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Breast cancer screening in Lebanon: Understanding knowledge, attitudes and barriers

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ABSTRACT

Background: Breast cancer (BC) has been increasing in both prevalence and incidence in Lebanon. Knowing the positive impact mammographic screening has on reducing mortality rates, we sought to investigate the knowledge, attitudes and barriers towards BC screening amongst Lebanese women across all districts.
Methods: We conducted a cross-sectional study with 400 Lebanese women aged 35–75, with no prior or current diagnosis of BC, employing an online questionnaire filled face-to-face with participants to gather sociodemographic data and assess BC history and screening practices. We utilized the Breast Cancer Screening Beliefs Questionnaire (BCSBQ) and Champion Health Belief Model Scale (CHBMS) to evaluate knowledge, attitudes, and barriers.
Results: Findings revealed inadequate attitudes towards general health check-ups (77.5 %) and insufficient BC screening knowledge (56.4 %). Furthermore, 38.5 % encountered obstacles to mammography screening. Education significantly affected BC knowledge. Interestingly, increased knowledge of BC reduced barriers to mammographic screening. Participants with healthcare connections or background exhibited better attitudes towards health check-ups and encountered fewer screening obstacles.
Conclusion: This is the first study that endeavors to comprehensively investigate Lebanese women's knowledge, attitudes, and barriers concerning BC screening, encompassing all demographics and regions using validated scales (BCSBQ and CHBMS). Our data highlight the crucial role of education in advocating for early BC screening and the necessity to reevaluate national campaigns, particularly in communication methods, to ensure equitable access to screening across Lebanon.

1. Introduction

Breast cancer (BC) is a pervasive health challenge, affecting women worldwide and stands as one of the most prevalent forms of cancer.[1] In 2020, the age-standardized BC incidence was approximately 48 cases per 100,000 individuals, with over two million reported cases globally and more than 600,000 deaths.[2,3]

In developed countries like Australia and New Zealand, BC incidence remains high at 95.5 cases per 100,000 women,[2] despite advanced healthcare systems, indicating the impact of financial and cultural

disparities on disease prevalence. Lebanon mirrors this trend, with BC as the most common cancer among women, constituting 36.2 % of all female cancer cases, with 9.1 % occurring in women under 40 [4]. In 2016, Lebanon's BC incidence was nearly double the global average at 96.8 cases per 100,000 women across all age groups,[4] emphasizing the urgency of addressing BC as a public health concern. Disparities in BC incidence highlight the need for tailored interventions considering diverse population contexts.

Early detection is effective for BC treatment and management. BC screening employs various technologies to detect the disease early, often

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before symptoms manifest, facilitating timely intervention, improved treatment outcomes and increased chances of survival. Screening methods include breast self-examination, clinical breast examination and mammography, with only mammography linked to decreased mortality.[5] In Western countries, the implementation of mammographic BC screening led to a significant decline in BC mortality due to early diagnosis, treatment and reduced healthcare costs.[1] Despite potential drawbacks such as radiation, false positive/negative results and over diagnosis, the benefits of early diagnosis outweigh these concerns.[1]

In Lebanon, financial obstacles represent a significant barrier to BC screening, primarily due to the expense associated with mammograms.[5] Furthermore, research indicates that Lebanese women from higher socio-economic backgrounds are more inclined to undergo BC screening.[1] Additionally, a cultural barrier emerged, with 81.7 % of participants expressing apprehension about discovering a disease during mammogram procedures.[5]

Since 2002, the Lebanese Ministry of Public Health has orchestrated annual BC awareness campaigns spanning a three-month period commencing in October. These offer free mammography screening to women aged 40 and above at public centers or at reduced rates at selected private centers.[6,7] Because of these campaigns, lifetime mammography utilization (proportion of women who have ever used mammography for BC screening), surged from 28.9 % in 2005 to 43 % in 2013. Regular yearly utilization increased from 18 % to 21 % over the same period.[6] Notably, there has been an increase in early-stage BC diagnoses and a decrease in late-stage diagnoses,[7] underscoring the importance of BC screening in enhancing survival rates and reducing mortality.

