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Knowledge and beliefs on breast cancer screening and uptake among Yemeni female school teachers in Malaysia

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Limited breast cancer screening uptake among women may lead to late-stage diagnosis and reduce the survival rate. Hence, this study was conducted to determine breast cancer screening (BCS) uptake and its association with knowledge, beliefs, and socio-demographic factors among female Yemeni school teachers in Malaysia. A cross-sectional study was conducted as part of a large cluster-randomized controlled trial (CRT) among 180 Yemeni female teachers aged 20 years and above. The sample was selected using cluster sampling from 12 Arabic schools in the Klang Valley area, Malaysia. Data was collected using a validated Arabic questionnaire. Data analysis was performed using the SPSS 22.0 software. Both descriptive and logistic regression analyses were employed. The logit model with a p-value less than 0.05 was conducted to determine the predictors of BCS uptake. The screening uptake by the study participants was 23.3% ($n=42$), 21.1% ($n=38$), and 5.6% ($n=10$) for breast self-examination (BSE), clinical breast examination (CBE) and mammogram (MMG), respectively. Additionally, the total mean knowledge score was 18.02 (SD = 5.82). Regarding the participants' beliefs, the mean benefits and mean barriers of BSE were 23.29 (SD = 3.77), and 12.97 (SD = 3.80), respectively. In addition, mean confidence in doing BSE and mean health motivation were 31.85 (SD = 7.17) and 27.95 (SD = 4.22), respectively. Besides, the mean benefits of MMG were 21.26 (SD = 4.07), and the mean barriers to MMG were 14.81 (SD = 2.14). The logit model showed that higher knowledge among study participants increased the probability of performing BSE, CBE, and MMG with (OR = 1.09, 95% CI 1.01–1.17, $p=0.021$), (OR = 1.08, 95% CI 1.00–1.16, $p=0.036$), and (OR = 1.47, 95% CI: 1.14–1.91, $p=0.003$), respectively. In addition, the higher confidence level increased the probability of performing BSE (OR = 1.090, 95% CI 1.017–1.168, $p=0.014$). However, more barriers to CBE were associated with a decrease in the probability of performing CBE (OR = 0.892, 95% CI 0.802–0.992, $p=0.034$). Moreover, as the participants got older, the MMG uptake increased (OR = 1.418, 95% CI 1.116–1.801, $p=0.004$). Breast cancer screening uptake and knowledge, as well as beliefs concerning BCS are low among Yemeni school teachers in Malaysia. Conducting educational interventions on BCS is needed to improve awareness and encourage early detection of BC among women.

Keywords Breast cancer screening uptake, Yemeni teachers, Knowledge, Beliefs, Practice

In 2020, about two million women were diagnosed with Breast Cancer (BC), and 685,000 of them died due to the disease[1]. Although efforts have been made to increase BC early detection, almost one-third of the patients worldwide have distant or regional metastasis at the time of diagnosis[2]. Among Yemeni women, BC is the most common cancer (30.0%)[3], which represents 18.5% of new cancer cases and it is responsible for the highest rate of mortality (12.1%)[4]. Moreover, most women are often diagnosed at a relatively younger age (40–49 years old)

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compared to women in Western countries (63–69 years old)[5], and the majority of them are diagnosed at an advanced stage[6].

Breast cancer screening (BCS) could increase the likelihood of early detection, increase survival rate, and lead to successful treatment of BC. There are several BCS approaches including Clinical Breast Exam (CBE), Breast Self-Examination (BSE), as well as Mammography (MMG)[1]. Various factors may influence BCS behaviours and preventive health behaviours, for example, demographic attributes, for instance, age, ethnicity, and socioeconomic[7]. low knowledge level, cultural beliefs, and negative perceptions of BC and BCS are found to be barriers to BCS[8–10].

Several models and theories have explained the significance of BC and BCS. Among the most commonly used models in promoting BCS is the Health Belief Model (HBM) which has been employed in several educational intervention studies and has been described as effective in predicting factors affecting BCS behaviours[8,10–19]. In the HBM model, individuals are prone to be involved in health behaviours when they value health, expect a positive outcome from a certain activity, and perceive the disease as a threat[7]. The HBM framework involves six constructs: perceived benefits, perceived severity, perceived barriers, perceived susceptibility, self-efficacy, and cues to action[20,21].

