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Original article

Breast Cancer Awareness, Early Detection Practices, and Knowledge of Risk Factors among Women in Outpatient Clinics in Benghazi, Libya: A Cross-Sectional Study

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Abstract
Breast cancer constitutes 31.4% of female cancer diagnoses in Libya, yet awareness and early detection rates remain critically low, particularly in Benghazi — a region whose healthcare infrastructure has been severely disrupted by prolonged conflict. This study aims to assess breast cancer awareness, knowledge of risk factors, and early detection practices among women attending outpatient clinics in Benghazi, Libya. A cross-sectional study was conducted from March to August 2024 among 302 women at five primary care and gynecology outpatient clinics. A structured, pilot-tested questionnaire captured socio-demographic data, risk factor and symptom knowledge, screening awareness, and screening practices. Binary logistic regression identified independent predictors of adequate knowledge and regular breast self-examination (BSE). Only 38.4% demonstrated adequate breast cancer knowledge. Although 85.8% were aware of BSE, merely 21.2% practiced it regularly, and only 58.3% knew the correct technique. Mammography and breast MRI awareness were low (50.7% and 35.1%, respectively). Family history and genetic factors were the most recognized risk factors (81.5%), whereas nulliparity was identified by only 23.8%. University education (AOR=3.82, 95% CI: 2.14–6.81, p<0.001), prior attendance at awareness campaigns (AOR=2.45, 95% CI: 1.32–4.56, p=0.005), and family history of breast cancer (AOR=2.18, 95% CI: 1.15–4.12, p=0.017) were independent predictors of adequate knowledge. Despite moderate general awareness, significant knowledge gaps persist regarding preventable risk factors and correct screening practices. Targeted educational interventions, strengthened primary healthcare capacity, and expanded mammography access are urgently needed to improve early detection and potentially reduce breast cancer mortality in Libya.
Keywords. Breast Cancer, Awareness; Early Detection, BSE, Screening.

Introduction

Breast cancer represents the most frequently diagnosed malignancy among women globally, with an estimated 2.3 million new cases reported in 2022, constituting 23.8% of all female cancers worldwide [1,2]. Despite advances in diagnostic technologies and therapeutic modalities, breast cancer remains the leading cause of cancer-related mortality among women, claiming over 662,000 lives annually [1]. Projections indicate a 77% increase in global cancer incidence by 2050, with breast cancer continuing to dominate the female cancer burden, particularly in low- and middle-income countries where late-stage presentation and limited access to quality care contribute to disproportionately high mortality rates [3].

The breast cancer burden in the Middle East and North Africa (MENA) region has escalated dramatically over the past two decades, with Libya experiencing particularly concerning trends. Current epidemiological data indicate that breast cancer accounts for 31.4% of all female cancer diagnoses in Libya, with an age-standardized incidence rate of 45.2 per 100,000 women [4,5]. Alarmingly, approximately 60-70% of Libyan breast cancer patients present with advanced-stage disease, significantly compromising survival outcomes and treatment efficacy [6]. This late-stage presentation pattern reflects a complex interplay of limited public awareness, inadequate screening infrastructure, cultural barriers to seeking care, and healthcare system disruptions resulting from prolonged political instability and armed conflict [7,8]. Early detection through screening programs has been consistently demonstrated to reduce breast cancer mortality by 20-40% in countries with organized screening initiatives [9,10].

The World Health Organization recommends a multi-tiered approach to early detection, encompassing breast awareness education, clinical breast examination (CBE) for women aged 40 years and older, and mammography screening in settings with adequate healthcare infrastructure [11]. In resource-limited contexts where population-based mammography screening may not be feasible, promoting awareness of breast self-examination (BSE) and improving access to clinical breast examination can serve as pragmatic interim strategies, provided they are implemented within comprehensive breast health programs [12,13]. However, the effectiveness of these approaches is fundamentally contingent upon women's knowledge of breast cancer risk factors, recognition of warning signs, and willingness to engage in screening behaviors [14]. Previous studies from the MENA region have documented substantial deficiencies in breast cancer awareness, with knowledge levels varying considerably across countries and population subgroups [15-18]. In Saudi Arabia, a recent cross-sectional study reported that only 42% of women demonstrated adequate knowledge of breast cancer risk factors, with even lower rates of regular BSE practice at 18.3% [16]. Similarly, investigations in Jordan and Qatar revealed that while general awareness of breast cancer existence was

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relatively high (>80%), detailed knowledge of specific risk factors and appropriate screening methods remained inadequate [17,18].

In Libya, limited research has been conducted to assess breast cancer awareness. A 2016 study in Tripoli found that 68% of women had heard of breast cancer, but only 35% could identify more than three risk factors [19]. More recently, a 2018 investigation in Benghazi reported low awareness of BSE among women, though a small sample size limited the study and did not comprehensively assess knowledge of risk factors or screening behaviors [20]. The paucity of recent, comprehensive data on breast cancer awareness in Benghazi is particularly concerning, given the city's unique challenges. As Libya's second-largest urban center and a major healthcare hub in eastern Libya, Benghazi has experienced significant healthcare infrastructure deterioration due to prolonged armed conflict from 2014 to 2017, which disrupted preventive health services and cancer screening programs [21]. Understanding current levels of breast cancer awareness and identifying factors associated with knowledge and screening practices is essential for designing evidence-based interventions tailored to the local context. This study aimed to comprehensively assess breast cancer awareness, knowledge of risk factors, and early detection practices among women attending outpatient clinics in Benghazi, Libya.

Methods

Study Design and Setting

This descriptive cross-sectional study was conducted from March 1 to August 31, 2024, in Benghazi, the second-largest city in Libya, with an estimated population of 670,000. Benghazi serves as the primary healthcare center for eastern Libya, hosting major tertiary hospitals and numerous primary care facilities. The study was conducted at five outpatient clinics purposively selected to represent diverse geographic areas and socioeconomic populations within Benghazi: two general primary care centers, two gynecology clinics, and one family medicine clinic. These facilities collectively serve approximately 15,000 female patients each month, providing routine healthcare services including maternal and child health, chronic disease management, and gynecological care.

Sample Size Calculation

The required sample size was calculated using the single population proportion formula: $n = Z^2p(1-p)/d^2$, where $Z = 1.96$ (corresponding to 95% confidence level), $p = 0.50$ (expected proportion of adequate awareness, based on previous regional studies showing awareness rates ranging from 35-68%) [19,20], and $d = 0.05$ (margin of error). This yielded a minimum sample size of 384. Anticipating a potential non-response rate of 20%, we targeted 461 participants. However, due to resource constraints and the study timeline, we ultimately recruited 302 participants, providing 80% power to detect associations with an odds ratio of 2.0 or greater at $\alpha = 0.05$.

Sampling Procedure

Systematic random sampling was employed at each participating clinic. During the six-month data collection period, research assistants attended each clinic on randomly selected days covering all weekdays to ensure representation of different patient populations. Every third woman attending the clinic for any reason was approached for potential participation. Women were eligible for inclusion if they were: (1) Libyan nationals; (2) aged 18 years or older; (3) able to read and understand Arabic; and (4) willing to provide informed consent. Exclusion criteria included: (1) previous diagnosis of breast cancer; (2) current pregnancy, as pregnancy-related breast changes might influence responses; (3) severe illness or cognitive impairment preventing questionnaire completion; and (4) healthcare professionals working in oncology or related fields, to avoid professional bias in responses. Of 428 women approached, 102 declined participations (citing time constraints or lack of interest), and 24 were excluded (18 due to previous breast cancer diagnosis, 4 pregnant, 2 with cognitive difficulties), resulting in a final sample of 302 participants (response rate: 70.6%). (Figure 1) presents the participant recruitment flowchart.

