n (%)**	**Neutral n (%)**	**Disagree[b] n (%)**
Breast self-exam is a trivial matter*	95 (3.8%)	92 (3.6%)	2343 (92.6%)
BSE is embarrassing*	466 (18.4%)	371 (14.7%)	1693 (66.9%)
Doing BSE is wasting time*	24 (0.9%)	102 (4.0%)	2404 (95.0%)
Doing BSE feels unpleasant*	336 (13.3%)	512 (20.2%)	1682 (66.5%)
If there is a lump, I prefer to get treatment from a traditional healer*	60 (2.4%)	156 (6.2%)	2314 (91.5%)
Avoid BSE because of the worry of getting breast cancer *	465 (18.4%)	530 (20.9%)	1535 (60.7%)
I feel uncomfortable when I can't do BSE once a month	515 (20.4%)	1234 (48.8%)	781 (30.9%)
All women should do BSE	2325 (91.9%)	136 (5.4%)	69 (2.7%)
I really care about my breasts	2215 (87.5%)	237 (9.4%)	78 (3.1%)
I am not afraid to think about breast cancer	522 (20.6%)	715 (28.3%)	1293 (51.1%)
I am interested in doing BSE	1979 (78.2%)	434 (17.2%)	117 (4.6%)
I search for BSE information (internet/magazines/newspapers)	1138 (45.0%)	790 (31.2%)	602 (23.8%)
I discuss BSE with friends	855 (33.8%)	807 (31.9%)	868 (34.3%)

BSE breast self-examination, [a]Agree includes both 'Strongly Agree' and 'Agree', [b]*Disagree includes both 'Strongly disagree' and 'Disagree'*. *Response of 'Disagree' reflects a more positive attitude.

Factors Associated with Regular BSE Practice

BSE practice increased progressively with academic year, from 6.9% in the 1st year to 10.7% in the 4th year (COR = 1.63, p = 0.029), and 11.8% among students in the 5th and 6th years (COR = 1.81, p = 0.012). Medical students were more likely to practice BSE than non-medical students (14.0% versus 7.1%, p < 0.001). They also demonstrated significantly higher knowledge scores regarding breast cancer warning signs (70.6 ± 24.3 versus 55.1 ± 24.0), breast cancer risk factors (51.1 ± 27.1 versus 32.8 ± 20.8), and BSE (53.6 ± 20.7 versus 45.0 ± 20.2), and more positive BSE attitude scores (71.4 ± 11.4 versus 69.6 ± 11.3); all comparisons were statistically significant (p < 0.001). Moreover, participants from families with more than sufficient income were more likely to practice BSE (COR = 1.59, p = 0.009). No significant associations were found for other sociodemographic variables (Table 4).

Table 4

Association of sociodemographic characteristics with breast self-examination practice among female undergraduate students, and univariate and multivariate regression analysis results.

Variables		Practicing BSE* n (%)	Univariate regression		Multivariate regression	
			COR (95% CI)	p-value	AOR (95% CI)	p-value
Overall		241 (9.5%)	-	-	-	-
Country	*Egypt*	115 (12.4%)	*ref*	-	*ref*	-
	Algeria	72 (7.8%)	0.60 [0.44–0.82]	**0.001**	0.525 [0.351–0.785]	**0.002**
	Saudi Arabia	34 (7.7%)	0.58 [0.39–0.87]	**0.008**	0.577 [0.367–0.906]	**0.017**
	Jordan	11 (6.7%)	0.51 [0.27–0.96]	**0.037**	0.478 [0.242–0.944]	**0.033**
	Syria	9 (11.3%)	0.89 [0.43–1.83]	0.755	0.585 [0.253–1.352]	0.210
Age	*Less than 21*	100 (9.1%)	*ref*	0.481	*ref*	**0.006**
	21 or above	141 (9.9%)	1.10 [0.84–1.44]		0.503 [0.309–0.818]	
Academic year	1st & foundation[a]	38 (6.9%)	*ref*	-	*ref*	-
	2nd	51 (9.9%)	1.49 [0.96–2.31]	0.073	1.400 [0.884–2.218]	0.151
	3rd	36 (6.9%)	1.01 [0.63–1.62]	0.974	1.189 [0.687–2.057]	0.536
	4th	52 (10.7%)	1.63 [1.05–2.52]	**0.029**	2.369 [1.246–4.501]	**0.008**