Due to the lack of security and the recent instability in Yemen, lots of Yemenis have chosen to relocate to Malaysia for job opportunities and/or educational purposes or to reside as immigrants. Consequently, in Malaysia, there are currently roughly 27,000 Yemenis. Amongst these are Yemeni women who might not have good knowledge as well as appropriate health beliefs on BCS. Yemeni women in Malaysia might experience several issues in acquiring BCS services and the information accessible to Malaysian women[22,23]. Apart from that, accessing these facilities is often laden with difficulties due to numerous barriers such as language, travel, culture, cost of the examination, and health care limitations. This results in a low level of BCS performance among this group[22].

Although many studies have identified specific factors contributing to delays in BC diagnosis among women worldwide[24–35]. For instance, while there has been little research on BCS uptake among female teachers in Malaysia, none has been done with Yemeni teachers. They might be crucial in promoting healthy behaviour and offering health education to be adopted by upcoming generations. Moreover, these teachers will disseminate the knowledge they have acquired in this field when they return home. Hence, deploying BCS research among these women could effectively shed light on BCS-associated factors in culturally diversified populations.

Research on BCS among teachers worldwide is insufficient, and there are none among Yemeni teachers located in Malaysia. Thus, the purpose of this study was to ascertain the knowledge, beliefs, as well as practices of BCS among Yemeni female teachers in Malaysia. Besides, it was also carried out to assess the relationship between socio-demographic characteristics, knowledge, and beliefs with the level of practice of BCS. To achieve these objectives, the study utilized the HBM as the theoretical framework. The HBM was chosen due to its well-established utility in exploring beliefs that influence health behaviors, especially preventive practices like cancer screening. Its focus on perceived susceptibility, severity, benefits, and barriers provided a relevant structure for understanding the unique cultural and logistical factors affecting BCS uptake among Yemeni female teachers in Malaysia.

Materials and methods

Study design and setting

This manuscript presents the baseline findings of a randomized controlled trial (RCT) conducted among Yemeni female teachers at 12 Arabic schools located in Klang Valley, Malaysia. Klang Valley is a region centered around Kuala Lumpur and includes Selangor state with its cities and towns. The baseline, cross-sectional data were collected prior to any intervention to assess the participants' knowledge, beliefs, and practices regarding BCS. There are 19 well-known Arabic schools in the Klang Valley area, with teachers from various Arab countries. However, the teaching bodies are predominantly Yemeni, as six of these schools are specifically Yemeni schools. This composition supported the selection of Yemeni teachers as a relevant study sample for understanding BCS practices within this community in Malaysia.

Sample size estimation

The total sample size for this study was originally calculated for a larger RCT, which aims to evaluate the impact of an educational intervention on BCS knowledge, beliefs, and practices among Yemeni female teachers. The calculation used the formula for the difference between two population proportions[36], with P1 = 0.71 and P2 = 0.43[14].

$$n = \frac{\left\{ z_{1-\alpha/2}\sqrt{2\overline{P}(1-\overline{P})} + z_{1-\beta}\sqrt{P_1(1-P_1)+P_2(1-P_2)} \right\}^2}{(P_1-P_2)^2}$$

The power calculations suggest that a minimum sample size of 47 is required.

$$\mathrm{n} = \{1.96\sqrt{1.14 * 0.43} + 0.84\sqrt{0.21} + 0.25\}^2/(0.71 - 0.43)^2 = 47$$

Then, since the current study is a cross-control study from a cluster-randomized controlled trial[22], it was adjusted for two arms. Later, it was adjusted for the expected proportion of eligibility (10%) and non-response rate (20%). Next, it is inflated by the design effect (1.4), with the intra cluster correlation coefficient (ICC) of 0.02. As a result, a total number of 183 female teachers aged ≥ 20 years who met the inclusion and exclusion criteria during the

study time were included. For the present analysis, we used the baseline data from these participants to perform a cross-sectional examination of BCS knowledge, beliefs, and practices.

Adjustment for sample size calculation

Criteria	Sample size
Adjust for two arms	47 × 2 = 94
Adjust for attrition rate	94/0.80 = 118
Adjust for expected proportion eligible	118/0.90 = 131
Adjusted for design effect	131 × 1.4 = 183

A cluster sampling approach was used for school selection, with the schools serving as the clusters. There were 19 Arabic schools in the Klang Valley, out of which 12 schools meeting the inclusion criteria were selected for the study. After selection, each of the 12 schools was assigned a unique serial number. To ensure the balance in group allocation, block randomization was performed to assign the selected schools to either the intervention or control group. All teachers within the selected schools who consented to participate were included in the study. The cluster effect, representing the potential correlation of responses among teachers within the same school, was accounted for in the sample size calculation using the ICC.