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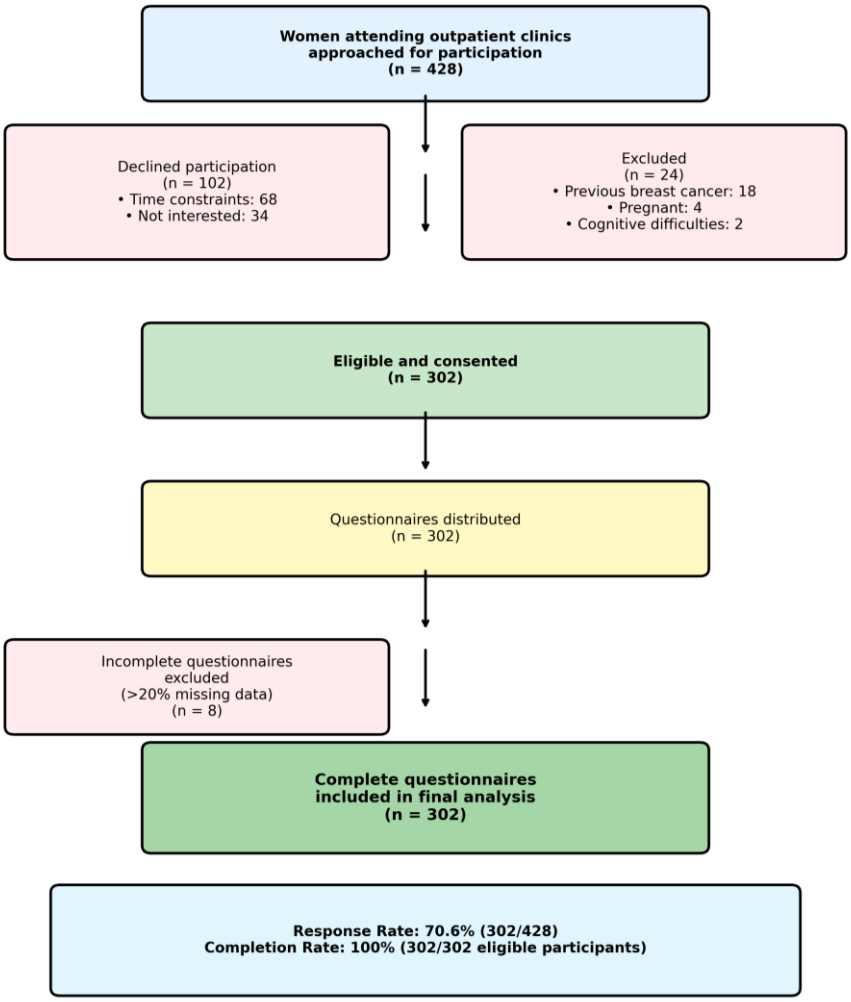

Figure 1. Participant Recruitment and Selection Flowchart

Data Collection Instrument

Data were collected using a structured, self-administered questionnaire developed specifically for this study based on an extensive literature review and adapted from validated instruments used in previous breast cancer awareness studies in the MENA region [15-18,22]. The questionnaire comprised five main sections:

Section 1: Socio-demographic characteristics (10 items): age, marital status, educational level, occupation, monthly household income, place of residence, parity, breastfeeding history, blood relationship between parents and family member with breast disease.

Section 2: Knowledge of breast cancer risk factors (12 items): participants were asked to identify factors that increase breast cancer risk from a list including both correct (e.g., family history, advanced age, nulliparity, late first pregnancy, obesity, physical inactivity, alcohol consumption, hormone replacement therapy) and incorrect options (e.g., breastfeeding, regular exercise). Each correct identification scored 1 point (a maximum of 12 points).

Section 3: Knowledge of breast cancer warning signs (8 items): participants identified breast cancer symptoms from a list including breast lump, nipple discharge, nipple retraction, breast skin changes, breast pain, breast swelling, axillary lump, and change in breast size. Each correct identification scored 1 point (maximum 8 points).

Section 4: Awareness and practice of early detection methods (15 items): questions assessed awareness of BSE, CBE, mammography, and breast MRI; knowledge of correct BSE technique and timing; frequency of BSE practice; history of CBE and mammography; reasons for not practicing screening; and perceived barriers to screening.

Section 5: Sources of breast cancer information and campaign exposure (6 items): participants indicated their primary sources of breast cancer information and whether they had attended awareness campaigns.

The total knowledge score (Sections 2 and 3 combined) ranged from 0 to 20 points. Based on the tertile distribution and expert consultation with three oncologists and two public health specialists, knowledge was categorized as: poor (<10 points, <50%), moderate (10-14 points, 50-70%), or adequate (≥15 points, ≥75%).

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Questionnaire Validation and Pilot Testing

Content validity was established through expert review by five specialists (two medical oncologists, one surgical oncologist, and two public health experts) who independently evaluated each item for relevance, clarity, and appropriateness. The content validity index (CVI) was 0.87, indicating good content validity. The questionnaire was then translated into Arabic by two independent bilingual translators, followed by back-translation to English by two different translators to ensure linguistic equivalence. A pilot study was conducted with 35 women attending a clinic not included in the main study. Based on pilot feedback, minor modifications were made to improve the clarity of three questions. The pilot data were not included in the final analysis. Internal consistency reliability for the knowledge section was assessed using Cronbach's alpha, which yielded a value of 0.79, indicating acceptable reliability. Test-retest reliability was evaluated with 20 participants who completed the questionnaire twice, two weeks apart, yielding a correlation coefficient of 0.84 ($p<0.001$), demonstrating good temporal stability.

Data Collection Procedure

Four trained research assistants (two medical students and two recent graduates from the Faculty of Biomedical Sciences) conducted data collection under the supervision of the principal investigator. Data collectors received comprehensive training on study objectives, ethical considerations, participant recruitment, and questionnaire administration. Women who met eligibility criteria were approached in clinic waiting areas, provided with detailed information about the study, and invited to participate. Those agreeing to participate provided written informed consent and were given the questionnaire to complete in a quiet, private area of the clinic. Research assistants were available to clarify questions if needed, but did not influence responses. Questionnaire completion required approximately 15-20 minutes. Upon completion, questionnaires were immediately checked for completeness; incomplete questionnaires (missing >20% of responses) were excluded (n=8). All completed questionnaires were assigned unique identification codes to ensure anonymity.

Ethical Considerations

Ethical approval was obtained from the Research Ethics Committee of the Faculty of Biomedical Sciences, University of Benghazi (Approval Reference: REC/FBS/2024/037, dated February 15, 2024). The study was conducted in accordance with the Declaration of Helsinki. All participants provided written informed consent after receiving detailed information about study objectives, procedures, the voluntary nature of participation, and confidentiality measures. Participants were informed of their right to withdraw at any time without consequences. No personal identifiers were recorded on questionnaires. All data were stored securely in locked cabinets with access restricted to the research team. Digital data files were password-protected.