BSE Breast Self-Examination, COR Crude Odds Ratio, CI Confidence Interval, AOR Adjusted Odds Ratio, *Practicing BSE is defined as performing it at least once a month, percentages are row-wise, [a]Foundation year is a preparatory year at the beginning of a university course, [b]Interns are in medical specialities only, [c]Other includes Married, divorced, widowed, **Scores are summarized as Mean (SD), % Correctly Predicted = 90.5, VIF < 2, AIC = 1456, BIC = 1619, Model $\chi 2 = 192$, $p < 0.001$, values in bold indicate statistical significance at $p < 0.05$.

Variables		Practicing BSE* n (%)	Univariate regression		Multivariate regression	
			COR (95% CI)	p-value	AOR (95% CI)	p-value
	5th & 6th[g]	41 (11.8%)	1.81 [1.14–2.88]	**0.012**	2.378 [1.212–4.666]	**0.012**
	Intern[b]	23 (21.7%)	3.76 [2.13–6.64]	**< 0.001**	3.269 [1.429–7.478]	**0.005**
Specialty	*Non-medical*	118 (7.1%)	*0.470 [0.360–0.614]*	**< 0.001**	0.771 [0.554–1.074]	0.124
	Medical	123 (14.0%)	*ref*		*ref*	
Marital Status	*Single*	229 (9.4%)	*ref*	-	*ref*	0.678
	Other[c]	12 (11.4%)	1.24 [0.67–2.29]	0.498	1.154 [0.587–2.265]	
Residence	*Urban*	173 (9.1%)	*ref*	0.184	*ref*	0.526
	Rural	68 (10.9%)	1.22 [0.91–1.64]		1.114 [0.797–1.557]	
Family Income	*Sufficient*	182 (9.0%)	*ref*	-	*ref*	-
	More than Sufficient	45 (13.6%)	1.59 [1.12–2.26]	**0.009**	1.392 [0.944–2.054]	0.095
	Insufficient	14 (8.3%)	0.92 [0.52–1.62]	0.764	1.156 [0.635–2.107]	0.635
Mother's Education	*University degree or higher*	111 (9.9%)	*ref*	-	*ref*	**-**
	High school graduate	73 (10.0%)	1.00 [0.73–1.37]	0.985	1.248 [0.857–1.818]	0.248

BSE Breast Self-Examination, COR Crude Odds Ratio, CI Confidence Interval, AOR Adjusted Odds Ratio, *Practicing BSE is defined as performing it at least once a month, percentages are row-wise, [a]Foundation year is a preparatory year at the beginning of a university course, [b]Interns are in medical specialities only, [c]Other includes Married, divorced, widowed, **Scores are summarized as Mean (SD), % Correctly Predicted = 90.5, VIF < 2, AIC = 1456, BIC = 1619, Model $\chi 2 = 192$, $p < 0.001$, values in bold indicate statistical significance at $p < 0.05$.