Recruitment of participants

After written consent to participate in the study was obtained from the responsible authorities, small meeting groups were arranged in each school. Subsequently, during the meeting, the objectives and benefits, and the inclusion and exclusion criteria of the study, were clarified to the participants. Subsequently, women were told that participating in the study was completely voluntary, and they could withdraw or refuse to participate at any time. We included Yemeni female school teachers who are teaching at the selected schools located in Klang Valley, those are aged 20 years old and above, and teachers who sign a consent form to participate in the study. We excluded teachers who retired during the study time, those who have been diagnosed with BC, and teachers who are pregnant or lactating.

Study instrument

Knowledge of breast cancer screening

Knowledge of BCS was assessed via a modified questionnaire involving items adapted from previous studies[8,31,37]. The self-administered questionnaire used in the current study involves 35 items comprising BC risk factors (14 items), symptoms of BC (6 items), BCS methods (10 items), and breast health awareness (5 items). The nominal scale of "Correct," "Wrong," and "I do not know" was utilised to evaluate the responses. For each "correct" answer, one point was awarded, and zero was given for every "wrong" or "I do not know" answer. The highest knowledge score is 35, and the minimum is 0. Finally, scores were summed, with higher scores implying better knowledge.

Health belief model scales

The Champion Health Belief Model Scale (CHBMS) for BCS was used to measure health beliefs regarding BC and its screening tests[20,21]. The 53 items on the scale are rated on a 5-point Likert scale, with one point denoting strongly disagree, two points for disagree, three points for neutral, four points for agree, and five points for strongly agree. The CHBMS also has eight subscales: seriousness (7 items), susceptibility (5 items), barriers of BSE (6 items), benefits of BSE (6 items), confidence (11 items), benefits of MMG (6 items), health motivation (11 items), as well as barriers of MMG (5 items). Moreover, permission was obtained from Parsa et al.[31] to use the validated sections of CBE with two subscales in relation to the benefits and barriers of CBE (10 items). Thus, the final version of the CHBMS instrument included ten subscales with 63 questions. The scores were then summated for analysis, with higher scores reflecting strong beliefs[20]. Furthermore, except for barriers, which had a negative correlation with screening behaviour, all scales had a positive relationship with it.

Breast cancer screening uptake

This section evaluates BSE practices and frequency using self-reported responses. Participants were asked two questions: (a) "Have you ever performed BSE?" (Response options: yes/no) and (b) "How often do you perform BSE?" (Response options: once a month, once every 2–3 months, other, never). Those who reported performing BSE at least once a month were categorized as practicing regular BSE, while participants who performed BSE less frequently or not at all were classified as practicing irregular BSE. Similarly, CBE and MMG uptake were assessed through self-reported responses and categorized as either "practicing" or "not practicing."

In addition, there were six questions on the participant's characteristics (age, income, education level, family history of BC, marital status, as well as past hearing or reading on BCS).

Psychometric properties for the study instrument

The translation of the questionnaire employed a forward-backward translation method. Afterward, a panel of seven experts, including three medical doctors, a psychology professor, a consultant radiologist, and two nurses, reviewed the materials for validity. Their feedback ensured that the content was clear and comprehensible. Revisions were made based on their recommendations to improve clarity and relevance. Following these adjustments, the tools were considered culturally appropriate, achieving a content validity index (CVI) of 0.95%.

A pre-test was then conducted with 30 Yemeni female teachers not participating in the main study to identify any difficult or inappropriate language. Based on their feedback, certain terms were revised, leading to the final versions of the questionnaire.

The internal consistency of each factor was assessed using Cronbach's alpha, with a value of $\alpha \geq 0.70$ considered acceptable. The reliability of the knowledge questionnaire was confirmed with alpha coefficients ranging from 0.81 to 0.95. Exploratory factor analysis (EFA) of the translated items revealed four factors, accounting for 55.89% of the variance. The factor loadings ranged from 0.51 to 0.89, indicating satisfactory reliability. For the CHBMS, alpha coefficients ranged from 0.76 to 0.87. EFA identified six factors for BSE, five for CBE, and five for MMG, with total variances explained at 47.69%, 51.19%, and 52.63%, respectively. Factor loadings ranged from 0.47 to 0.88, demonstrating satisfactory associations among the items. A more comprehensive discussion of the study's validity is available elsewhere[23].

Statistical analysis

The Statistical Package for Social Sciences (SPSS) 22.0 software was utilised to analyse the data. Continuous variables were checked for normality before the analysis. The alpha level of significance was set at a value of less than 0.05. Consequently, data were described using descriptive analyses, with the mean and standard deviation for continuous variables, as well as the frequency and percentages for categorical variables.