Statistical Analysis

Data were entered into Microsoft Excel 2019 and analyzed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Data entry accuracy was verified through double-entry of 10% of questionnaires, with a concordance rate of 99.2%. Descriptive statistics were calculated for all variables. Continuous variables were assessed for normality using the Kolmogorov-Smirnov test and presented as mean ± standard deviation (SD) for normally distributed data or median (interquartile range, IQR) for non-normally distributed data. Categorical variables were presented as frequencies and percentages. Bivariate analyses were conducted to examine associations between socio-demographic characteristics and knowledge level (adequate vs. poor/moderate) as well as BSE practice (regular vs. irregular/never). Chi-square tests (or Fisher's exact test when expected cell frequencies were <5) were used for categorical variables, and independent t-tests (or Mann-Whitney U tests for non-normal data) were used for continuous variables. Variables demonstrating associations with $p<0.25$ in bivariate analyses were entered into binary logistic regression models using the enter method to identify independent predictors of: (1) adequate knowledge, and (2) regular BSE practice. Results were reported as adjusted odds ratios (AOR) with 95% confidence intervals (CI). Model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test. Multicollinearity was evaluated using variance inflation factors (VIF), with VIF <5 considered acceptable. Statistical significance was set at $p<0.05$ (two-tailed) for all analyses.

Results

Socio-demographic Characteristics of Participants

(Table 1) presents the socio-demographic characteristics of the 302 study participants. The mean age was 34.8 ± 11.2 years (range: 18-64 years), with the largest proportion (37.1%) in the 30-39 age group. The majority were married (71.5%), had university-level education (54.3%), and were unemployed or homemakers (63.6%). Nearly one-third (31.8%) reported a monthly household income below 1,500 Libyan dinars (approximately $310 USD). Most participants were parous (68.9%), and 82.2% of parous women reported a history of breastfeeding. Family history of breast cancer was reported by 18.4% of participants, while 12.3% had a family member history of benign breast disease.

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Table 1. Socio-demographic Characteristics of Study Participants (N=302)

Demographics	Statistics
Mean Age (years)	34.8 ± 11.2
Age Groups	
18-29 years	87 (28.8%)
30-39 years	112 (37.1%)
40-49 years	68 (22.5%)
≥50 years	35 (11.6%)
Marital status	
Single	72 (23.8%)
Married	216 (71.5%)
Divorced/Widowed	14 (4.6%)
Educational level	
Primary or less	41 (13.6%)
Secondary	97 (32.1%)
University or higher	164 (54.3%)
Employment status	
Employed	110 (36.4%)
Unemployed/Homemaker	192 (63.6%)
Monthly household income (LYD)	
<1,500	96 (31.8%)
1,500-3,000	118 (39.1%)
>3,000	88 (29.1%)
Place of residence	
Urban central	187 (61.9%)
Urban peripheral	85 (28.1%)
Suburban	30 (9.9%)
Parity	
Nulliparous	94 (31.1%)
Parous	208 (68.9%)
Breastfeeding history (among parous, n=208)	
Yes	171 (82.2%)
No	37 (17.8%)
Family history of breast cancer	
Yes	56 (18.4%)
No	246 (81.5%)
Family history of benign breast disease	
Yes	37 (12.3%)
No	265 (87.7%)

LYD = Libyan Dinar (1 LYD ≈ 0.21 USD as of 2024)

Family history is an important factor that influences women's awareness of breast cancer and their willingness to undergo early screening. (Figure 2) shows the distribution of participants according to their family history of breast cancer and the blood relationship between parents. The data showed that approximately one-third of the participants (30.5%, n=92) had consanguinity, while the majority, 69.5% (n=210), did not report any consanguineous relationship. Regarding family history of breast cancer, the results showed that 18.4% (n=56) of the participants had a family History with breast cancer or at risk of developing it, distributed as follows: mother: 4.3% (n=13), sister: 2.6% (n=8), maternal aunt: 4.9% (n=15), paternal aunt: 6.7% (n=20), while no cases were recorded among the participants' daughters. Minor discrepancies in totals are due to rounding.

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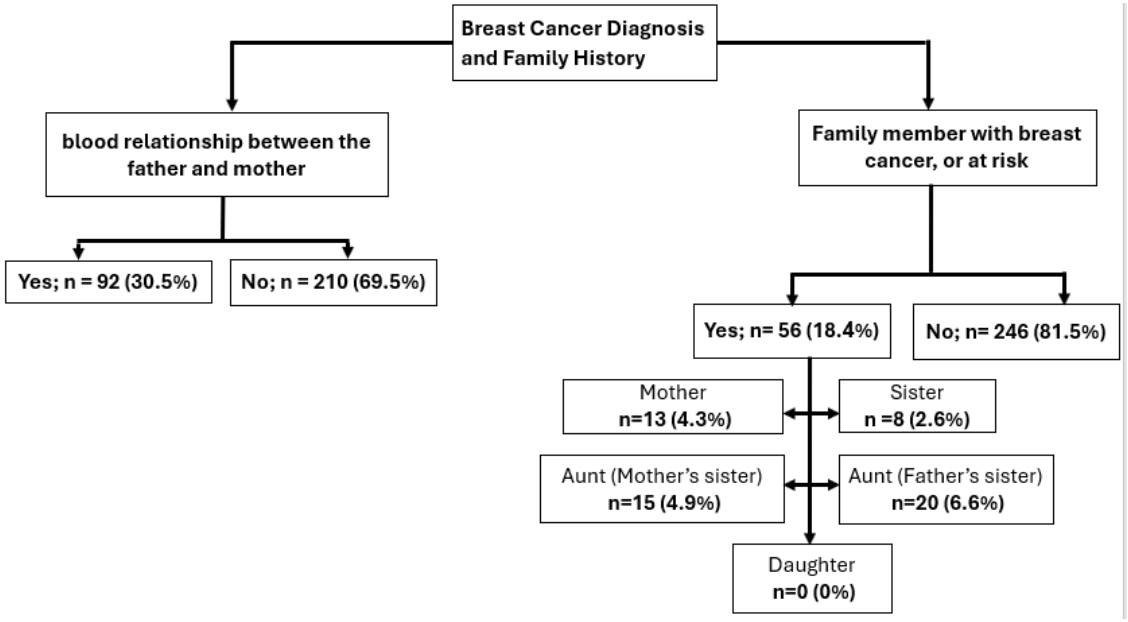

Figure 2. Family history of breast cancer diagnosis of female respondents (n=302)

Knowledge of Breast Cancer Risk Factors and Warning Signs

(Table 2) summarizes participants' knowledge of breast cancer risk factors and warning signs. The mean total knowledge score was 11.4 ± 4.3 out of 20 possible points. Knowledge was categorized as poor in 28.8% of participants, moderate in 32.8%, and adequate in 38.4%. (Figure 3) illustrates the distribution of knowledge scores and categorization.