Variables		Practicing BSE* n (%)	Univariate regression		Multivariate regression	
			COR (95% CI)	p-value	AOR (95% CI)	p-value
	Did not complete high school	57 (8.4%)	0.83 [0.59–1.15]	0.262	1.275 [0.822–1.979]	0.278
Father's Education	*University degree or higher*	128 (10.3%)	*ref*	-	*ref*	-
	High school graduate	63 (9.4%)	0.91 [0.66–1.25]	0.543	1.176 [0.803–1.724]	0.405
	Did not complete high school	50 (8.0%)	0.76 [0.54–1.07]	0.112	1.027 [0.662–1.592]	0.907
Breast Cancer Family History	*No family history*	188 (9.1%)	*ref*	-	*ref*	-
	Yes (First-degree)	11 (13.3%)	1.53 [0.80–2.93]	0.204	1.482 [0.745–2.950]	0.262
	Yes (Second-degree)	42 (11.0%)	1.24 [0.87–1.76]	0.238	1.385 [0.950–2.018]	0.090
Fear Level	*Low*	19 (9.2%)	*ref*	-	*ref*	-
	Moderate	67 (9.1%)	0.98 [0.58–1.68]	0.953	1.424 [0.802–2.530]	0.227
	High	155 (9.8%)	1.07 [0.65–1.76]	0.804	1.526 [0.880–2.646]	0.132
Scale scores	*Knowledge of breast cancer warning signs*	69.67 (24.25)**	1.017 [1.011–1.023]	**< 0.001**	1.000 [0.993–1.008]	0.947
	Knowledge of breast cancer risk factors	49.53 (27.30)**	1.017 [1.012–1.022]	**< 0.001**	1.006 [0.999–1.013]	0.072

BSE Breast Self-Examination, COR Crude Odds Ratio, CI Confidence Interval, AOR Adjusted Odds Ratio, *Practicing BSE is defined as performing it at least once a month, percentages are row-wise, [a]Foundation year is a preparatory year at the beginning of a university course, [b]Interns are in medical specialities only, [c]Other includes Married, divorced, widowed, **Scores are summarized as Mean (SD), % Correctly Predicted = 90.5, VIF < 2, AIC = 1456, BIC = 1619, Model $\chi 2 = 192$, $p < 0.001$, values in bold indicate statistical significance at $p < 0.05$.

Variables		Practicing BSE* n (%)	Univariate regression		Multivariate regression	
			COR (95% CI)	p-value	AOR (95% CI)	p-value
	Knowledge of BSE	57.42 (18.58)**	1.028 [1.020–1.036]	**< 0.001**	1.015 [1.006–1.024]	**< 0.001**
	Attitudes toward BSE	76.71 (10.98)**	1.065 [1.051–1.080]	**< 0.001**	1.065 [1.048–1.081]	**< 0.001**

BSE Breast Self-Examination, COR Crude Odds Ratio, CI Confidence Interval, AOR Adjusted Odds Ratio, *Practicing BSE is defined as performing it at least once a month, percentages are row-wise, [a]Foundation year is a preparatory year at the beginning of a university course, [b]Interns are in medical specialities only, [c]Other includes Married, divorced, widowed, **Scores are summarized as Mean (SD), % Correctly Predicted = 90.5, VIF < 2, AIC = 1456, BIC = 1619, Model $\chi 2 = 192$, $p < 0.001$, values in bold indicate statistical significance at $p < 0.05$.

Factors Predicting Regular BSE Practice

Univariate regression demonstrated that several sociodemographic factors, along with higher knowledge scores for symptoms (COR = 1.017, $p < 0.001$), risk factors (COR = 1.017, $p < 0.001$), and BSE (COR = 1.028, $p < 0.001$), as well as more positive attitudes toward BSE (COR = 1.065, $p < 0.001$), were significantly associated with regular practice (Table 4).

After adjustment for all variables within the multivariate model, students from Algeria, Saudi Arabia, and Jordan had lower odds of practicing BSE compared to their Egyptian counterparts. In addition, academic year was an independent predictor of regular BSE practice, with students in the 4th year and those in 5th-6th years showing higher odds of practicing BSE compared with first-year and foundation students. Age was also independently associated with BSE practice, with students aged 21 or above years demonstrating higher odds of regular BSE practice. Furthermore, both knowledge of BSE and attitudes toward BSE were independent predictors of regular BSE practice (Table 4).

Sources of Information

The most frequently cited sources of information on breast cancer were media outlets (47.5%) and academic courses (43.1%). Notably, “awareness campaigns” was the least common response (0.2%) (Table 5). Categories are not mutually exclusive. Country specific sources of information are provided in **Supplementary file 1**.