Knowledge, attitudes and barriers to BC screening, encountered by Lebanese women, have been previously evaluated using the Champion Health Belief Model Scale (CHBMS).[5,8] However, studies primarily focused on Lebanese women of Armenian descent[8] or those residing in Beirut.[5] Our study endeavors to comprehensively investigate these aspects encompassing all demographics and regions for the first time. To achieve this objective, we used the Breast Cancer Screening Beliefs Questionnaire (BCSBQ), validated for Arabic-speaking women,[9] along with selected barriers from the CHBMS questionnaire. This combined approach ensures a thorough examination of all potential obstacles faced by Lebanese women in BC screening. Establishing these findings as baseline values will provide a solid framework for future research to monitor the evolution of knowledge, attitudes, and barriers related to BC among Lebanese women. Additionally, our study delves into novel aspects such as the influence of having a healthcare professional in the family or being employed in the healthcare sector on BC screening, thus providing valuable insights previously unexplored in Lebanon.

2. Material and methods

2.1. Study design

A cross-sectional sample of 400 adult women, aged 35–75, without prior or current BC diagnosis, was recruited from the Lebanese population between January and June 2023 via a 10–15 min Google Forms survey filled through face-to-face interaction with participants. Initially selected from each Lebanese district, participants were asked to share the questionnaire with their contacts through WhatsApp until achieving a representative sample size, ensuring generalizability and external validity. All data was obtained upon consent and was kept anonymous.

2.2. Questionnaire

The online self-administered questionnaire consisted of 37 questions that were either closed-ended or 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The first 10 questions targeted the respondents' sociodemographic characteristics, including age, residency area, education level, marital status, occupation, perceived economic status, living space and the presence of a healthcare professional in the family. The following five questions inquired about BC family history, access to BC screening facilities, awareness of reduced mammography prices and history of BC screening through national screening campaigns. The next 4 questions assessed the participants' attitudes towards general health check-ups using the validated BCSBQ.[10] The next set of questions assessed the participants' knowledge about BC screening (4-item subscale from the validated BCSBQ[10]) and the multifactorial barriers to BC screening in Lebanon (4-item subscale adapted from the validated BCSBQ[10] and 10 questions adapted from the validated CHBMS scale).[11] The last BCSBQ subscale on barriers to mammographic screening was used, except one question inquiring about the English language being a barrier to mammography, which was omitted because it does not apply to the Lebanese population. Both scales used a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The average response to the items of each subscale in the BCSBQ questionnaire was subsequently calculated, participants answering "strongly disagree" on all questions get a score of 4 for each subscale and those answering "strongly agree" get a score of 20. The score was then transformed to fall within the range of 0–100. Women who responded with a score of 5 to all items within a given subscale would obtain a final score of 100, while those who answered with a score of 1 for all items in that subscale would achieve a score of 0. Women with a score of less than 35 are regarded as having satisfactory knowledge about BC, satisfactory attitude towards general health check-ups and less barriers towards BC screening.[12] A similar score was calculated for the barriers adapted from the CHBMS questionnaire.

Prior to starting the questionnaire, an introduction outlined the study's purpose, consent criteria (voluntary participation, confidentiality, anonymity), and provided contact details for the principal investigator and Institutional Review Board (IRB) for inquiries or withdrawal.

The English questionnaire was translated to Arabic and back-translated for consistency and validity by a certified bilingual translator.[13] Both English and Arabic versions were presented in the same form. Pilot testing on 15 women assessed clarity, readability, cultural relevance, and completion time estimation. This data was not included in the final analysis but used to edit the questionnaire before online administration. The study was approved by the IRB committee.

2.3. Statistical analysis

Collected data were analyzed using SPSS 28.0. Descriptive analysis employed frequency and percentage for categorical variables, mean and standard deviation (SD) for quantitative variables. For dependent variables, the median and interquartile region were presented.