A simple logistic regression analysis was run to screen for variables potentially associated with BCS practice. This step aimed to identify candidate variables for further analysis, using a p-value threshold of ≤ 0.25 to ensure inclusion of relevant predictors. Variables meeting this criterion were then included in the multivariable logistic regression model, which was used to identify independent predictors of BCS uptake. Results from the final model were presented as adjusted odds ratios (AORs) along with their corresponding 95% confidence intervals (CIs) to highlight the strength and precision of associations. To ensure the robustness of the model, we assessed its goodness of fit using the Hosmer–Lemeshow test, where a p-value < 0.05 indicates a poor fit. Additionally, we tested for multicollinearity using variance inflation factors (VIF) to confirm that the independent variables were not highly correlated.

Ethics approval and consent to participate in this study

Ethical approval was obtained from the Ethical Review Committee of Universiti Putra Malaysia (Ref No. FPSK(EXP16) P151). This research was conducted in accordance with the Declaration of Helsinki principles. Informed consent was obtained from all study participants.

Results

Characteristics of the participants

A total of 180 female teachers were recruited into the research with a 98.4% response rate. The participants' mean age was 33.47 years (SD = 5.93) (range 23–50 years). Most of them were married (76.6%), and around two-thirds had a bachelor's degree (67.8%) with a mean income of RM 1843.33 (SD = 416.17). Overall, 33 respondents reported having a family history of BC. In addition, most of them have read/heard about BCS (73.3%) (Table 1).

Variables	Mean (SD[a])	Frequency "*n*"	Percentage "%"
Age (years) (min–max)	33.47 (5.93) (23–50)		
Income (RM) (min–max)	1843.33 (416.17) (1000–3000)		
Marital status			
Married		138	76.6
Divorced/separated		5	2.8
Widowed		1	0.6
Single		36	20.0
Education level			
Diploma		39	21.6
Bachelor		122	67.8
Master		14	7.8
PhD		5	2.8
Family history of BC			
Yes		33	18.3
No		147	81.7
Read/heard about BCS			
Yes		132	73.3
No		48	26.7

Table 1. Characteristics of study participants ($n = 180$). SD[a], standard deviation; RM, Malaysian Ringgit (1RM = 0.21USD), BC, Breast cancer; BCS, Breast cancer screening.

BCS uptake, knowledge, and beliefs on BC and BCS among study participants

The screening uptake by the study participants was 23.3% ($n=42$), 21.1% ($n=38$), and 5.6% ($n=10$) for BSE, CBE and MMG, respectively. Additionally, the total mean knowledge score was 18.02 (SD = 5.82). Regarding the participants' beliefs, the mean benefits and mean barriers of BSE were 23.29 (SD = 3.77), and 12.97 (SD = 3.80), respectively. Furthermore, the mean susceptibility of BC was 19.70 (SD = 3.26), and the mean seriousness of BC was 25.72 (SD = 4.56). In addition, mean confidence in doing BSE and mean health motivation were 31.85 (SD = 7.17) and 27.95 (SD = 4.22), respectively. Besides, the mean benefits of MMG were 21.26 (SD = 4.07), and the mean barriers to MMG were 14.81(SD = 2.14) (Table 2).

Predictors of BSE

As displayed in Table 3, in the simple logistic regression, six variables were statistically significant with BSE performance at the significance level of ≤ 0.25 namely family history, knowledge, benefit of BSE, barriers of BSE, confidence, and motivation. In the adjusted logit model, only two variables still significant which are knowledge and confidence of BSE, where higher knowledge found to be associated with higher probability of performing BSE (AOR = 1.092, 95% CI 1.013–1.177, $p=0.021$), and the higher confidence of BSE associated with increase the probability of performing of BSE among study participants (AOR = 1.090, 95% CI 1.017–1.168, $p=0.014$).

Predictors of CBE

Table 4 shows that seven variables were statistically significant with CBE performance in simple logistic regression at the significance level of ≤ 0.25. The multiple logistic models reveals that total knowledge was an independent predictor of CBE performance with higher knowledge associated with more likelihood of performing of CBE among the study participants (AOR = 1.081, 95% CI 1.005–1.163, $p=0.036$), and more barriers of CBE associated with less likelihood of performing CBE (AOR = 0.892, 95% CI 0.802–0.992, $p=0.034$) (Table 4).