Table 2. Knowledge of Breast Cancer Risk Factors and Warning Signs (N=302)

Knowledge Item	Correct Response n (%)
Risk Factors	
Family history/genetic predisposition	246 (81.5%)
Age over 50 years	203 (67.2%)
Early menarche (before age 12)	158 (52.3%)
Hormone replacement therapy	132 (43.7%)
Alcohol consumption	126 (41.7%)
Late first pregnancy (after age 30)	110 (36.4%)
Obesity/overweight	103 (34.1%)
Lack of breastfeeding	94 (31.1%)
Physical inactivity	86 (28.5%)
Nulliparity (never having children)	72 (23.8%)
Late menopause (after age 55)	68 (22.5%)
Previous breast radiation	59 (19.5%)
Warning Signs/Symptoms	
Breast lump or mass	271 (89.7%)
Nipple discharge	225 (74.5%)
Skin changes (dimpling, puckering)	206 (68.2%)
Breast swelling or a change in size	178 (58.9%)
Nipple retraction or inversion	144 (47.7%)
Breast pain or tenderness	136 (45.0%)
Axillary (armpit) lump	128 (42.4%)
Redness or scaliness of breast skin	115 (38.1%)
Overall, Knowledge Score	
Mean score ± SD (out of 20)	11.4 ± 4.3
Median score (IQR)	11.0 (8.0-15.0)
Knowledge Level Categories	
Poor (<10 points, <50%)	87 (28.8%)
Moderate (10-14 points, 50-70%)	99 (32.8%)
Adequate (≥15 points, ≥75%)	116 (38.4%)

IQR = Interquartile Range

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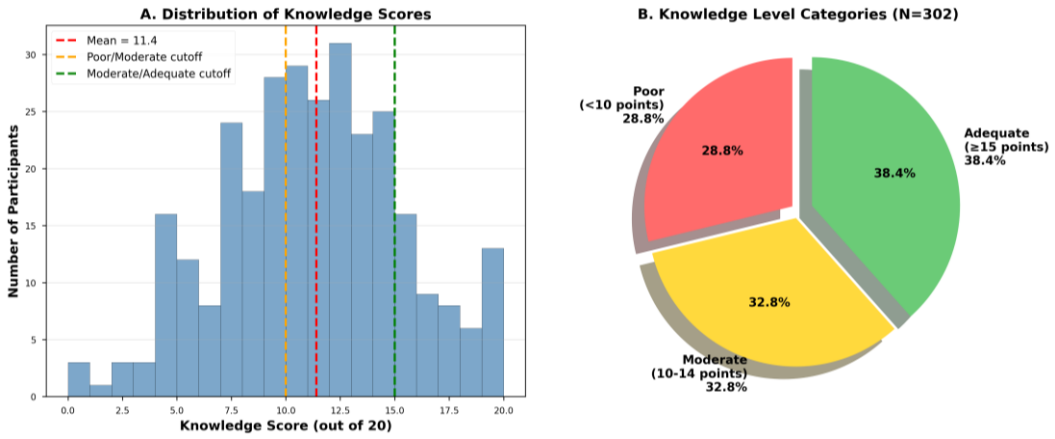

Figure 3. Distribution of Breast Cancer Knowledge Scores Among Participants

Regarding risk factors, family history and genetic predisposition were the most widely recognized (81.5%), followed by advanced age over 50 years (67.2%) and early menarche (52.3%). However, awareness of modifiable lifestyle-related risk factors was considerably lower: obesity (34.1%), physical inactivity (28.5%), and alcohol consumption (41.7%). Knowledge of reproductive risk factors was also suboptimal, with only 23.8% recognizing nulliparity, 36.4% identifying late first pregnancy, and 31.1% acknowledging lack of breastfeeding as a risk factor. Hormone replacement therapy was correctly identified as a risk factor by 43.7% of participants. Concerning warning signs, breast lumps were recognized by the vast majority (89.7%), followed by nipple discharge (74.5%) and skin changes (68.2%). However, less than half of the participants identified nipple retraction (47.7%), breast pain (45.0%), or axillary lumps (42.4%) as potential warning signs.

Awareness and Practice of Early Detection Methods

(Table 3) presents data on awareness and practice of breast cancer early detection methods. Overall, 85.8% of participants had heard of breast self-examination (BSE), but only 58.3% reported knowing the correct technique to perform it. Merely 21.2% practiced BSE regularly (monthly), while 37.1% performed it occasionally, and 41.7% never practiced it. Among those who performed BSE (n=176), only 27.8% correctly identified the post-menstrual phase (7-10 days after menstruation) as the optimal timing.

Table 3. Awareness and Practice of Breast Cancer Early Detection Methods (N=302)

Early Detection Method	n (%)
Breast Self-Examination (BSE)	
Heard of BSE	259 (85.8%)
Know how to perform BSE correctly	176 (58.3%)
Frequency of BSE practice	
Regularly (Monthly)	64 (21.2%)
Occasionally (irregular)	112 (37.1%)
Never	126 (41.7%)
Timing of BSE (among those aware, n=259)	
Know correct timing (7-10 days post-menstruation)	72 (27.8%)
Incorrect timing/Don't know	187 (72.2%)
Clinical Breast Examination (CBE)	
Heard of CBE	190 (62.9%)
Ever had CBE by a healthcare professional	105 (34.8%)
Had CBE in the past year	58 (19.2%)
Mammography	
Heard of mammography	153 (50.7%)
Ever had a mammogram	46 (15.2%)
Had a mammogram in the past 2 years	28 (9.3%)
Among women aged ≥40 years (n=103):	
Ever had a mammogram	28 (27.2%)
Had a mammogram in the past 2 years	18 (17.5%)
Breast MRI	
Heard of breast MRI as a diagnostic tool	106 (35.1%)
Reasons for not practicing BSE regularly (N=238, Multiple Responses Allowed)	
Don't know how to perform correctly	101 (42.5%)

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Forgot to do it	91 (38.3%)
Believe it's unnecessary without symptoms	69 (29.0%)
Fear of finding something abnormal	53 (22.3%)
Lack of time	45 (18.9%)
Embarrassment/discomfort	32 (13.4%)
Don't believe it's effective	28 (11.8%)
Barriers To Clinical Screening (n=302, multiple responses allowed)	
Cost/lack of insurance coverage	156 (51.7%)
Don't know where to get screened	134 (44.4%)
Long waiting times	98 (32.5%)
Fear of results	87 (28.8%)
Lack of time	76 (25.2%)
Cultural/modesty concerns	54 (17.9%)
Transportation difficulties	43 (14.2%)

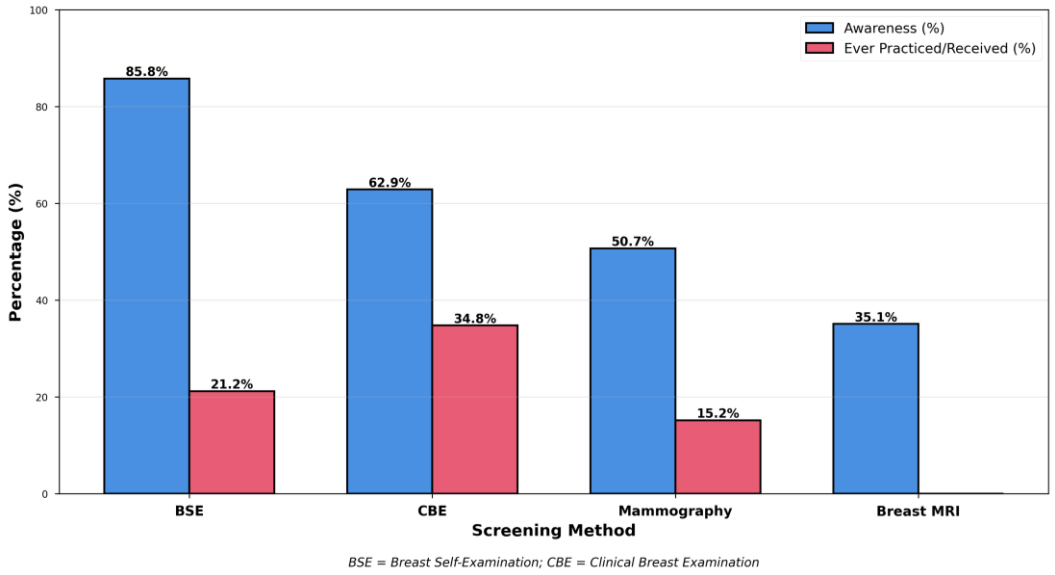

Figure 4. Awareness and Practice of Breast Cancer Screening Methods (N=302)