Bivariate analysis used Chi-square test for dichotomous or multinomial variables, with dependent variables dichotomized. Significance was set at p-value <0.05.

Logistic regression with ENTER method was used for multivariable analysis on dichotomous dependent variables, with model adequacy checked via Hosmer Lemeshow test. Independent variables introduced in the models included baseline clinical variables and sociodemographic factors, with consideration for sample size limitations.

3. Results

3.1. Demographic characteristics

A total of 400 women consented to participate in this study with an average age of 49.59 ± 8.71 years. The general characteristics and history of BC screening practices of the study population are presented in Table 1. Most of the participants were from Mount Lebanon (37.5 %), held bachelor's degrees (45.3 %), and were married (81.5 %). Three-quarters of participants considered their economic status sufficient for basic needs and savings. Around 18.2 % worked in the healthcare sector and 38.2 % reported having a healthcare professional within their

Table 1

Characteristics of the surveyed participants (n = 400).

Age (years): Mean ± Standard Deviation	49.59 ± 8.71
Variable	Frequency (N) Percent (%)
Sociodemographic Characteristics	
Area of Residency	
Akkar and North	62 (15.5)
Baalbek-Hermel and Bekaa	54 (13.5)
Beirut	44 (11.0)
Mount-Lebanon	150 (37.5)
South	90 (22.5)
Education	
School Education	160 (40.0)
University – Bachelor's Degree	181 (45.3)
University – Higher Studies	59 (14.7)
Marital Status	
Single	54 (13.5)
Married	326 (81.5)
Other	20 (5.0)
Perceived Economic Status	
Enough for basic needs	281 (70.3)
Enough for basic needs and savings	44 (11.0)
Not enough for basic needs	75 (18.7)
Occupation	
Healthcare sector	73 (18.2)
Non-healthcare sector	195 (48.8)
Retired	26 (6.5)
Unemployed	106 (26.5)
Healthcare Professional in the Family	
Yes	153 (38.2)
No	247 (61.8)
BC History and Screening Practices	
Family History of BC in First Degree Relative	
Yes	93 (23.3)
No	307 (76.7)
Access to Nearby BC Screening Facilities	
Yes	342 (85.5)
No	58 (14.5)
Awareness of Reduced Mammography Prices through National BC Screening Campaigns	
Yes	191 (47.8)
No	209 (52.2)
Underwent BC Screening through a National Campaign	
Yes	83 (20.8)
No	317 (79.2)

family. One fifth of the respondents were retired or unemployed. Around 23.3 % had a first-degree relative with a history of BC. The majority (85.5 %) reported having access to BC screening facilities such as hospitals and radiology centers. When asked about BC screening campaigns, respondents reported never been screened for BC (79.3 %) and not being aware of the reduced prices of mammograms (52.2 %) through national BC screening campaigns.

3.2. Attitudes towards general health check-ups

Attitudes of the participants towards general health check-ups was ascertained by a 4-item subscale from the BCSBQ[10] (Table S1). The mean score (SD) of attitudes was 12.11 (5.37) [scale: 4–20], with 77.5 % of participants having inadequate attitude *vs* 22.5 % with satisfactory attitude (Table 2).

Table 3 presents the proportion of respondents with inadequate and satisfactory attitudes, along with the significant unadjusted explanatory variables, after cross-tabulating all four questions.

Bivariate analysis revealed that attitudes towards general health check-ups depended on the education level ($P = 0.015$), occupation ($P = 0.029$), and the presence of a healthcare professional in family ($P < 0.001$) (Table 3). After adjustment, participants employed in the healthcare sector and with a healthcare professional in their family exhibited better attitudes compared to unemployed participants (odds ratio (OR) and confidence interval (CI) of 2.48 [1.06–5.83]; $P = 0.03$) and to those without a healthcare professional in their family (OR and CI of 2.44 [1.46–4.08]; $P < 0.001$), respectively (Table 4).

