Review

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Tools for the assessment of breast cancer screening beliefs in women: a literature review

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Aim: This review aims to compare the development, characteristics and validity of three widely used breast cancer screening belief tools (the Champion's Health Belief Model Scale [CHBMS], the Breast Module of a Cancer Awareness Measures [BCAM] and the Breast Cancer Screening Beliefs Questionnaire [BCSBQ]). **Materials & methods:** Literature reports were retrieved from electronic databases, including PubMed, EMBASE, Web of Science and the Cochrane Library, and other references. All three tools had good reliability and validity. Certain significant differences between these tools should be noted. **Results:** CHBMS, BCAM and BCSBQ are valid and reliable instruments within certain populations. Due to the high heterogeneity among the targeted population, their characteristics and those of the instruments should be fully considered for clinical decision-making. **Conclusion:** The conclusion of this review contributes to the development of a more comprehensive and objective instruments based on the deficiencies of the existing studies.

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Keywords: BCAM • BCSBQ • breast cancer • CHBMS • literature review • screening belief

Breast cancer is one of the major causes of death in women and seriously endangers their health. A total of 345,000 new cases of breast cancer are estimated to occur every year in Europe, and 130,000 women die of this disease [1]. Breast cancer is also the most common cancer among women in the USA and Canada, and is the second leading cause of death among women in Canada [2,3]. Recently, the incidence of breast cancer in China has accounted for 12.1% of new breast cancer cases worldwide, showing an upward trend [4], and breast cancer deaths in China account for 9.6% of global breast cancer deaths each year [5]. In addition to cancer-related death, the physical, psychological and functional problems caused by breast cancer, such as changes in body image, can seriously affect the physical function and psychosocial well-being of patients [6]. Overall, the high incidence and mortality of breast cancer as well as the damage to individual physical and mental health have aroused people's attention to this disease.

Previous studies have shown that breast cancer screening is a crucial measure that has a recognized effect on improving the prognosis and reducing breast cancer mortality [7–9]. Belief in the effectiveness of screening is acknowledged as a major contributor to screening behavior [10]. The formation of screening belief is the individual's approach to meet her physiological and safety needs. Therefore, accurate assessment of women's breast cancer screening beliefs is critical for prediction of their screening behavior. This enables the public health system to develop specific interventions for people with low screening beliefs to increase screening rates and achieve the ultimate goal of reducing breast cancer mortality.

Currently, three breast cancer screening belief tools are available: the Champion's Health Belief Model Scale (CHBMS), the Breast Module of a Cancer Awareness Measures (BCAM) and the Breast Cancer Screening Beliefs Questionnaire (BCSBQ). These tools are reliable evaluation methods with good reliability and validity. However, due to the lack of standardized evaluation criteria for breast cancer screening beliefs, sometimes using existing evaluation methods to help healthcare providers accurately assess breast cancer screening beliefs in all targeted population can be difficult. Therefore, this study compared and analyzed the differences among these three widely used instruments. Our findings may help health providers choose a better evaluation tool to evaluate and make