Figure 4 compares the awareness and practice of breast cancer screening methods, where awareness of clinical breast examination (CBE) was 62.9%, but only 34.8% had ever undergone CBE by a healthcare professional. Mammography awareness was notably lower at 50.7%, with only 15.2% reporting having ever had a mammogram. Among women aged 40 years and older (n=103), only 27.2% had undergone mammography. Awareness of breast MRI as a diagnostic tool was the lowest at 35.1%.
When asked about reasons for not practicing BSE regularly (n=238), the most common responses were: not knowing how to perform it correctly (42.5%), forgetting to do it (38.3%), believing it is unnecessary without symptoms (29.0%), fear of finding something abnormal (22.3%), and lack of time (18.9%).

Sources of Breast Cancer Information and Campaign Exposure

(Table 4) displays participants' sources of breast cancer information and campaign exposure. The internet and social media platforms were the most commonly cited sources (55.0%), followed by healthcare providers at clinics (38.6%), television and radio (34.4%), family and friends (28.5%), and newspapers and magazines (19.9%). Formal education (school or university) was mentioned by 24.5% of participants, as shown in Figure 5. Approximately one-third of participants (33.1%) reported attending breast cancer awareness campaigns or events, where (44.0%) believed that breast cancer awareness activities in their community were insufficient, while (38.1%) considered them adequate.

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Table 4. Sources of Breast Cancer Information and Campaign Exposure (N=302)

Information Source	**n (%)***
Internet/social media	166 (55.0%)
Healthcare providers at clinics	117 (38.6%)
Television/Radio	104 (34.4%)
Family and friends	86 (28.5%)
School/University education	74 (24.5%)
Newspapers/Magazines	60 (19.9%)
Awareness campaigns/events	100 (33.1%)
Religious institutions	42 (13.9%)
Community health workers	38 (12.6%)
Number of Information Sources	
None (no information received)	18 (6.0%)
1-2 sources	142 (47.0%)
3-4 sources	106 (35.1%)
≥5 sources	36 (11.9%)
Attendance At Breast Cancer Awareness Campaigns	
Yes, attended at least one campaign	100 (33.1%)
No, never attended	202 (66.9%)
Perception of community awareness efforts	
Insufficient	133 (44.0%)
Adequate	115 (38.1%)
Unsure/Don't know	54 (17.9%)
Preferred Format for Future Education (N=302)	
Face-to-face workshops/training	148 (49.0%)
Social media campaigns	132 (43.7%)
Television/Radio programs	98 (32.5%)
Printed materials (brochures, posters)	87 (28.8%)
Mobile phone text messages	65 (21.5%)
Community outreach programs	56 (18.5%)

**Multiple responses allowed; percentages may not sum to 100%*

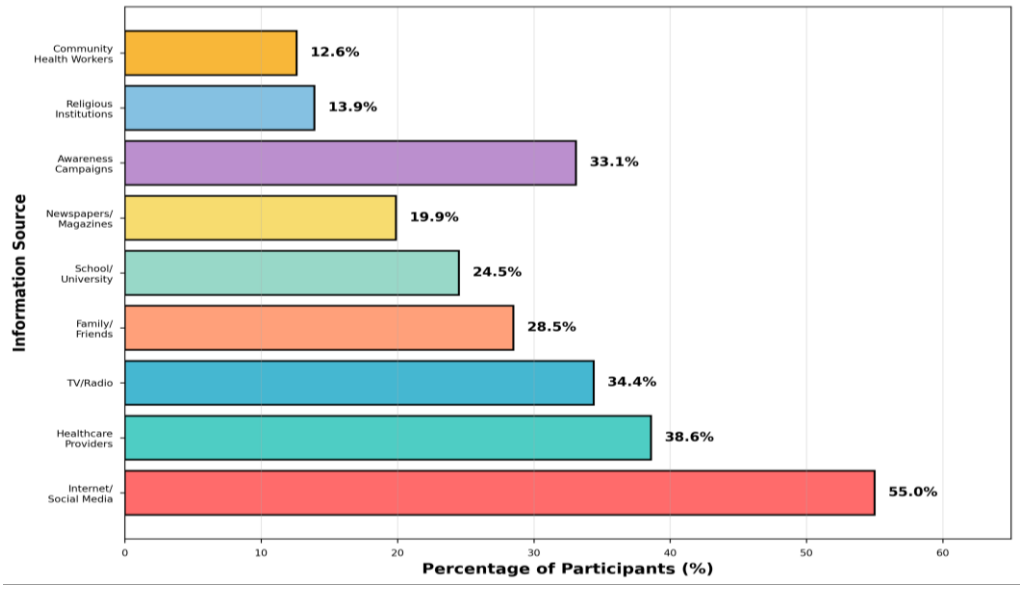

Figure 5. Sources of Breast Cancer Information (N=302)

Factors Associated with Adequate Knowledge of Breast Cancer

(Table 5) presents bivariate analyses examining associations between sociodemographic characteristics and adequate knowledge of breast cancer. Adequate knowledge was significantly associated with younger age (30-39 years group had highest proportion, p=0.040), university education (50.0% vs. 17.1% for primary education, p<0.001), employment status (52.7% among employed vs. 30.2% among unemployed, p=0.001), higher monthly income (p<0.001), family history of breast cancer (53.6% vs. 35.0%, p=0.012), and previous attendance at awareness campaigns (58.0% vs. 28.7%, p<0.001). No significant associations were found with marital status, parity, or history of benign breast disease.

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Table 5. Bivariate Analysis of Factors Associated with Adequate Knowledge (N=302)

Variable	Adequate Knowledge n=116 (%)	Poor/Moderate Knowledge n=186 (%)	x^2	p-value
Age group			8.32	0.040
18-29 years	29 (33.3%)	58 (66.7%)		
30-39 years	52 (46.4%)	60 (53.6%)		
40-49 years	25 (36.8%)	43 (63.2%)		
≥50 years	10 (28.6%)	25 (71.4%)		
Educational Level			48.73	<0.001
Primary or less	7 (17.1%)	34 (82.9%)		
Secondary	27 (27.8%)	70 (72.2%)		
University or higher	82 (50.0%)	82 (50.0%)		
Employment Status			11.24	0.001
Employed	58 (52.7%)	52 (47.3%)		
Unemployed/Homemaker	58 (30.2%)	134 (69.8%)		
Monthly Income (LYD)			22.15	<0.001
<1,500	24 (25.0%)	72 (75.0%)		
1,500-3,000	42 (35.6%)	76 (64.4%)		
>3,000	50 (56.8%)	38 (43.2%)		
Marital Status			2.14	0.343
Single	31 (43.1%)	41 (56.9%)		
Married	80 (37.0%)	136 (63.0%)		
Divorced/Widowed	5 (35.7%)	9 (64.3%)		
Parity			0.89	0.346
Nulliparous	39 (41.5%)	55 (58.5%)		
Parous	77 (37.0%)	131 (63.0%)		
Family history of BC			6.32	0.012
Yes	30 (53.6%)	26 (46.4%)		
No	86 (35.0%)	160 (65.0%)		
Family member history of benign breast disease			1.87	0.171
Yes	18 (48.6%)	19 (51.4%)		
No	98 (37.0%)	167 (63.0%)		
Campaign Attendance			18.45	<0.001
Yes	58 (58.0%)	42 (42.0%)		
No	58 (28.7%)	144 (71.3%)		

