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The development and validation testing of a comprehensive frailty assessment in women with breast cancer

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Abstract

Background Women with breast cancer are known to suffer from disease and treatment, and the generic measurement tools may underestimate their frailty. A specific instrument comprehensively measuring frailty among women with breast cancer has not yet been developed. This study aims to develop and validate the tool of breast cancer comprehensive frailty scale (BCCFS).

Methods A descriptive and explorative study design was used. We collected the data through systematic literature and modified Delphi method. After an initial search and screening process, a total of 33 articles were included for review and consideration in the item design. Ten experts were invited to generate and validate initial items. The validity was assessed using a sample of 205 women with breast cancer in Taiwan. Its validity was then tested using item analysis, exploratory factor analysis, confirmatory factor analysis, criterion-related validity and areas under the receiver-operating characteristic, while its reliability was evaluated through internal consistencies and test-retest analyses.

Results A three-factor solution with 16 items was chosen and accounted for approximately 58.57% of the total variance by exploratory factor analysis (KMO = 0.85; Bartlett's Test of Sphericity: $\chi 2 = 2881.34$, $p < 0.001$). The factors were interpreted as (1) deterioration of body and mobility, (2) negative emotions, and (3) cognitive impairment. The goodness of fit indices of the confirmatory factor analysis were as follows: chi-square = 234.498 ($p < 0.01$), normed chi-square = 2.322, SRMR = 0.055, RMSEA = 0.08, CFI = 0.930, and LI = 0.917. The Cronbach's alpha calculated for the BCCFS (16 items) was 0.91 (95% confidence interval: 0.89 to 0.93), and the test-retest reliability coefficient was 0.60. Using the G8 screening tool as a standard indicator of frailty, analysis of receiver operating characteristic curve showed that 31.5 was the best cut point (area under curve = 0. 816, 95% confidence interval: 0.757 to 0.874) with a sensitivity of 63.5% and specificity of 84.4%.

Conclusion The instrument exhibited acceptable psychometric properties, proving it to be a valuable tool for evaluating frailty in women with breast cancer. Further assessments of its reliability, validity, and generality from health providers' views in different contexts and cultures are recommended.

Keywords Breast cancer, Frailty, Psychometrics, Sensitivity, Specificity

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Background

The incidence of breast cancer in Taiwan is on the rise (63.16 per 100,000 in 2010 and 82.10 per 100,000 in 2020) [1]. The mortality rate of breast cancer in Taiwan is 24.1% which is higher than that in the United States (19.1 per 100,000) [2]. The median age of death in breast cancer group is 63 that is much lower than other cancers (70 years) [1]. Women with breast cancer have a significantly shorter life expectancy than other cancers. Further attention needs to be paid to the factors that influence death or negative health-related factors in those women. In women with advanced cancer, breast carcinogenesis, tumor progression, and response to drug therapy alter muscle homeostasis, resulting in substantial muscle loss, which tends to increase overall patient frailty, leading to decreased survival and impaired quality of life [3]. The indicator of frailty is a significant predictor of mortality [4, 5]. Hanlon et al.'s study [6] showed pre-frailty and frailty were significantly associated with mortality for all age strata and suggested to identify, manage, and prevent frailty should include middle-aged individuals with multimorbidity.

The concept of frailty was defined as an individual's health state of increased vulnerability that results from decreased reserve and function of multiple physiological systems associated with aging, and therefore an impaired ability to cope with daily stressors [7]. A comprehensive frailty assessment in breast cancer was expected to evaluate multiple domains of health that results in better assessment of a patient's overall fitness and allows directed intervention to improve patient outcomes. There is no consensus regarding instruments of comprehensive frailty assessment in breast cancer [8, 9]. The definition of comprehensive frailty proposed by van Oostrom et al. [10] for the general public includes physiological, psychological, cognitive, and social domains, which is currently the most widely used description. In terms of the concept of physiological frailty, the Fried frailty phenotype [11] which is one of the most widely used criteria assesses physical frailty through five criteria (unintentional weight loss, weakness or poor handgrip strength, self-reported exhaustion, slow walking speed, and low physical activity). Among the five attributes, those who meet three or more of these attributes are considered frail. Both hand grip strength and five times sit to stand test were common methods to measure upper and lower extremity physical frailty [12, 13]. Psychological frailty is a complex concept that lacks a consistent definition. It should include both psychological characteristics and physical frailty. Depression and other psychological disorders are commonly applied to define psychological frailty [9, 14–16]. Cognitive frailty can be conceptualized as a state of reduced cognitive reserve in the individual [17]. The International Academy of Nutrition and Aging and the International Association of Gerontology and Geriatrics have proposed an operational definition of cognitive frailty, indicating that both physical frailty and cognitive impairment are present without diagnosed dementia [18]. A previous study showed older, long-term breast cancer survivors had lower cognitive performance and higher levels of frailty compared to controls [19]. The concept of social frailty is mainly derived from the lack of social resources and support [20]. Social frailty has not been widely explored in the past compared to physical, psychological and cognitive frailty [10].