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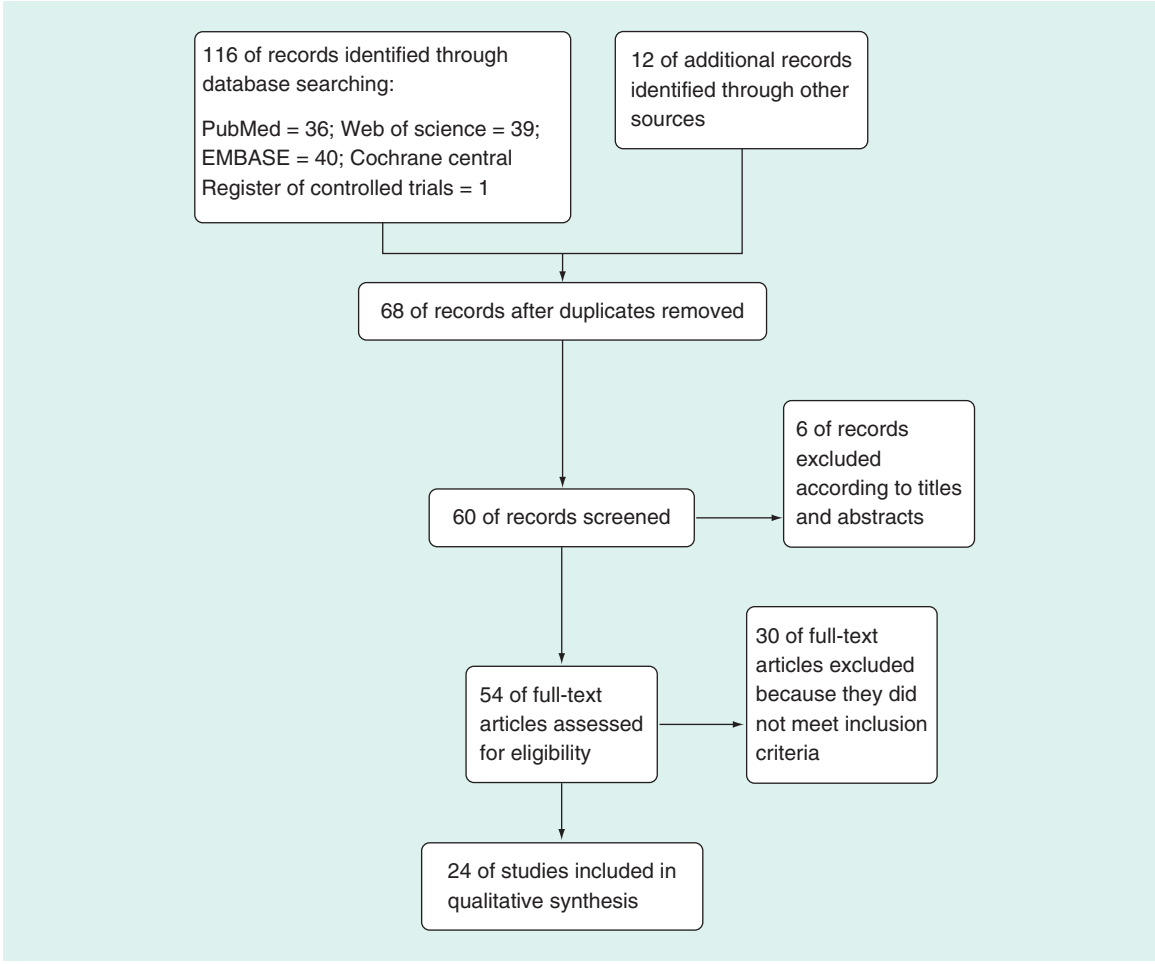

Figure 1. The flow diagram of studies screening.

clinical decisions based on the strength of the tools and the characteristics of the target population. Our study serves as a basis for developing more general and objective instruments in the future.

Materials & methods

Literature searches were conducted using PubMed, EMBASE, Web of Science and the Cochrane Library for studies published from inception until August 2018. The following search terms were used: 'breast neoplasms,' 'breast cancer,' 'breast tumour,' 'questionnaire,' 'survey,' 'instrument,' 'assessment' and 'evaluate' combined with 'CHBMS,' 'BCAM' and 'BCSBQ.' The included studies discussed at least one of the following aspects: development, characteristics, validity and reliability. All studies were reviewed independently by two reviewers for potential inclusion, and any inconsistencies were resolved by discussion with a third reviewer. No language restrictions were used. The reference lists of the relevant articles were reviewed and screened for any additional studies. Information, including the instruments' development, characteristics, validity and reliability, was retrieved from each included paper.

Results

The initial search identified a total of 128 articles. After excluding 68 duplicate studies and 36 articles that did not meet the inclusion criteria, 24 studies were included in this review (Figure 1) that specifically included the CHBMS (n = 14), BCAM (n = 3) and BCSBQ (n = 7).