BC = Breast Cancer; LYD = Libyan Dinar

(Table 6) presents the results of the multivariate logistic regression analysis identifying independent predictors of adequate knowledge. After adjusting for potential confounders, university education remained the strongest predictor (AOR=3.82, 95% CI: 2.14-6.81, p<0.001), followed by previous attendance at awareness campaigns (AOR=2.45, 95% CI: 1.32-4.56, p=0.005), and family history of breast cancer (AOR=2.18, 95% CI: 1.15-4.12, p=0.017). Employment status and monthly income, while significant in bivariate analysis, did not remain significant in the multivariate model, likely due to collinearity with education level. The Hosmer-Lemeshow test indicated good model fit (x^2=6.34, p=0.609). Figure 6 presents a forest plot of the predictors of adequate knowledge.

Table 6. Multivariate Logistic Regression: Predictors of Adequate Knowledge (N=302)

Variable	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Educational Level				
Primary or less	1.00 (Reference)	-	1.00 (Reference)	-
Secondary	1.87 (0.75-4.68)	0.179	1.65 (0.64-4.25)	0.302
University or higher	4.85 (2.03-11.60)	<0.001	3.82 (2.14-6.81)	<0.001
Employment Status				
Unemployed/Homemaker	1.00 (Reference)	-	1.00 (Reference)	-
Employed	2.58 (1.62-4.11)	<0.001	1.54 (0.89-2.67)	0.124
Monthly Income (LYD)				
<1,500	1.00 (Reference)	-	1.00 (Reference)	-
1,500-3,000	1.66 (0.93-2.96)	0.088	1.23 (0.66-2.29)	0.518
>3,000	3.95 (2.14-7.29)	<0.001	1.87 (0.95-3.68)	0.070
Family History of BC				

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No	1.00 (Reference)	-	1.00 (Reference)	-
Yes	2.15 (1.21-3.81)	0.009	2.18 (1.15-4.12)	0.017
Campaign Attendance				
No	1.00 (Reference)	-	1.00 (Reference)	-
Yes	3.43 (2.09-5.62)	<0.001	2.45 (1.32-4.56)	0.005
Age Group				
18-29 years	1.00 (Reference)	-	1.00 (Reference)	-
30-39 years	1.73 (1.00-3.01)	0.051	1.42 (0.78-2.58)	0.252
40-49 years	1.16 (0.61-2.23)	0.646	0.98 (0.48-2.01)	0.958
≥50 years	0.80 (0.35-1.85)	0.601	0.76 (0.30-1.93)	0.563

Model statistics: Hosmer-Lemeshow x^2=6.34, p=0.609; Nagelkerke R^2=0.342; Accuracy=72.5%
BC = Breast Cancer; OR = Odds Ratio; CI = Confidence Interval

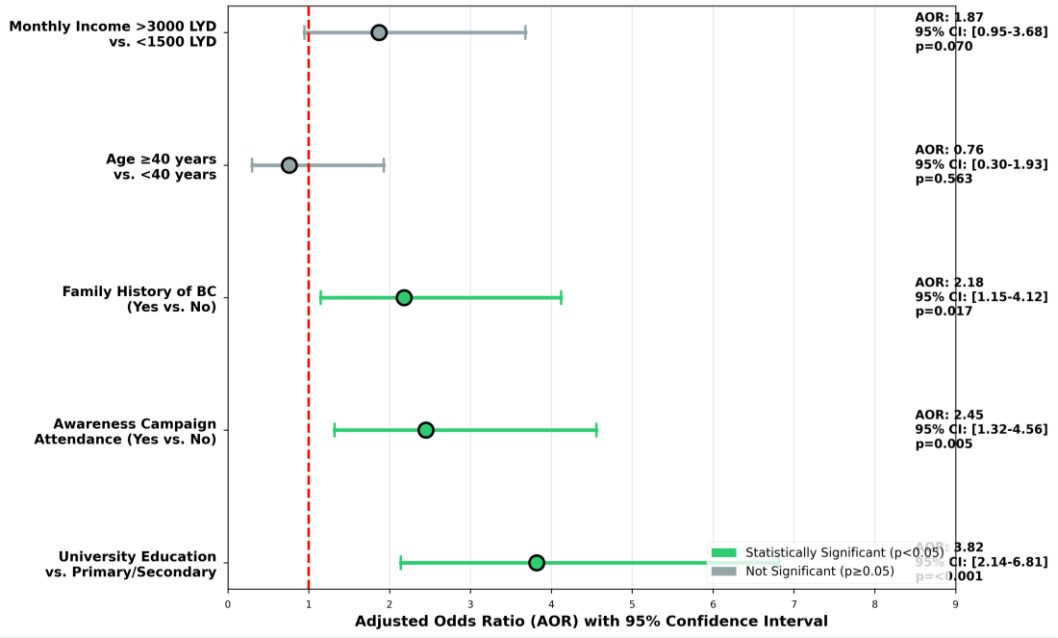

Figure 6. Predictors of Adequate Breast Cancer Knowledge – Multivariate Logistic Regression (N=302)

Factors Associated with Regular BSE Practice

(Table 7) presents bivariate analyses examining associations between socio-demographic characteristics and regular BSE practice. Regular BSE was significantly associated with adequate knowledge level (33.6% among those with adequate knowledge vs. 8.0% among those with poor knowledge, p<0.001), university education (28.7% vs. 9.8% for primary education, p=0.002), family history of breast cancer (39.3% vs. 17.1%, p<0.001), and previous campaign attendance (32.0% vs. 15.8%, p=0.006). Age, marital status, employment, and income were not significantly associated with regular BSE practice.

Table 7. Bivariate Analysis of Factors Associated with Regular BSE Practice (N=302)

Variable	Regular BSE n=64 (%)	Irregular/Never n=238 (%)	x^2	p-value
Knowledge Level			35.67	<0.001
Poor (<10)	7 (8.0%)	80 (92.0%)		
Moderate (10-14)	18 (18.2%)	81 (81.8%)		
Adequate (≥15)	39 (33.6%)	77 (66.4%)		
Age group			4.28	0.233
18-29 years	15 (17.2%)	72 (82.8%)		
30-39 years	28 (25.0%)	84 (75.0%)		
40-49 years	15 (22.1%)	53 (77.9%)		
≥50 years	6 (17.1%)	29 (82.9%)		
Educational Level			12.45	0.002
Primary or less	4 (9.8%)	37 (90.2%)		
Secondary	13 (13.4%)	84 (86.6%)		
University or higher	47 (28.7%)	117 (71.3%)		
Employment status			3.72	0.054
Employed	30 (27.3%)	80 (72.7%)		
Unemployed/Homemaker	34 (17.7%)	158 (82.3%)		