3.3. Knowledge and perceptions about BC

Knowledge of the respondents about BC screening was assessed by a 4-item subscale from the BCSBQ[10] (Table S1). The mean score (SD) of knowledge was 9.04 (4.52) [scale: 4–20], with 56.8 % of the participants exhibiting inadequate knowledge about BC while 43.3 % had satisfactory knowledge (Table 2).

Table 3 presents the proportion of respondents with inadequate and satisfactory knowledge, along with the significant unadjusted explanatory variables, after cross-tabulating all four questions. Bivariate analysis highlighted the influence of age ($P = 0.035$), education ($P < 0.001$), marital status ($P = 0.021$), occupation ($P = 0.004$), and the presence of a healthcare professional in family ($P = 0.004$) (Table 3). After adjustment, only individuals with university education (OR = 2.41 [1.44–4.05]; $P < 0.001$) and higher degrees (OR = 4.91 [2.40–10.06]; $P < 0.001$), significantly possessed more satisfactory knowledge compared to those with only a school education (Table 4).

3.4. Barriers to mammographic screening

Multifactorial barriers to BC screening in Lebanon were ascertained by a 4-item subscale adapted from the validated BCSBQ[10] (Table S1) and 10 questions from the validated CHBMS[11] (Table S2). The mean score (SD) for barriers to mammographic screening was 7.52 (4.17) [scale: 4–20], with 64.8 % of the respondents reporting a low number of barriers (Table 2).

Participants reported various barriers to BC screening, including: cost (31 %), forgetfulness (25.8 %), fear of bad news (22.3 %), prioritizing other problems (18.7 %), concerns about mammogram consequences on breasts and transportation problems (17.8 %), lack of support from relatives (17.3 %), pain from mammogram (16.1 %), radiation exposure (15 %), age eligibility (14.6 %), lack of procedure understanding (12.5 %), embarrassment (12.3 %), time constraints (11.3 %) (Tables S1 and S2).

Table 3 presents the proportion of respondents with more and less barriers, along with the significant unadjusted explanatory variables, after cross-tabulating all 14 questions. Bivariate analysis identified significant associations with education level ($P < 0.001$), marital status ($P = 0.009$), occupation ($P = 0.004$), and the presence of a healthcare professional in family ($P = 0.006$) (Table 3). After adjustment, healthcare workers encountered less barriers to mammographic screening than unemployed individuals (OR = 2.31 [0.97–5.47]; $P = 0.057$).

Table 2

Attitudes, knowledge, and barriers mean scores.

	Min; Max Median[IQR]	Mean Score (SD)	Adjusted Mean Score (SD)	Inadequate N (%)	Satisfactory N (%)
Attitudes towards General Health Check-ups	4; 20 12[8,16]	12.11 (5.37)	60.55 (26.85)	310 (77.5)	90 (22.5)
Knowledge and Perceptions about Breast Cancer	4; 20 8[5,12]	9.04 (4.52)	45.2 (22.6)	227 (56.8)	173 (43.3)
Barriers to Mammographic Screening	4; 20 6[4,10]	7.52 (4.17)	37.6 (20.85)	154 (38.5)	246 (61.5)

Table 3

Bivariate analysis for attitudes towards general health check-ups, knowledge about breast cancer, and barriers to mammographic screening.