Table 1. Comparison of the characteristics of different versions of the Champion's Health Belief Model Scale.

Assessment tools	Subscales	No. of items
CHBMS-1984	Perceived susceptibility	6
	Perceived seriousness	12
	Perceived benefits	5
	Perceived barriers	8
	Health motivation	8
	In total	*39*
CHBMS-1993	Perceived susceptibility	5
	Perceived seriousness	7
	Perceived benefits	6
	Perceived barriers	6
	Health motivation	7
	Perceived confidence	11
	In total	*42*
CHBMS-1995	Mammography benefits	6
	Mammography barriers	5
	In total	*11*
CHBMS-1997	Perceived susceptibility	5
	Perceived benefits	8
	Perceived barriers	24
	Self-efficacy	10
	In total	*47*
CHBMS-1999	Perceived susceptibility	3
	Perceived benefits	5
	Perceived barriers	11
	In total	*19*

Development

CHBMS

CHBMS, which was the first tool in the literature to measure women's breast cancer screening beliefs, was developed by Champion [11] based on the Health Belief Model (HBM). The CHBMS-1984 contained five domains. The item pool was generated from previous concept measurement studies, with 20–24 items in each domain. To test the content validity of the CHBMS, the list of items was made available to eight professional teachers and doctoral students who studied the HBM. Items accepted by more than six of the experts were included in the CHBMS-1984, resulting in 10–12 items in each domain. Through convenience sampling, 301 women, who were mostly white and Protestant, were eventually selected. As a result, 39 items were included in the CHBMS-1984.

After exploring the assessment contents of the CHBMS, the developers repeatedly revised it to better measure women's breast screening beliefs and formulated several versions [12–15]. Each version had different characteristics, such as different breast cancer screening methods, with different CHBMS versions including breast self-examination (BSE), mammography or both of these methods (Table 1).

BCAM

The Cancer Awareness Measure (CAM) was established to assess cancer screening awareness, but this instrument did not specifically target a specific type of cancer [16]. Using the CAM, Cancer Research UK, King's College London and University College London developed the Breast Module (BCAM) to evaluate women's breast cancer screening beliefs. The BCAM consists of the following seven domains: knowledge of symptoms; confidence, skills and behavior in relation to detecting a breast change; anticipated delay in contacting the doctor; barriers to seeking medical help; knowledge of age-related and lifetime risk; knowledge of the National Health Service (NHS) Breast Screening Program; and knowledge of risk factors. The reliability and validity of the scale were demonstrated by Linsell *et al.* [17]. The item pool was generated from a review of existing breast cancer screening awareness assessment studies and gray literature as well as previous research experience with breast cancer patients. Phrases or daily terms

that did not apply to British women were revised, and items not used in previous questionnaires were added. After agreeing on the items listed, the initial version of BCAM was allocated to an expert panel comprising academic researchers, representatives of cancer charities, oncologists and experts in the design of evaluation questionnaires. Additionally, the researchers conducted cognitive interviews with 20 older women they knew and improved the wording of BCAM items.

This study conducted a BCAM pilot study on 82 women aged between 67 and 70 years who participated in the NHS Breast Screening Program and validated their applicability with different item formats. The scale was modified depending on the results of the pilot survey, and the revised version of BCAM was used for the national survey. The readability, acceptability and retest reliability of the scale were assessed by analyzing data from 712 women aged from 67 to 73 years. The finalized version of BCAM included three items with a total of 18 questions.