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Monthly income (LYD)			5.89	0.053
<1,500	15 (15.6%)	81 (84.4%)		
1,500-3,000	22 (18.6%)	96 (81.4%)		
>3,000	27 (30.7%)	61 (69.3%)		
Marital Status			1.87	0.393
Single	18 (25.0%)	54 (75.0%)		
Married	44 (20.4%)	172 (79.6%)		
Divorced/Widowed	2 (14.3%)	12 (85.7%)		
Family history of BC			12.78	<0.001
Yes	22 (39.3%)	34 (60.7%)		
No	42 (17.1%)	204 (82.9%)		
Campaign Attendance			7.52	0.006
Yes	32 (32.0%)	68 (68.0%)		
No	32 (15.8%)	170 (84.2%)		

BSE = Breast Self-Examination; BC = Breast Cancer; LYD = Libyan Dinar

(Table 8) presents the results of the multivariate logistic regression analysis identifying independent predictors of regular BSE practice. Adequate knowledge was the strongest predictor (AOR=5.23, 95% CI: 2.67-10.24, p<0.001), followed by family history of breast cancer (AOR=3.15, 95% CI: 1.58-6.28, p=0.001). University education and campaign attendance, while significant in bivariate analysis, did not remain significant predictors in the multivariate model, suggesting that knowledge level may account for part of the observed relationship. The Hosmer-Lemeshow test indicated acceptable model fit (x^2=8.91, p=0.350). Figure 7 presents a forest plot of the predictors of regular BSE practice.

Table 8. Multivariate Logistic Regression: Predictors of Regular BSE Practice (N=302)

Variable	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Knowledge Level				
Poor/Moderate	1.00 (Reference)	-	1.00 (Reference)	-
Adequate	5.74 (3.21-10.26)	<0.001	5.23 (2.67-10.24)	<0.001
Educational Level				
Primary/Secondary	1.00 (Reference)	-	1.00 (Reference)	-
University or higher	3.46 (1.88-6.38)	<0.001	1.76 (0.87-3.57)	0.117
Family History of BC				
No	1.00 (Reference)	-	1.00 (Reference)	-
Yes	3.14 (1.70-5.80)	<0.001	3.15 (1.58-6.28)	0.001
Campaign Attendance				
No	1.00 (Reference)	-	1.00 (Reference)	-
Yes	2.50 (1.45-4.31)	0.001	1.68 (0.88-3.21)	0.118
Age Group				
<40 years	1.00 (Reference)	-	1.00 (Reference)	-
≥40 years	1.18 (0.69-2.02)	0.543	1.03 (0.55-1.92)	0.934

Model statistics: Hosmer-Lemeshow x^2=8.91, p=0.350; Nagelkerke R^2=0.298; Accuracy=79.8%
BSE = Breast Self-Examination; OR = Odds Ratio; CI = Confidence Interval

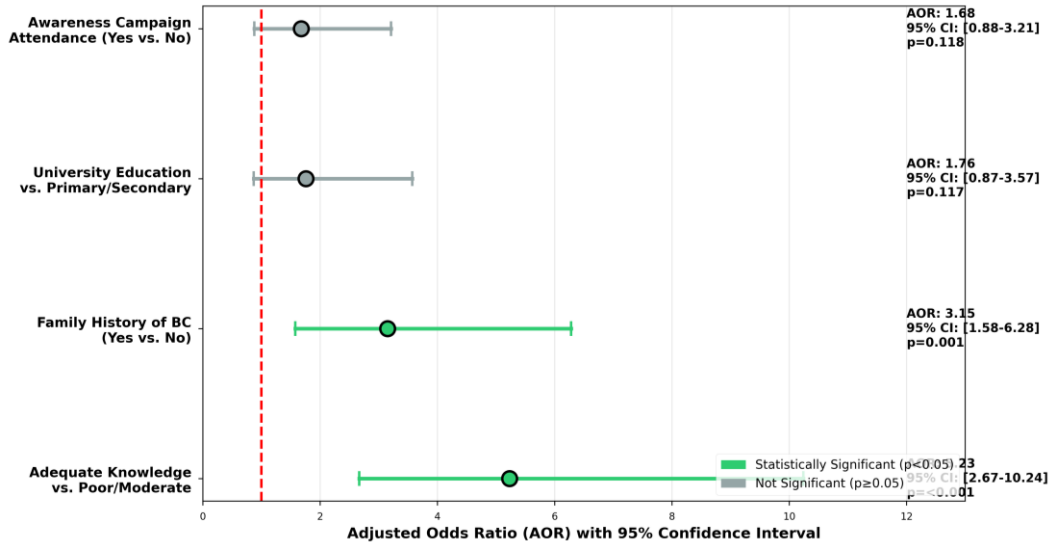

Figure 7. Predictors of Regular BSE Practice – Multivariate Logistic Regression Analysis (N=302)

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Discussion

This cross-sectional study provides comprehensive, contemporary data on breast cancer awareness, knowledge, and early detection practices among women in Benghazi, Libya. Our findings reveal a complex picture: while general awareness of breast cancer existence is relatively high, significant deficiencies persist in detailed knowledge of modifiable risk factors and appropriate screening behaviors. Only 38.4% of participants demonstrated adequate overall knowledge, and merely 21.2% practiced regular breast self-examination despite 85.8% being aware of this screening method. These findings underscore substantial gaps in translating awareness into actionable knowledge and preventive behaviors.

Our finding that 85.8% of women had heard of BSE represents an improvement compared to the 2018 Benghazi study by Ziuo et al., which reported only 67% awareness [20]. This increase may reflect the growing penetration of internet access and the spread of social media health campaigns in Libya over the past six years. However, our observed rate of regular BSE practice (21.2%) remains comparable to the 18-24% range reported in previous Libyan studies [19,20] and aligns closely with findings from other MENA countries, including Saudi Arabia (18.3%) [16], Jordan (24.5%) [23], and Palestine (22.7%) [24]. This consistency across the region suggests common underlying barriers to screening behavior that transcend national boundaries, likely including cultural factors, healthcare system limitations, and inadequate practical skills training.

Interestingly, our study revealed lower mammography awareness (50.7%) compared to the 2016 Tripoli study, which reported 68% [19]. This geographic disparity may reflect the differential impact of armed conflict on healthcare infrastructure and public health messaging in eastern versus western Libya. Benghazi experienced more prolonged and intense conflict from 2014-2017, which disrupted healthcare services and cancer screening programs more severely than in Tripoli [21]. The extremely low mammography utilization rate among women aged 40 and older (27.2%) is particularly concerning and substantially lower than rates reported in neighboring countries such as Jordan (47%) and Saudi Arabia (38%) [16,23], highlighting the urgent need for improved access to mammography services in Benghazi.