Predictors of MMG

Table 5 indicates that six variables were statistically significant with MMG performance at the significance level of ≤ 0.25. However, in the adjusted logistic model, only two factors were found to be associated with MMG performance which are age and knowledge. The model shows that increasing age is associated with increasing the likelihood of performing MMG (AOR = 1.418, 95% CI 1.116–1.801, $p=0.004$). In addition, higher knowledge is associated with higher probability of performing MMG among study respondents (AOR = 1.478, 95% CI 1.144–1.910, $p=0.003$).

Discussion

As far as the researchers are aware, this is the first study on BCS uptake, knowledge, as well as beliefs among Yemeni women, carried out in Malaysia. Pertaining to the present study, most of the Yemeni female teachers had a low level of BCS uptake, where 23.3% had performed BSE, 21.1% had performed CBE, and 5.6% had

Variables	Mean (SD[a])	Frequency (*n*)	Percentage (%)
Performing BSE			
Yes		42	23.3
No		138	76.7
Ever having CBE			
Yes		38	21.1
No		142	78.9
Ever having MMG			
Yes		10	5.6
No		170	94.4
Total knowledge	18.02 (5.82)		
CHBMS subscale			
Susceptibility of BC	19.70 (3.26)		
Seriousness of BC	25.72 (4.56)		
Benefits of BSE	23.29 (3.77)		
Barriers of BSE	12.97 (3.80)		
Confidence of BSE	31.85 (7.17)		
Health motivation	27.95 (4.22)		
Benefits of CBE	15.96 (2.77)		
Barriers to CBE	17.96 (3.89)		
Benefits of MMG	21.26 (4.07)		
Barriers to MMG	14.81 (2.14)		

Table 2. BCS uptake, knowledge and beliefs on BC and BCS among study participants ($n=180$). SD[a], standard deviation; BC, Breast cancer; BCS, Breast cancer screening; BSE, breast self-examination; CBE, clinical breast examination; MMG, mammogram.

Variables	COR (95% CI)	*P*-value	AOR (95% CI)	*P*-value
Age	1.024 (0.966–1.085)	0.419		
Income	1.000 (0.999–1.001)	0.892		
Marital status				
Married	0.816 (0.368–1.809)	0.617		
Single	1.00 (ref)			
Education				
Undergraduate and diploma	0.624 (0.221–1.758)	0.372		
Postgraduate	1.00 (ref)			
Family history				
Yes	2.645 (1.179–5.932)	0.018*	1.954 (0.777–4.912)	0.154
No	1.00 (ref)			
Read/heard on BCS				
Yes	1.032 (0.471–2.262)	0.936		
No	1.00 (ref)			
Knowledge	1.148 (1.071–1.231)	< 0.001*	1.092 (1.013–1.177)	0.021*
CHBMS subscale				
Susceptibility	0.997 (0.897–1.109)	0.956		
Seriousness	1.046 (0.968–1.131)	0.252		
Benefit of BSE	1.099 (0.997–1.211)	0.058*	1.018 (0.913–1.135)	0.751
Barriers of BSE	0.877 (0.792–0.970)	0.011*	0.957 (0.852–1.076)	0.463
Confidence	1.139 (1.070–1.212)	< 0.001*	1.090 (1.017–1.168)	0.014*
Motivation	1.074 (0.983–1.173)	0.112*	1.002 (0.908–1.106)	0.966

Table 3. The predictors of BSE performance. *Significant for multiple logistic regression model ($p < 0.05$), ** Significant for simple logistic regression model ($p \leq 0.25$). COR, Crude odds ratio; AOR, adjusted odds ratio, Assumptions of logistic regression have been met and the Hosmer–Lemeshow goodness-of-fit test indicated good fit ($X^2 = 5.9$, $p = 0.650$); Negelkerke $R^2 = 0.239$, variance inflation factors (VIF) are less than five for all variables included in this model.

performed MMG. Comparable results were nearly reported among Yemeni women in Yemen, where, according to Bawazir et al.[3], CBE and BSE were practised by 21.9% and 30.3% of the women, accordingly. Meanwhile, MMG was carried out by only 1.6% of them. Other studies conducted in Yemen also found the percentage of female practicing BSE varies from 11 to 17.4%[38,39]. Numerous earlier studies performed in different countries[9,13,40–43], which focused on school teachers, stated that they had insufficient BCS uptake.