BCSBQ

CBCSBQ, which was the initial version of BCSBQ, was developed by Kwok *et al.* [18] and was used to assess the beliefs, knowledge and attitudes of Chinese–Australian women toward breast cancer and screening practices. The CBCSBQ development process was divided into two phases: item generation, evaluation of content validity and cultural appropriateness, and translation; and evaluation of psychometric properties. The original items were generated through a comprehensive review of existing tools and in-depth interviews with the target population, and the original questionnaire contained 32 items. Then, a panel of four health experts (including a psychology professor, nursing professor, director of the screening program and research scholar) and four lay-people representing different social backgrounds assessed the content and face validity of the initial questionnaire and reviewed the phrasing, response formats, relevance and fitness of items. Eight experts also provided feedback on how well the items captured information about the measured variables. The content equivalence of the CBCSBQ was assessed by a literature review, and a consensus was finally reached. In addition to general items, the questionnaire contained special items for breast cancer, such as 'I don't want to have a mammogram because I would need to take off my clothes and expose my breasts.' Then, the questionnaire was translated using the back-translation technique to verify semantic equivalence.

In the second stage, participants were recruited from churches, social and community service centers and other Chinese community organizations. Through convenience sampling, 292 Chinese–Australian women aged 18 years and above were eventually included. The results of the multitrait-scaling analysis resulted in deletion of three items with a correlation coefficient of less than 0.3. Then, a factor analysis was conducted on the remaining 29 items, and 11 items with a factor load less than 0.4 were deleted. The factor analysis was conducted a second time for the remaining 18 items, among which five items failed to meet the standard of factor loading higher than 0.4 and were eliminated. Therefore, the final questionnaire contained 13 items.

Characteristics

The comparison of the CHBMS, BCAM and BCSBQ is shown in Table 2. All of these instruments were intended to measure women's beliefs concerning breast cancer screening, but some differences existed between them.

CHBMS

The goal of the CHBMS-1984 was to measure breast cancer beliefs of American women. It included five subscales ('perceived susceptibility', 'perceived seriousness', 'perceived benefits', 'perceived barriers' and 'health motivation') with a total of 39 items. All items were based on Likert's 5-point scale, with a range from one = 'strongly disagreed' to five = 'strongly agreed'; the higher the score of each subscale, the higher the intensity of the measurement in that domain. Notably, the CHBMS-1984 rated the perceived benefits and barriers of BSE, which was consistent with the CHBMS-1993 and different from the other versions of the CHBMS.

Compared with use of the other versions, the CHBMS-1993 and CHBMS-1999 were widely utilized. The CHBMS-1993 included 'perceived susceptibility' (perception of personal risk of breast cancer), 'perceived seriousness' (perception of the level of personal breast cancer-related threats), 'perceived benefits' (perception of the benefits of BSE for the individual), 'perceived barriers' (perception of negative components of BSE for the individual), 'health motivation' (health-related beliefs and behaviors) and 'perceived confidence' (perception of the procedural ability to perform a BSE with the perception of competence to detect abnormal lumps). Different from the CHBMS-1984, this scale added the 'perceived confidence' dimension and contained 42 items in six subscales. All items were rated on a 5-Likert scale; the higher the score, the greater the intensity of the content. The

Table 2. Comparison of the characteristics of Champion's Health Belief Model Scale, the Breast Module of a Cancer Awareness Measures and the Breast Cancer Screening Beliefs Questionnaire.

Characteristics	CHBMS (1984)	BCAM (2010)	BCSBQ (CBCSBQ, 2010)
Purpose	Develop an effective scale and test the HBM to evaluate women's breast cancer screening beliefs	Validate BCAM and assess women's breast cancer awareness	Measure women's beliefs, knowledge and attitudes toward breast cancer and breast screening behaviors
Response options	5-point Likert scale	Multiple choice	5-point Likert scale
Number of items	39	18	32
Items format	Statement	Question	Statement
Item organization	Items grouped into subscales	Items grouped into subscales	Items grouped into subscales
Subscales	Perceived susceptibility; Perceived seriousness; Perceived benefits; Perceived barriers; Motivation	Knowledge of breast cancer symptom; Knowledge of age-related risk; Reported frequency of breast checking	Attitudes toward health checkups; knowledge and perceptions about breast cancer; Concerned perceived barriers to mammography screening
Subscale components	Multi-item subscale	Multi-item subscale	Multi-item subscale
Scoring	Range from 1 to 5 per item	Range from 0 to 1 per item	Range from 1 to 5 per item
Available versions	Arabic, Korean, Turkish, Lithuanian, Malaysian, Iranian, Spanish	British, Arabic, Kenyan	Hong Kong–Chinese, Arabic, African–Australian, Indian–Australian, Mainland–Chinese, Korean