The disproportionately high recognition of genetic and family history as risk factors (81.5%) compared to modifiable lifestyle factors such as obesity (34.1%) and physical inactivity (28.5%) represents a critical knowledge gap with important public health implications. This pattern has been consistently observed across MENA region studies [15-18] and may reflect cultural beliefs emphasizing fate and heredity over personal agency in disease causation. Such beliefs can inadvertently discourage engagement in risk-reducing behaviors. The low recognition of reproductive risk factors—particularly nulliparity (23.8%) and lack of breastfeeding (31.1%)—is especially concerning in the Libyan context, where fertility patterns are changing, with increasing age at first birth and declining breastfeeding rates due to urbanization and women's workforce participation [25]. The substantial gap between BSE awareness (85.8%) and regular practice (21.2%) exemplifies the well-documented knowledge-behavior discordance in health promotion research [26]. Our multivariate analysis provides insight into this phenomenon: adequate knowledge was the strongest predictor of regular BSE practice (AOR=5.23), suggesting that superficial awareness without detailed understanding of technique and rationale is insufficient to motivate behavior change. This finding aligns with constructs from the Health Belief Model, which posits that perceived benefits and self-efficacy (confidence in one's ability to perform the behavior) are essential determinants of health behaviors [27]. The fact that 42.5% of non-practitioners cited not knowing the correct technique as their primary barrier reinforces the need for hands-on skills training rather than passive information dissemination.

Our finding that university education was the strongest predictor of adequate knowledge (AOR=3.82) is consistent with extensive literature demonstrating education as a fundamental determinant of health literacy [28]. However, this association raises equity concerns, as women with lower educational attainment, who may face higher breast cancer risk due to associated socioeconomic factors, are least likely to possess the knowledge necessary for early detection. This suggests that awareness campaigns be specifically designed and delivered through channels accessible to women with limited formal education, using simplified language, visual aids, and community-based approaches. The significant association between awareness campaign attendance and adequate knowledge (AOR=2.45) provides encouraging evidence that structured educational interventions can effectively improve knowledge, even after controlling for education level. However, the low campaign attendance rate (33.1%) and the perception among 44% of participants that community awareness efforts are insufficient highlight the need for expanded, sustained, and strategically targeted awareness initiatives. The predominant reliance on the internet and social media as information sources (55.0%) suggests opportunities for digital health interventions, though this must be balanced with efforts to reach women with limited internet access through traditional channels such as healthcare facilities, community centers, and religious institutions. The strong association between family history of breast cancer and both adequate knowledge (AOR=2.18) and regular BSE practice (AOR=3.15) reflects the powerful influence of personal experience on health behaviors. Women with affected relatives demonstrate heightened risk perception and motivation to engage in preventive behaviors. This suggests that family-based intervention approaches, where women diagnosed with breast cancer are supported to educate their female relatives, could be an effective strategy to extend awareness within high-risk families.

Several findings warrant interpretation within the specific cultural and healthcare context of Libya. The relatively high reliance on internet sources rather than healthcare providers suggests either limited patient-

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provider communication about preventive health or insufficient trust in healthcare system information. This may reflect the broader healthcare system challenges in post-conflict Libya, including shortages of trained personnel, limited consultation time, and focus on acute care at the expense of preventive services [21]. Strengthening primary care providers' capacity and incentives to deliver breast health education during routine encounters represents a crucial intervention opportunity. The reported barriers to BSE practice, particularly fear of finding something abnormal (22.3%), reflect psychological factors that require sensitive, culturally appropriate counseling. In conservative Middle Eastern societies, breast-related health issues may carry stigma, and fear of cancer diagnosis can lead to avoidance behaviors [29]. Educational interventions must address these psychological barriers through messages emphasizing curability when detected early and normalizing breast health discussions.

These findings have several important implications for breast cancer control efforts in Libya. First, awareness campaigns must evolve beyond simply increasing general awareness toward providing detailed, actionable information about modifiable risk factors and specific screening behaviors. Educational content should emphasize that while genetic factors are important, lifestyle modifications can substantially reduce risk, even among women with a family history. Second, BSE education must include hands-on training with demonstration and return demonstration to build self-efficacy, rather than relying solely on informational materials. Third, efforts to improve mammography access are urgently needed, including mobile mammography units, subsidized screening programs, and integration of screening into primary care services.

Healthcare provider training represents another critical intervention point. Our finding that only 38.6% of women cited healthcare providers as information sources suggests missed opportunities for patient education during clinical encounters. Brief, structured breast health counseling protocols integrated into routine gynecological and primary care visits could substantially expand the reach of educational messages. Additionally, establishing referral pathways from primary care to mammography services would facilitate translation of awareness into screening uptake. Policy-level interventions should consider establishing national breast cancer screening guidelines appropriate for the Libyan context, along with dedicated funding for screening programs. Given resource constraints, a phased approach might prioritize high-risk groups (women with family history, women over 40) while simultaneously building infrastructure for eventual population-based screening.

Strengths and Limitations

This study's strengths include its relatively large sample size, systematic sampling approach, use of a pilot-tested questionnaire with demonstrated reliability, comprehensive assessment of multiple knowledge and practice domains, and multivariate analysis controlling for confounders. The inclusion of multiple clinics across different areas of Benghazi enhances the representativeness of the urban female population seeking healthcare. However, several limitations warrant consideration. First, the cross-sectional design precludes causal inference; we cannot determine whether knowledge preceded behavior change or whether engagement in screening behaviors enhanced knowledge. Longitudinal studies would better elucidate temporal relationships. Second, our clinic-based sampling strategy may introduce selection bias, as women attending healthcare facilities likely have higher health-seeking behavior and potentially greater health awareness than the general population. This suggests our findings may actually overestimate community-wide awareness levels, making the identified gaps even more concerning. Third, reliance on self-reported data introduces potential recall bias and social desirability bias, which may have inflated reported screening behaviors. Future studies incorporating objective verification of screening behaviors (e.g., medical record review) would strengthen validity. Fourth, our questionnaire, while pilot-tested and demonstrating acceptable reliability, was not validated against gold-standard breast cancer knowledge measures, as validated Arabic-language instruments specific to the Libyan context are not available. Fifth, our sample was limited to Benghazi and may not be generalizable to rural populations or other Libyan regions with different healthcare access and cultural contexts. Finally, we did not objectively assess the quality of the BSE technique among women who reported practice, so we cannot determine whether self-reported practice translates to effective screening.

Future Research Directions

Several important research questions emerge from this study. Intervention research is needed to evaluate the effectiveness of different educational modalities (e.g., peer education, healthcare provider counseling, digital interventions, mass media campaigns) in improving knowledge and screening behaviors in the Libyan context. Qualitative research exploring cultural beliefs, attitudes, and barriers to screening in greater depth would inform the design of a culturally tailored intervention. Studies examining healthcare provider knowledge, attitudes, and practices regarding breast cancer screening would identify training needs and system-level barriers. Cost-effectiveness analyses of different screening strategies appropriate for resource-limited settings would guide policy decisions. Finally, longitudinal cohort studies tracking women's screening behaviors over time and their association with breast cancer stage at diagnosis would provide crucial outcome data to justify investment in early detection programs.

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Conclusion

Women in Benghazi demonstrate moderate general awareness of breast cancer but possess inadequate knowledge of modifiable risk factors and appropriate screening practices. The substantial discordance between awareness and regular screening behavior highlights that information alone is insufficient to drive behavior change. University education, participation in awareness campaigns, and family history of breast cancer independently predict adequate knowledge, while adequate knowledge and family history predict regular breast self-examination practice. These findings underscore the urgent need for comprehensive, multi-level interventions that go beyond raising general awareness to providing practical skills training, addressing psychological barriers, improving healthcare provider capacity for patient education, and expanding access to clinical screening services, particularly mammography. Targeted efforts reaching women with lower educational attainment are essential to address health equity. Strengthening breast cancer early detection programs through evidence-based, culturally tailored strategies represents a critical priority for reducing breast cancer mortality in Libya.

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Conflict of interest. Nil

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