Unlike the results of the present research, study that was carried out by Marzo and Salam[44] among school teachers revealed that 73% of the respondents performed BSE. However, only 17% and 24% of them performed the test at the recommended interval and time. The reasons behind such low screening uptake among Yemeni women in Malaysia could be attributed to the low health beliefs and inadequate knowledge about BC, which are the main challenges that stand to BCS in this population[39]. On top of that, Yemeni women in Malaysia are foreign nationals who may encounter numerous barriers that could limit their access to BCS services. Moreover, previous studies in Malaysia and Iran have attributed the low level of practice among women to the lack of educational intervention concerning knowledge and health beliefs[8,10]. In addition to the effect of inequitable health services regarding access, resources, and provision[45].

The findings from our study reveal a notably low uptake of BCS services among Yemeni teachers residing in Malaysia. This lower participation can be partially explained by the structural and financial barriers specific to foreign residents in Malaysia, as identified in prior studies[46]. Malaysia's national BCS program promotes regular screenings through MMG and CBE, with established guidelines that target women aged 40 and above. Despite the availability of these services, overall screening uptake remains low, even among Malaysian women, largely influenced by factors such as socio-economic status, education, and ethnicity[47].

Barriers for foreign residents in accessing screening services

Foreign residents, including Yemeni teachers, encounter additional challenges. Although some foreign workers have mandatory insurance, the coverage is often inadequate for preventive services such as BCS. Furthermore, higher fees for non-citizens and limited access to government-subsidized healthcare create significant financial barriers, potentially discouraging preventive healthcare-seeking behavior[48]. The referral pathways available to Malaysian citizens are reorganised for early diagnosis and treatment; however, for foreign residents, navigating these pathways can be challenging due to additional administrative requirements and, in some cases, language and cultural barriers. Such obstacles may contribute to delays or hesitancy in utilizing screening services, especially if individuals are unfamiliar with the local healthcare system[49].

Variables	COR (95% CI)	*P*-value	AOR (95% CI)	*P*-value
Age	1.056 (0.994–1.122)	0.076	1.023 (0.956–1.094)	0.513
Income	1.001 (1.000–1.002)	0.058	1.001(1.000–1.002)	0.092
Marital status				
Married	0.976 (0.420–2.267)	0.954		
Single	1.00 (ref)			
Education				
Undergraduate and diploma	0.537 (0.190–1.524)	0.243		
Postgraduate	1.00 (ref)			
Family history				
Yes	2.222 (0.964–5.125)	0.061	1.779 (0.715–4.427)	0.216
No	1.00 (ref)			
Read/heard on BCS				
Yes	5.412 (1.581–18.534)	0.007*	3.523 (0.962–12.895)	0.057
No	1.00 (ref)			
Knowledge	1.114 (1.041–1.192)	0.002*	1.081 (1.005–1.163)	0.036*
CHBMS subscale				
Susceptibility	1.051 (0.939–1.175)	0.386		
Seriousness	1.026 (0.948–1.111)	0.524		
Benefit of CBE	1.105 (0.964–1.266)	0.151	1.021 (0.875–1.193)	0.788
Barriers of CBE	0.879 (0.797–0.970)	0.010*	0.892 (0.802–0.992)	0.034*
Motivation	1.007 (0.925–1.097)	0.866		

Table 4. The predictors of CBE performance. *Significant for multiple logistic regression model ($p < 0.05$), ** Significant for simple logistic regression model ($p \leq 0.25$). COR, Crude odds ratio; AOR, adjusted odds ratio; Assumptions of logistic regression have been met and the Hosmer–Lemeshow goodness-of-fit test indicated good fit ($X^2 = 9.3$, $p = 0.316$); Negelkerke $R^2 = 0.652$, variance inflation factors (VIF) are less than five for all variables included in this model.

Variables	COR (95% CI)	*P*-value	AOR (95% CI)	*P*-value
Age	1.309 (1.137–1.507)	< 0.001**	1.418 (1.116–1.801)	0.004*
Income	1.002 (1.000–1.003)	0.031**	1.001(0.999–1.003)	0.280
Marital status				
Married	1.231 (0.251–6.032)	0.798		
Single	1.00 (ref)			
Education				
Undergraduate and diploma	0.242 (0.057–1.031)	0.055**	0.397 (0.041–3.821)	0.424
Postgraduate	1.00 (ref)			
Family history				
Yes	2.000 (0.489–8.182)	0.335		
No	1.00 (ref)			
Knowledge	1.375 (1.167–1.620)	< 0.001**	1.478 (1.144–1.910)	0.003*
CHBMS subscale				
Susceptibility	1.135 (0.921–1.399)	0.233		
Seriousness	1.076 (0.929–1.246)	0.327		
Benefit of MMG	1.133 (0.979–1.311)	0.093**	0.892 (0.663–1.201)	0.453
Barriers of MMG	0.639 (0.460–0.887)	0.008**	0.524 (0.263–1.043)	0.066
Motivation	1.063 (0.904–1.250)	0.459		