BCAM: Breast Module of a Cancer Awareness Measures; BCSBQ; Breast Cancer Screening Beliefs Questionnaire; CBCSBQ: The Chinese version of Breast Cancer Screening Beliefs Questionnaire; CHBMS: Champion's Health Belief Model Scale; HBM: Health belief model.

CHBMS-1999 included only three subscales regarding the perceived susceptibility, benefits and barriers related to mammography. The researchers removed items with redundant or low factor loading from the original version, adjusted and added the susceptibility and barrier subscale content, and finalized 19 items (Table 1).

BCAM

The BCAM was intended to measure British women's breast cancer-related attitudes and behaviors and included three items ('knowledge of breast cancer symptoms', 'age-related risk' and 'reported frequency of breast checking') with 18 questions. The BCAM scoring principle was as follows: the knowledge of breast cancer symptoms item included nine options, if participants chose five or more nonlump symptom options, the women were considered to have knowledge about breast cancer. The correct answer to the 'age-related risk' item was that 70-year-old women were most likely to develop breast cancer in the following year than younger people. For the last item, a self-reported breast examination at least once a week or month was an appropriate response. The correct answer to an item received one point, and thus the total score of BCAM was between zero and three points. The BCAM focused on specific early signs of breast cancer (such as breast and nipple changes), which was different from the other instruments. The study showed that BCAM performed well among young and old adult women and could be used to assess screening awareness for additional cancers.

BCSBQ

CBCSBQ included: 'attitude toward health checkups', 'knowledge and perception about breast cancer', and 'mammography screening practice', for a total of 13 items. The items were rated on a 5-point Likert scale ranging from one = 'strongly agree' to five = 'strongly disagree.' The higher the score, the higher the understanding of breast cancer and more positive the attitude toward health examinations and breast cancer screening. Notably, the breast cancer screening method evaluated by the CBCSBQ was mammography, which was different from that of the CHBMS-1984.

Validity & reliability

CHBMS

Champion [11] developed the CHBMS-1984 to evaluate women's beliefs about breast cancer screening. Verification of internal consistency was based on the removal of less relevant items until the correlation coefficient began to drop after deletion of an item. At this time, the Cronbach's α was recognized as the largest value, and thus 39 items were finalized. The results showed that the correlation coefficients of the other three subscales were greater

than 0.7 except for that of the 'perceived benefit' subscale (Cronbach's α was 0.61) and 'health motivation subscale' (Cronbach's α was 0.62). Retesting was performed 2 weeks after the initial measurement. The results reported that the test–retest reliability coefficients of the other four subscales were significant and greater than 0.7 except for that of the 'perceived benefit' subscale (r = 0.47). The structure validity of the scale was tested by factor analysis, and seven factors were extracted by principal component analysis. The analyses suggested that the 'perceived seriousness' subscale contained three factors, whereas the remaining subscales contained only one factor. The structure validity of the CHBMS-1984 was also confirmed by mutual exclusion of five subscales. The multiple regression analysis results indicated that the multiple R was 0.51 ($p \leq 0.01$), which explained 26% of the variance, and proved again that the scale had good structural validity. Although the variance explained by the 'perceived barrier' and 'health motivation' subscales was 23 and 4%, respectively, the variance explained by all subscales was not significant. Subsequently, the reliability and validity of the CHBMS were verified in Arabia, Korea, Turkey, Lithuania, Malaysia, Iran and Spain with consistent results [19–26].