		Attitudes towards General Health Check-ups			Knowledge and Perceptions about Breast Cancer			Barriers to Mammographic Screening		
		Inadequate N (%)	Satisfactory N (%)	P-value	Inadequate N (%)	Satisfactory N (%)	P-value	More N (%)	Less N (%)	P-value
Age	≤ 43	92 (79.3)	24 (20.7)	0.701	60 (51.7)	56 (48.3)	0.035	47 (40.5)	6 (59.5)	0.166
	44–49	68 (73.9)	24 (26.1)		53 (57.6)	39 (42.4)		28 (30.4)	64 (69.6)	
	50–55	77 (80.2)	19 (19.8)		48 (50)	48 (50)		35 (36.5)	61 (63.5)	
	≥56	73 (76)	23 (24)		66 (68.8)	30 (31.3)		44 (45.8)	52 (54.2)	
Education	School Education	135 (84.4)	25 (15.6)	0.015	116 (72.5)	44 (27.5)	<0.001	85 (53.1)	75 (46.9)	<0.001
	University Education	135 (74.6)	46 (25.4)		92 (50.8)	89 (49.2)		52 (28.7)	129 (71.3)	
	Higher Studies	40 (67.8)	19 (32.2)		19 (32.2)	40 (67.8)		17 (28.8)	42 (71.2)	
Marital Status	Single	42 (77.8)	12 (22.2)	0.972	33(61.1)	21 (38.9)	0.021	26 (48.1)	29 (51.9)	0.009
	Married	252 (77.3)	74 (22.7)		177 (54.3)	149 (47.7)		115 (35.3)	211 (64.7)	
	Other	16 (80)	4 (20)		17 (85)	3 (15)		13 (65)	7 (35)	
Perceived Economic Status	Not Enough for Basic Needs	59 (78.7)	16 (21.3)	0.149	50 (66.7)	35 (33.3)	0.068	35 (46.7)	40 (53.3)	0.159
	Just Enough for Basic Needs	222 (79)	59 (21)		157 (55.9)	124 (44.1)		106 (37.7)	75 (62.3)	
	Enough for Basic Needs and Savings	29 (65.9)	15 (34.1)		20 (45.5)	24 (54.5)		13 (29.5)	31 (70.5)	
SES Quartiles	≤0.6	99 (79.2)	26 (20.8)	0.647	76 (60.8)	49 (39.2)	0.295	53 (42.4)	72 (57.7)	0.728
	0.61–0.8	75 (75)	25 (25)		49 (49)	51 (51)		38 (38)	62 (62)	
	0.81–1	78 (75)	26 (25)		59 (56.7)	45 (43.3)		38 (36.5)	66 (63.5)	
	≥1.01	58 (81.7)	13 (18.3)		43 (60.6)	28 (39.4)		25 (35.2)	46 (64.8)	
Occupation	Healthcare Sector	49 (67.1)	24 (32.9)	0.029	30 (41.1)	43 (58.9)	0.004	17 (23.3)	54 (76.7)	0.004
	Non-healthcare Sector	151 (77.4)	44 (22.6)		109 (55.9)	86 (44.1)		74 (37.9)	121 (62.1)	
	Retired	19 (73.1)	7 (26.9)		19 (73.1)	7 (26.9)		10 (38.5)	16 (61.5)	
	Unemployed	91 (85.8)	15 (14.2)		69 (65.1)	37 (34.9)		53 (50)	53 (50)	
Healthcare Professional in the Family	Yes	103 (67.3)	50 (32.7)	<0.001	73 (47.7)	80 (52.3)	0.004	46 (30.1)	107 (69.9)	0.006
	No	207 (83.8)	40 (16.2)		154 (62.3)	93 (37.7)		108 (43.7)	139 (56.3)	
Family History of BC in First Degree Relative	Yes	71 (76.3)	22 (23.7)	0.761	48 (51.6)	45 (48.4)	0.254	40 (43)	53 (57)	0.308
	No	239 (77.9)	68 (22.1)		179 (58.3)	128 (41.7)		114 (37.1)	193 (62.9)	

Additionally, individuals with a healthcare professional in their family experienced less barriers than those without (OR = 2.41 [1.42–4.08]; P = 0.001). Notably, individuals with a better knowledge score about BC had less barriers compared to those with lower knowledge scores (OR = 3.23 [1.88–5.58; P < 0.001) (Table 4).

4. Discussion

The study explored BC knowledge, attitudes and barriers among Lebanese women aged 35–75 with no prior BC diagnosis. The prevalence of surveyed participants with satisfactory knowledge and attitude levels was relatively low whereas the percentage of respondents reporting a high number of obstacles to BC screening was modest. Participants with family healthcare or healthcare providers themselves showed better attitudes towards general health checkups and reported fewer barriers to BC screening. Education level significantly influenced BC knowledge, with higher education correlating with greater BC knowledge fewer barriers towards BC screening.