Table 5. The predictors of MMG performance. *Significant for multiple logistic regression model ($p < 0.05$), ** Significant for simple logistic regression model ($p \leq 0.25$). COR, Crude odds ratio; AOR, adjusted odds ratio; Assumptions of logistic regression have been met and the Hosmer–Lemeshow goodness-of-fit test indicated good fit ($X^2 = 12.0$, $p = 0.150$); Negelkerke $R^2 = 0.223$, variance inflation factors (VIF) are less than five for all variables included in this model.

Impact of cultural and educational gaps

Further, differences in health beliefs and knowledge regarding cancer risks may also impact screening uptake. Research on Malaysia's multi-ethnic population has shown varied screening rates that are often influenced by specific health beliefs and awareness campaigns tailored to local communities. Foreign residents, lacking similar targeted awareness efforts, may experience lower perceived susceptibility to BC, which could further impact their motivation to seek regular screenings[50].

Most of the study participants knew very little about BC and BCS. The current study's findings are in line with the poor knowledge level among Yemeni women in Yemen, as reported by Al-Sakkaf & Basaleem[39], who stated that two-thirds of the participants had poor knowledge levels. Comparable results were also reported by Ahmed[38] and Alwabr[51], who indicated the low level of knowledge among female university students and female workers in Yemen. Another study in Jordan revealed limited knowledge of the participants on BC and BCS practices[52]. Other than that, a randomised controlled trial conducted by Heydari & Noroozi[13] among female elementary school teachers in Iran indicated that of the total study sample, only 14.2% of teachers were knowledgeable about BC. These studies' findings support the current investigation, whereby the knowledge of the female Yemeni teachers appears insufficient for them to practice BCS. Contrasting the results of this particular investigation, prior research in Turkey revealed that most women had good knowledge of BC early detection[53]. The explanation for such contradictory findings could be due to differences in the work environment setting, where the participants of the study conducted by Açıkgöz et al.[53] were working in a university hospital. Thus, a higher awareness rate was anticipated for BC early detection due to the ability to get information from health care staff.

The current study shows that most female Yemeni school teachers had low health beliefs regarding BC and BCS. Likewise, Taresh et al.[54] found that female Yemeni school teachers had poor health beliefs. Several previous studies in different countries have also examined the level of beliefs among women[8,11,13,55–57]. The findings of these studies reported a low level of health beliefs of BC among women. Apart from that, Akhtari-Zavare et al.[8] reported a low level in all health belief subscales among Malaysian female university students before implementing the intervention. Subsequently, the results of the current investigation are in line with those of Kocaöz et al. and Yılmaz et al.[56,57] in the pre-post designs, who stated that perceived benefits, perceived susceptibility, perceived seriousness, self-efficacy, perceived barriers, as well as health motivation were low prior to the intervention. Furthermore, a study done in the Philippines by Marzo & Salam[44], which focused on school teachers, implied that teachers perceived belief regarding confidence in performing BSE was only 33%, although 65% were motivated. The majority of the teachers had wrong beliefs about BC susceptibility and seriousness. Therefore, the present study's results are aligned with those reported by the above-mentioned studies.

Various findings determined BCS performance by women's knowledge of BCS[58–61]. Likewise, in the current study, respondents with higher knowledge of BCS uptake were likelier to practice BSE. Moreover, the current investigation revealed that women who felt more comfortable performing BSE were almost ten times more likely to do so than their counterparts. A study that was conducted among Ethiopian female school teachers revealed an analogous result[61]. An explanation of the current study's significant increase in BSE performance may be due to the better motivation among respondents with higher confidence to perform BSE. Such results also resemble previous studies[61–63] that found high perceived confidence significantly predicted BSE practice.

According to the results of the present investigation, people with fewer barriers were more prone than their counterparts to engage in CBE. This particular result agrees with previous studies[59,63,64], which revealed that fewer barriers significantly predict CBE performance. In our study, older women practiced MMG more often than younger women. Meanwhile, younger women claimed they did not have to perform the test. In accordance with the present study, previous studies[58,59] exposed that age is a significant predictor of MMG screening.