BCAM

Linsell *et al.* validated the psychometric properties of BCAM by evaluating 1035 women who participated in the NHS Breast Screening Service [17]. All participants were divided into three groups to test the scale's acceptability, change sensitivity and test–retest reliability. The BCAM acceptability was assessed by 292 women aged between 67 and 73 years who received interventions to improve breast cancer awareness and early symptom prevention. After completing the 18 questions included in the three items, the participants were asked to answer some feedback questions about the scale, such as whether any items needed improvements, the time required to complete the scale and the evaluations of these items. A total of 87% of the respondents answered these questions, and more than 90% of them were content with BCAM. In terms of changing sensitivity, breast cancer awareness was compared between the two groups by evaluating 576 older women receiving two different interventions (10-min interaction with health professional supported by booklet VS using only booklet). The results indicated that both interventions had significant effects but that the interaction group had the best improvements. The test–retest reliability was measured by recruiting 167 women over the age of 50 years who participated in the mammography screening program in south-east London. Two evaluations were conducted during the day of the screening and at 2 weeks of follow-up, with 76% of the participants completing the reassessment; the results confirmed the retest reliability of BCAM. The Kappa statistics for all items ranged from moderate to good (0.42–0.70), although the Kappa value for one item (whether the breast lumps are the alarming sign of breast cancer) was low (0.28).

The scale was distributed to 18 female cancer experts and 33 nonmedical senior scholars, and the structural validity was verified using the 'known group' method and Fisher's exact test. The results suggested significant differences in 'knowledge of breast cancer symptom' and 'age-related risk' items between the two groups, but no significant difference was found in the 'reported frequency of breast checking' item. Based on the Flesch Reading Ease formula with a value range of 0–100, 60–70 is an acceptable standard. The higher the score, the higher the readability. The results showed that BCAM had a readability score of 87.9, which meant that it was easier to understand than standard adult books. Currently, BCAM has been translated into Kenyan and Arabic versions, and studies proved that they could accurately assess women's breast cancer awareness [27,28].

BCSBQ

Kwok *et al.* tested the multitrait scaling and verified the psychometric properties of the CBCSBQ [18]. The researchers recruited Chinese–Australian women over the age of 18 years who had literacy with Chinese and English and no history of breast cancer. The correlation coefficients between most items and their corresponding subscales exceeded the standard of r = 0.3. Specifically, in the 'attitude toward general health checkups' subscale, the correlation coefficients between all items and their corresponding subscales were above 0.7; however, the coefficients of three items was lower than 0.3 in the subscales 'knowledge and perception about breast cancer' and 'mammography screening practices', which were excluded from further analysis. The construct validity of the CBCSBQ was verified through factor analysis of the KMO measure and Bartlett's test of Sphericity results. According to the factor analysis results, after excluding items with a factor loading lower than 0.4, the questionnaire ultimately contained only 13 items. After eliminating items that did not meet the eligibility criteria, an internal consistency verification was conducted for the final revised questionnaire. The results suggested that the Cronbach's α of the three subscales ranged from 0.70 to 0.79 and was 0.76 for the 13-item questionnaire, indicating that the questionnaire had sufficient internal consistency. Then, the CBCSBQ was translated into multiple versions

to test the breast cancer screening beliefs of Chinese–Australian women (Hong Kong), Arabic–Australian women, African–Australian women, Australian–Indian community women and Australian women living in China and Korea, and their reliability and validity were verified [29–34].

Discussion

Due to the particularity of the study population, recommending gold standard criteria for breast cancer screening beliefs is difficult. This paper reviewed and compared these three commonly used instruments to provide a theoretical basis and allow medical staff to select an appropriate instrument for breast cancer screening beliefs, which can help improve the accuracy of clinical decision-making. Moreover, this study provides a reference for future research and development of a more comprehensive instrument for breast cancer screening beliefs.