Table 5
Sources of information on breast cancer (N = 2530)

Variables	Total n (%)
Media outlets	1202 (47.5%)
Academic courses	1090 (43.1%)
Reading (books, articles)	911 (36.0%)
Social media	897 (35.5%)
Relatives	660 (26.1%)
Healthcare providers	530 (21.0%)
Friends	395 (15.6%)
No information	11 (0.4%)
Awareness campaigns	6 (0.2%)
Categories are not mutually exclusive	

Discussion

The burden of breast cancer continues to pose a significant global health challenge, as it is the leading cancer in women in the MENA region and is projected to increase worldwide. In the Arab region, breast cancer has shifted from being a disease primarily seen later in life to one that is increasingly reported in younger women [2]. Among this global burden, BSE has emerged as an important technique for promoting breast self-awareness and facilitating early detection [15]. This multinational cross-sectional study assessed the knowledge, attitudes, and practices of female undergraduate students from five MENA countries regarding breast cancer and BSE, with the goal of informing strategies and interventions to address this critical global health issue.

This study found that only 9.5% of participants practiced BSE monthly. While this figure appears substantially lower than rates reported in prior regional studies, such as in the United Arab Emirates (27.7%) and a multi-center study (33.15%) [22, 38], these disparities are likely influenced by differences in how the rates were calculated. Specifically, uptake in these studies was calculated among participants who had ever practiced BSE, whereas our figure represents BSE practice among the total student population to better reflect the public health burden. These differences may also reflect variations in student composition and sampling, as this study included a larger and more diverse group of students across medical and non-medical faculties, while the multicenter study focused more heavily on health-related disciplines. When calculated among those who had ever performed BSE in our study, 31.7% of our participants practiced it regularly, a rate comparable to regional estimates. Although there is considerable variation in the literature, this uptake aligns with findings from Croatia (13%) [39], Ethiopia

(11.23%) [40], and Ghana (8.1%) [41]. Nonetheless, our finding is higher than the 1.3% reported in an Egyptian study [20], conducted in 2013, which may be partly explained by the increasing availability of breast cancer awareness campaigns over time.

Although overall BSE uptake was low, the findings indicate that academic year was an independent predictor of practice, demonstrating a gradual increase across academic years, consistent with trends reported in previous studies [42, 19]. This pattern likely reflects greater exposure to health education and peer discussions as students advance through their studies, suggesting that universities are an ideal setting for strengthening breast health literacy and preventive practices through awareness campaigns, curricular integration, and practical BSE training. Interestingly, age showed a significant inverse association with BSE practice in the multivariate model, indicating that older students within the same academic level were less likely to perform BSE. While this may appear contradictory to the effect of academic progression, it rather suggests that educational exposure, rather than chronological age, is the primary driver of BSE practice in this population. Moreover, younger students may also be more receptive to health education and adopting preventive habits, reinforcing the importance of initiating breast health awareness interventions during early university years, rather than waiting until later adulthood.

Students in medical disciplines, particularly those in their internship years, were twice as likely to perform BSE, suggesting that curricular and clinical training play a key role in motivating practice [43]. While parental education had no significant effect, higher family income was associated with greater BSE practice, suggesting that socioeconomic advantage facilitates preventive behaviors by reducing financial and psychosocial constraints [44]. Moreover, among students who did not practice BSE, 32% cited being too busy and 11% cited lack of private space as reasons for not practicing BSE, underscoring the influence of time and privacy on BSE uptake.

The findings showed that BSE knowledge and attitudes were both significant predictors of BSE practice. Higher BSE knowledge scores increased the odds of practicing BSE (AOR = 1.015), and more positive attitudes similarly predicted greater practice (AOR = 1.061). Yet, despite a generally positive attitude toward BSE among participants, with most students recognizing its value, it was not sufficient to drive behavior, and practice remained low. This study also indicated weak knowledge of BSE among the majority of the participants, with 60% of non-practicing students reporting a lack of knowledge on how to perform the procedure as the barrier. Additionally, misconceptions were widespread, particularly regarding the correct timing and frequency of BSE. Similar patterns have been reported across the MENA region, where inadequate knowledge is the predominant barrier to BSE practice, as shown in studies from Palestine [45], Yemen [46], and three countries in MENA [38]. These findings suggest that the primary obstacle was not a fundamental lack of interest or negative attitude, but a practical deficit in "how-to" knowledge. This observation is of utmost importance, as it underscores the need for targeted educational efforts to translate awareness into effective practice. It also indicates that existing awareness is often superficial and incomplete, further highlighting the need for targeted, practical education rather than general awareness campaigns.