The findings of this study highlight a low uptake of BCS among Yemeni female teachers in Malaysia, which has significant implications for public health efforts targeting this population. In the short term, the results suggest an urgent need for targeted educational interventions to raise awareness and encourage BCS participation among Yemeni teachers. Addressing barriers such as cultural beliefs, lack of awareness, and misconceptions about BCS could be key to improving screening rates. In the long term, the study underscores the importance of integrating culturally tailored health education programs into workplace settings, especially in schools, to sustain and increase BCS uptake. These findings may also inform policymakers about the need to design specific outreach strategies for immigrant populations, which could help reduce screening disparities and improve early detection of BC within these communities.

Strengths of the study

The present study has several advantages. Firstly, it is the first of its kind in Malaysia to assess Yemeni women's uptake, knowledge, as well as beliefs regarding BCS. The study's high response rate preserved the population distribution and assured the study results validity. Furthermore, applying the validated CHBMS to determine women's beliefs is another strength of this research.

Limitations of the study

A few restrictions on this study must be highlighted. First, the participants in this study are only limited to one group (school teachers). Furthermore, the results of the investigation may not apply to all Yemeni women in Malaysia because the study was limited to the Klang Valley region, and the sample size was small. Thus, it is recommended that future research be conducted and the findings replicated on other groups of women despite their workplaces, cultures, nationalities, regions, and religions, utilising larger sample sizes to acquire outcomes that could be generalised. An additional limitation that could produce a biased outcome is self-reporting responses to questionnaires. Even though prejudice would always exist, the investigators made an effort to lessen it during the data collection phase by being more impartial, using accurate terms, as well as guaranteeing

the respondents' confidentiality and anonymity. Cultural differences and language are the main limitations to sufficient BCS pertaining to this investigation. Finally, future studies could use other health behavioural models or theories to understand cultural and psychosocial factors affecting BCS behaviours among women.

Conclusions

This study exposed that the level of BCS knowledge, practices, as well as beliefs is low among Yemeni female school teachers in Malaysia. Such findings highlight the importance of culturally tailored health education interventions to enhance BCS knowledge and behavior among this group. Based on the findings, several practical recommendations are proposed to further improve BCS uptake and health education among foreign teachers in Malaysia. First, health education programs should be culturally sensitive and adapted to the diverse backgrounds of foreign teachers, particularly Yemeni teachers. By doing so, health education interventions will be more effective in conveying the importance of BC prevention and early detection. In addition, facilitating access to healthcare services is crucial. Given the language barriers and potential logistical challenges, schools should collaborate with local healthcare providers to offer accessible and affordable BCS services. To overcome communication challenges, providing bilingual support, including translators, during screenings will help foreign teachers feel more comfortable and confident in seeking care.

Moreover, raising awareness about available healthcare resources is essential. Schools should distribute information in Arabic about local clinics, hospitals, and healthcare hotlines to ensure foreign teachers know where they can seek BCS and other health services. This will help teachers feel more informed and empowered to utilize the healthcare system. Schools can organize mandatory workshops and training sessions focused on BC prevention and self-examination. Such initiatives would ensure that foreign teachers receive essential information on how to detect early signs of BC and encourage them to take proactive measures for their health. Furthermore, policy advocacy is necessary to ensure that foreign teachers have equitable access to healthcare services. Schools and educational authorities can work to ensure that foreign teachers are included in national health programs and have access to medical benefits through their work permits.

Finally, tailored communication strategies are crucial for ensuring that foreign teachers are informed and engaged in health-related matters. Providing healthcare materials in Arabic, such as pamphlets, posters, and newsletters, will ensure that teachers receive accurate and relevant information in a language they understand. This approach will help bridge communication gaps and ensure that important health messages are effectively conveyed. In conclusion, integrating these recommendations into health education and policy frameworks can significantly improve the health outcomes and wellbeing of foreign teachers in Malaysia, particularly in relation to BCS practices.

Data availability

the corresponding authors can provide the datasets utilised and/or analysed in the current study upon reasonable request.

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Author contributions
Conceptualization, S.N.; methodology, S.N., H.A.R., and S.I.; formal analysis, N.M.E.E.; investigation, S.N., M.A., M.A.A. and K.M.K.; writing—original draft preparation, S.N. and N.M.E.E.; writing—review and editing, S.N. and M.A. All authors have read and agreed to the published version of the manuscript.

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Declarations

Competing interests
The authors declare no competing interests.

Institutional review board statement
The procedures were followed along with all applicable standards and regulations. The Universiti Putra Malaysia Ethics Committee granted ethical approval (Ref No. FPSK(EXP16) P151).

Informed consent
Informed consent was obtained from all participants.

Additional information
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