The research purposes of the CHBMS, BCAM and BCSBQ are similar, but the conceptual frameworks are different. For example, the CHBMS had more domains, and common assessments include perceived susceptibility, benefits and barriers to breast screening. Meanwhile, the multiple versions of the CHBMS also differ to some extent. With respect to the assessment dimensions, the 'health motivation' subscale was included in the CHBMS-1984 and CHBMS-1993, whereas the CHBMS-1993 and CHBMS-1997 contained the 'perceived confidence' subscale (Table 1); in terms of screening method-related items, the CHBMS-1984 and CHBMS-1993 assessed the benefits and barriers of BSE, the CHBMS-1995 and CHBMS-1999 evaluated the perceived benefits and barriers of mammography, and the CHBMS-1997 evaluated both BSE and mammography. Moreover, 'knowledge of breast cancer symptoms' and 'age-related risk' were unique domains for BCAM. Both BCAM and CBCSBQ included breast cancer knowledge as an aspect of assessment, but the latter also independently rated the 'attitudes toward health checks' and 'mammography screening practices' (Table 2). Each tool had unique advantages, which did not mean that it ignored other important aspects. Because their reliability and validity were confirmed by a large number of studies, they were deemed to be reliable and effective instruments. Therefore, these existing instruments provided a reference for developing targeted interventions to improve breast cancer screening beliefs and screening behavior.

Various breast screening methods exist, such as BSE, clinical breast examination (CBE), mammography, breast ultrasonography and MRI, and so on [35]. The American Cancer Society (ACS) recommends that women around the age of 20 years should perform a BSE every month, women aged 20–39 years should have a regular BSE and CBE every 3 years, and women over 40 years should receive CBE and mammograms every year [36–38]; these recommendations are similar to the guidelines recommended by the National Comprehensive Cancer Network (NCCN) [39]. The Chinese Anti-Cancer Association, Committee of the Breast Cancer Society (CACA–CBCS) suggests that breast ultrasonography should be used as an auxiliary screening method for women with a high breast density [35]. In addition, the ACS, NCCN and CACA–CBCS all suggest that MRI should be used as a complementary screening method for mammography for high-risk women; for instance, women who are BRCA1 or BRCA2 mutation carriers should have an MRI every year [35,39].

Among these screening modalities, mammography is recommended by most Western countries as the optimal breast cancer screening method [40]. However, differences in breast physiology exist between women of different races. For instance, Asian women have different breast characteristics than Western women, with the former having a smaller size and dense texture. In fact, as the breast density increases, the sensitivity to mammography decreases significantly [41]. Furthermore, the CACA–CBCS suggested that the high-density breast population should choose the combined mammography and ultrasound screening pattern [35]. Based on these factors, the breast cancer screening methods recommended by Western countries may not be universal [9]. Therefore, choosing an appropriate breast cancer screening belief tool based on the breast characteristics and sociodemographic properties of the study population is critical for healthcare providers.

These instruments had some deficiencies. Different versions of the CHBMS have certain limitations, such as homogeneity of the research sample, a short evaluation time interval, inadequate interpretation of the structured content related to mammography and the self-reported breast examination frequency. Similarly, BCAM did not assess women's perceptions of the benefits of breast cancer screening, but these variables might be key factors influencing women's actual screening beliefs and behaviors [42]. In addition, the options included in the 'age-related risks' item provided three exact values rather than the corresponding age range, which might have limited the participants' choices. Furthermore, unlike the other instruments, the response format of BCAM was evaluated based on the number of appropriate response items. The first item contained nine options in total; according to the scoring principle, if more than five nonlump options were selected, the individual would receive one point. The

level of knowledge about breast cancer was indistinguishable and incomparable between the scorer and nonscorer groups. Moreover, the screening method evaluated by the CBCSBQ was mammography, which was not desirable for Chinese females according to their breast characteristics. The research results were not representative due to the language limitations of the recruited research population and the high educational levels of the participants, and therefore the promotion and application of this questionnaire were restricted. Furthermore, existing tools were only used as research methods but were not widely used in clinical practice and lacked clinical practice guidelines.