In our study sample, nearly a quarter of female participants reported a first-degree family history of BC in a close relative. This figure is higher than previously recorded rates (9.7 %) amongst females living in the capital city of Beirut,[5] as well as in various other countries including Jordan (13.7 %) and China (3.8 %).[14,15] This suggests a potential rise in BC prevalence in Lebanon, emphasizing the growing threat it poses to public health and underscoring the necessity for updated census data.

Over half of participants lacked BC knowledge, although higher education correlated positively with an improvement in knowledge, which is in alignment with prior research.[5,15–19] Lower educational attainment usually correlates with decreased health literacy, implying a diminished capacity to fully grasp health education materials and instructions.[20] Contrary to prior research, our data showed no significant correlation between education and attitudes towards general health check-ups or barriers to screening.[5,15,21,22] Despite this, a significant proportion of Arab women in the Middle East was reported to display insufficient BC knowledge and attitude.[23] Over three quarters of our participants displayed an inadequate attitude towards general health check-ups, with more than a half believing that they do not need to consult with a physician if healthy (Table S1). Interestingly, participants in healthcare or with healthcare professionals in the family exhibited better attitudes toward health check-ups and fewer screening barriers, echoing findings

Table 4

Multivariate analysis for attitudes towards general health check-ups, knowledge about breast cancer, and barriers to mammographic screening.

		Satisfactory Attitudes towards General Health Check-ups				Satisfactory Knowledge and Perceptions about Breast Cancer				Less Barriers to Mammographic Screening			
		OR	95 % CI		P-value	OR	95 % CI		P-value	OR	95 % CI		P-value
Age	≤ 43[a]												
	44–49	1.441	0.727	2.856	0.295	0.823	0.457	1.483	0.517	1.569	0.775	3.173	0.211
	50–55	1.013	0.495	2.072	0.972	1.378	0.758	2.506	0.294	0.969	0.467	2.010	0.932
	≥56	1.937	0.864	4.340	0.108	0.851	0.424	1.707	0.649	2.058	0.893	4.744	0.090
Education	School Education[a]												
	University Education	1.568	0.858	2.866	0.144	**2.419**	**1.441**	**4.059**	**<0.001**	1.270	0.681	2.371	0.453
	Higher Studies	1.748	0.806	3.793	0.157	**4.916**	**2.401**	**10.065**	**<0.001**	1.216	0.545	2.715	0.633
Marital Status	Married[a]												
	Single	1.086	0.502	2.350	0.834	0.924	0.471	1.816	0.819	1.137	0.513	2.517	0.752
	Other	1.104	0.315	3.877	0.877	0.361	0.093	1.409	0.143	1.429	0.391	5.228	0.590
Perceived Economic Status	Not Enough for Basic Needs[a]												
	Just Enough for Basic Needs	0.905	0.462	1.770	0.769	1.228	0.684	2.205	0.491	0.850	0.424	1.704	0.647
	Enough for Basic Needs and Savings[a]	1.433	0.570	3.599	0.444	1.582	0.673	3.718	0.293	1.350	0.527	3.461	0.532
Occupation	Unemployed[a]												
	Healthcare Sector	**2.489**	**1.062**	**5.836**	**0.036**	1.425	0.685	2.966	0.344	**2.312**	**0.977**	**5.473**	**0.057**
	Non-healthcare Sector	1.717	0.833	3.541	0.143	0.964	0.538	1.728	0.903	1.767	0.846	3.689	0.130
	Retired	1.993	0.650	6.111	0.227	0.674	0.229	1.985	0.474	2.249	0.697	7.254	0.175
Healthcare Professional in the Family	No[a]												
	Yes	**2.447**	**1.467**	**4.083**	**<0.001**	1.357	0.867	2.123	0.181	**2.413**	**1.426**	**4.085**	**0.001**
Family History of BC in First Degree Relative	No[a]												
	Yes	1.174	0.654	2.105	0.591	1.430	0.860	2.377	0.169	1.077	0.589	1.968	0.810
Adequate Knowledge Score	Yes *vs.* No									**3.239**	**1.880**	**5.581**	**<0.001**

[a] Refers to the reference group. Significant values are highlighted in bold.

from Jordan and Qatar.[24,25] This highlights the influential role that healthcare professionals play in shaping the attitudes of their family members.