Interestingly, family history of breast cancer was not associated with higher BSE practice, despite 84.9% of respondents recognizing it as a risk factor. This finding is consistent with studies from Saudi Arabia [35] and Turkey [47], but contrasts with results from Iraq [48] and other MENA settings [38]. These discrepancies may be explained by differences in study populations, since, unlike this study's broader student sample, the latter studies focused on breast cancer patients and students from medical backgrounds respectively, who have greater risk awareness or education. However, our results also point to another explanation: psychological barriers. Using the Champion Fear Scale, 62.7% of participants reported high fear of breast cancer, and heightened fear has been shown to foster anxiety or fatalism, which can suppress screening behaviors like BSE [49]. This high level of fear could be explained by the high perceived severity of breast cancer, as shown in a recent study on breast cancer stigma in Egypt, where even among medical students, the severity aspect was the most pronounced [50]. This fear and fatalistic belief could potentially make the thought of performing BSE more stressful, leading to avoiding it altogether. In line with this, 18.3% of our respondents cited fear of discovering an abnormality as their reason for avoiding BSE, echoing previous reports [35]. This suggests that public health efforts must do more than highlight risk; they must also train and empower women to act on that knowledge.

In light of these findings, a substantial knowledge–practice gap exists around BSE. Low practice rates reflect inadequate skills-based education and persistent sociocultural barriers rather than lack of awareness. As breast cancer incidence continues to rise, sporadic awareness campaigns that merely stress the importance of breast health are insufficient. Addressing this challenge requires a multi-faceted approach that integrates cultural, educational, and practical components to translate awareness into sustained practice.

This approach begins by reframing BSE in educational campaigns as a breast-awareness tool rather than a screening method [51]. While this may seem like a minor semantic shift, it can reduce the anxiety associated with viewing BSE as an inadequate screening tool [52] and instead encourage young women to adopt it as a lifelong practice of self-familiarity. Evidence from Arab settings suggests that framing BSE within culturally acceptable narratives, particularly when endorsed by same-gender religious leaders as an act of self-care, reduces embarrassment and improves acceptance and retention [53]. This reframing is particularly important in the MENA region, where access to high-quality, regular mammographic screening remains inconsistent, and is compounded by cultural beliefs that may discourage formal screening for modesty and religious reasons [54]. Culturally and religiously sensitive BSE education can therefore empower women, foster positive attitudes toward breast health, and increase self-efficacy towards BSE practice.

Given that undergraduate university students represent a receptive and accessible population, targeted interventions can be implemented efficiently. One promising strategy is incorporating compulsory practical BSE training in wellness courses, delivered by peer educators. This approach not only ensures equitable access to essential skills but also overcomes the self-selection bias inherent in voluntary workshops. The peer-teaching component further helps normalize the conversation, reducing the embarrassment and has shown effectiveness in MENA contexts [55]. Additional low-cost strategies

include leveraging social networking apps and online campaigns, which were the most commonly cited sources of breast cancer information among the participants [56]. However, evidence shows that the most effective BSE educational strategies in the MENA region are multi-component, culturally tailored interventions that combine skills-based education with practical support and explicit attention to religious and modesty concerns [57]. Hence, interventions must be context-specific and tailored to the populations they serve, as demonstrated by a program in a rural Egyptian setting that successfully improved both BSE knowledge and practice among girls with hearing loss [58] and a slum-based breast health educational program [59].