Certain limitations should be noted. First, since the focus of the present review was limited to the original versions of these instruments, the results might be partial. Second, although the language of the studies was not restricted, all of the studies in this review were published in English, and the analysis results might be not comprehensive. Therefore, in future research, we recommend popularizing and applying these tools in diverse regions and targeted groups.

Conclusion

This review introduced the characteristics of the CHBMS, BCAM and BCSBQ, which had good reliability and validity. Among them, the CHBMS was the most widely used. Each instrument had unique characteristics and advantages, and thus we could not draw conclusions about how one tool was superior to the others. The selection of instruments requires scientific decision-making based on the traits of the research population and the needs of clinical practice. In addition, the process status of the evaluation tools for breast cancer screening belief was elucidated based on the analysis and comparison of existing tools in this study. More comprehensive evaluation dimensions and more objective evaluation variables are needed to increase the applicability of the tools and the comparability of the results, which have great significance for future research. In conclusion, this study serves as a theoretical basis for further academic and clinical studies.

Future perspective

Development of an instrument with a reasonable theoretical basis and comprehensive evaluation dimensions will be useful for comparisons and analyses of differences among different research groups and will provide health service providers with an opportunity to improve the screening behavior and prognosis of breast cancer patients. At the same time, instruments must be combined with clinical assessment to help medical staff formulate targeted measures based on the evaluation of screening beliefs, improve the screening beliefs of women with poor screening beliefs and promote the formation of healthy habits of the targeted population to achieve the ultimate goal of reducing breast cancer mortality. An evaluation of breast cancer screening beliefs should include more quantitative and measurable variables, increase the reliability and stability of the instruments, and reduce deviations caused by subjective factors. Comprehensive instruments should be used to evaluate supplementary screening means, such as breast ultrasonography and MRI, and achieve a comprehensive and accurate assessment of women's screening beliefs. Highly sensitive and stable instruments are an essential prerequisite for the medical system to promote the development of effective screening programs or strategies. Accurate measurement of differences in screening beliefs among targeted populations and detection of women with inadequate screening beliefs are critical for improving cancer screening practices.

Supplementary data

To view the supplementary data that accompany this paper please visit the journal website at: www.futuremedicine.com/doi/full/10.2217/cer-2018-0142

Author contributions

N Liu and W Zhang contributed to the conception and design of this study; N Liu and J Wang performed the statistical analysis and drafted the manuscript; DD Chen, WJ Sun and W Zhang critically reviewed the manuscript and supervised the whole study process. All the authors read and approved the final manuscript.

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Executive summary

- Breast cancer is a fatal disease with high morbidity and mortality among women and threatens their health.
- Breast cancer screening can dramatically reduce the rate of breast cancer-related death, and breast cancer screening beliefs are predictors for breast cancer screening practices.
- The purpose of this review was to analyze and compare the development, characteristics, reliability and validity of three widely used instruments (the Champion's Health Belief Model Scale [CHBMS], the Breast Module of a Cancer Awareness Measures [BCAM] and the Breast Cancer Screening Beliefs Questionnaire [BCSBQ]).
- The item pools of the three instruments were generated from previous research or cognitive interviews. Inappropriate items were removed after evaluation of the content validity.
- Items in CHBMS and CBCSBQ were rated using a Likert 5-point scale. Different from the other instruments, the score of BCAM ranged from 0 to 3 according to the answers selected by the participants.
- All three tools were modified by content and structural validity and translated into multiple versions to evaluate women in different regions.
- Each type of instrument has certain strengthens and limitations, and thus recommending which instrument is superior is difficult.
- Application of instruments should combine the characteristics of the targeted population and the clinical environment to promote scientific clinical decision-making.

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•• **Provides a new direction for future research and is of great significance for the development of evaluation tools.**

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