Mammographic screening cost emerged as the top barrier, reported by 31 % of the participants, consistent with previous findings.[5] Perceived socioeconomic status and SES quartiles did not significantly affect barriers to BC screening, differing from studies linking lower socioeconomic status to increased screening barriers.[26,27]

Fear of BC diagnosis ranked third among barriers, consistent with other Arab studies,[14,21,28] indicating cultural influences on BC screening practices.

Despite annual BC awareness campaigns since 2002, nearly 80 % of participants have not undergone BC screening through these initiatives, and half were unaware of reduced mammograms prices, indicating advertising issues in the campaigns. Research showed that BC awareness interventions notably improve screening attendance.[29,30] Therefore, future national campaigns should be extensively promoted to reach Lebanese women nationwide. Furthermore, our findings reveal that even when screening costs are covered, insufficient knowledge remains a key factor in screening decisions. Individuals with better knowledge encounter fewer barriers to screening, irrespective of financial status.

This study is the first comprehensive assessment of BC knowledge, attitudes, and barriers in Lebanon, covering all districts and targeting women aged 35–75, without prior or current BC diagnosis. Our study sample was diverse, encompassing a broad range of socio-demographic variables, including socioeconomic status and education levels, thereby enhancing its generalizability. The sample diversity accurately mirrored the demographics of Lebanon, ensuring that our findings are applicable across the Lebanese population and supporting external validity. While our study correlated the BCSBQ scale with various socio-demographic factors, it did not explore the impact of these factors on BC screening practices such as breast self-examination and clinical breast examination. Moreover, using a snowball method for recruitment and WhatsApp distribution,[13] may limit the representation of the Lebanese population. Thus, an overrepresentation of younger women with higher education and higher access to WhatsApp is expected, leading to an overestimation of knowledge, positive attitudes and correct practices. However, this bias is not expected to change the associations that were found in this study. Moreover, an information bias due to subjective interpretation of questions, the possibility of low sensitivity and specificity of the used tool, and the social desirability that is known to culturally exist in Lebanon are acknowledged; nevertheless, the non-differential nature of this phenomenon is only expected to drive the results towards the null, leading to lower *p*-values. Despite multivariate analysis, residual confounding bias may persist due to unaccounted variables, which could influence the observed associations. Further studies that take into account these potential biases are recommended to confirm the current findings.

In conclusion, our research highlights the importance of widespread public education on BC screening, as demonstrated by the protective impact of BC knowledge compared to screening barriers. There is a critical need for nationwide campaigns with an extended reach to remote areas and to target younger audiences below the age of 40, given the increasing incidence of BC in this age group.

Ethics approval and consent to participate

The study was approved by the Lebanese American University IRB committee under the code number *LAUMCRH. TR1.19/Dec/2022*. All methods were carried out in accordance with relevant guidelines and regulations. All participants provided informed consent.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed for this study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

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No funding was received for conducting this study.

Authors' contributions

TE-R conceived, designed and supervised the research project, was involved in data curation & interpretation and reviewing the manuscript. EI, EA, MAK were involved in the data acquisition, curation & interpretation, and participated in drafting the original manuscript. PS performed the statistical analysis, contributed to data curation & interpretation, and reviewing the manuscript. AA-G contributed to the conception, design and supervision of the research project, was involved in data curation & interpretation, writing, reviewing & editing the manuscript. All authors read and approved the final manuscript.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used ChatGPT 3.5 to improve readability and language. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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