Beyond local interventions, we recommend that national breast cancer programs prioritize community-based, hands-on breast awareness education to reach women with limited access to the internet or higher education. Evidence from existing initiatives supports the effectiveness of this approach. The Jordan Breast Cancer Program (JBCP), for example, emphasizes multiple early detection pathways, including breast self-examination [60]. Through home visits, educational lectures, and community-based workshops that focus on early detection and hands-on BSE instruction, the program has successfully extended breast health education to underserved populations [61]. Similarly, Egypt's Baheya Foundation integrates practical self-examination training with risk-factor education and clear referral pathways to clinical services, facilitating both awareness and action [62]. More importantly, national programs should follow international guidelines, such as the WHO early detection recommendations [63]. While policies exist, their impact depends on effective implementation, highlighting the need for national programs to translate international recommendations into actionable, context-specific interventions.

In other MENA settings, Syria's ongoing conflict has severely disrupted healthcare utilization [64], making BSE awareness and skills particularly valuable where formal screening systems are lacking. Even in Saudi Arabia, despite being a high-income country, many women, especially in rural areas, report limited access to breast cancer screening [65]. Awareness of existing national interventions is also limited, reducing their effectiveness and reach [17]. Thus, strengthening BSE awareness emerges as a unifying strategy that addresses gaps across diverse economic and infrastructural contexts in the region. Global evidence suggests that task-shifting breast awareness and BSE education to community or lay health workers can be an effective approach in resource-constrained Arab settings, provided these workers are properly trained, supported, and integrated into organized early-detection pathways [66].

A primary limitation of the study is its cross-sectional design, which precludes establishing causal relationships between knowledge, attitudes, and BSE practice. Additionally, the reliance on self-reported data could introduce recall and social desirability biases. Although we maintained participant anonymity to minimize these issues, it is possible that respondents over-reported their knowledge and positive health behaviors. Convenience sampling and online data collection may have introduced selection bias, favoring students with better internet access, greater interest in health topics, or who were more receptive to online surveys, limiting generalizability and potentially underrepresenting students in less urbanized areas. Moreover, removing an item from the knowledge of risk factors component may affect the comparability of our risk factor knowledge scores with other studies that used the original scale.

Finally, by focusing exclusively on female university students, our findings may not be generalizable to the wider female population in the MENA region, particularly those who have not pursued higher education. These limitations highlight the need for future research using longitudinal designs and more diverse populations.

Conclusion

This multinational study demonstrates that despite widespread recognition of the importance of BSE, both knowledge and practice among female university students in the MENA region remain limited. The most critical barriers were gaps in practical “how-to” knowledge and persistent misconceptions, rather than a lack of interest or negative attitudes. These findings call for structured, skills-based breast health education integrated into university settings and complemented by culturally tailored outreach to translate awareness into meaningful preventive practices. Such efforts are essential to strengthen early detection and reduce the rising burden of breast cancer in low- and middle-resource settings.

Abbreviations

BSE
Breast Self–Examination
MENA
Middle East and North Africa
BCAM
A–Breast Cancer Awareness Measure–Arabic
CBCFS
Arabic–Champion's Breast Cancer Fear Scale–Arabic
LMICs
Low–and Middle–Income Countries
CBE
Clinical Breast Examination
WHO
World Health Organization
STROBE
Strengthening the Reporting of Observational Studies in Epidemiology
SPSS
Statistical Package for the Social Sciences
SD
Standard Deviation
COR
Crude Odds Ratio
AOR
Adjusted Odds Ratio

CI
Confidence Interval
VIF
Variance Inflation Factor
AIC
Akaike Information Criterion
BIC
Bayesian Information Criterion
JBCP
Jordan Breast Cancer Program

Declarations

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Data availability The datasets generated and analysed during this study are available from the corresponding author on reasonable request.

Author contributions

The conception and design of the study were done by MIM, MAAM, TD, and AE. Acquisition of data was done by NS, OI, SFL, ANI, RAS, MK, KRA, HAT, TD, NAT, MAA, and MS. Analysis and interpretation of data were done by MIM, MS, and AE. Drafting the manuscript was done by MIM, TD, MS, SHE, NS, AMA, KRA,

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