Past studies measuring frailty in women with breast cancer have mostly used instruments for the general elderly [20–23] or instruments with unknown reliability and validity [24]. Those studies didn't not take cancer and its treatment-related factors into account, nor did they include middle-aged adults who may have pre-frailty. Measurement using different instruments for different domains of frailty could encounter challenges, such as varying descriptions at the time of the survey (e.g., past week or year). Some studies regarding development of cancer frailty tools have only focused on physical frailty [25], without concerning on psychological, cognitive, or social frailty, which lack comprehensive and holistic frailty assessment and tend to underestimate the frailty of women with breast cancer. A specific instrument comprehensively measuring frailty among women with breast cancer has not yet been developed. Hence, with reference to the four domains of frailty proposed by van Oostrom et al. [10], the study aimed to develop and validate the tool of Breast Cancer Comprehensive Frailty Scale (BCCFS). This instrument was expected to serve as an indicator for promoting frailty, preventing unanticipated accidents and deaths due to frailty, and improving the quality of life in women with breast cancer.

Methods

Aim

The aim of this study was to develop and validate a comprehensive frailty instrument for women with breast cancer.

Study design and settings

A descriptive and explorative study design was used to develop the new BCCFS, conceived to measure overall level of fitness or frailty of patient with breast cancer. Scale development and validation were conducted through a two-stage process at a public hospital in Taipei from August 2022 to June 2023. Approval was granted by the Ethics Committee of Taipei Veterans General Hospital (2022-01-004 C).

Instrument and procedure

Stage I: scale development

Item generation and reduction were conducted at this stage. Relevant concepts were first established via a literature review. The comprehensive frailty in our study was addressed in the context of age, breast cancer and related treatments. It induced clinical symptoms, carried an increased risk for poor health outcomes and lose independence. Three electronic databases were systematically searched from inception to September 2022, including CINAHL, PubMed and National Digital Library of Theses and Dissertations in Taiwan. The researchers searched the literature using three keywords: frailty, comprehensive geriatric assessment, breast cancer. After the primary search and screening, 33 articles that met the purpose of this study were reviewed in their entirety. Based on our literature findings, comprehensive frailty in women with breast cancer specifically refer to physiological, psychological, cognitive and social domains. Initially, the researchers identified 20 potential questions through the four domains mentioned in the literature. A modified Delphi method was then conducted to augment these items from 5 professionals majoring in aging care, 3 physicians specializing in in breast cancer, and 2 oncology nurse practitioners. Inclusion criteria of experts were clinical experience, research experience of at least 10 years, or a combination of both. Those who had no contact with breast cancer patients were excluded. Background information of the above personnel was shown in the supplementary material 1. Those experts were asked to rate the original items of the new BCCFS and report whether each item was relevant and important. Each item was rated on three domains: relevance, importance and appropriate. This rating was based on a 5-point scale. The higher the scale score, the more relevant or important it was. Questions with an average rating of less than 3 were simply deleted. Questions with an average rating of 3 or more were discussed and revised in online meetings with all professionals. There were 8 questions with semantic amendments. Finally, a 20-item BCCFS was generated. Each item was scored using a 5-point Likert scale (1 = not agree, 2 = somewhat agree, 3 = agree, 4 = quite agree, and 5 = highly agree), with a higher scale score associated with a worse frailty. We invited three patients with breast cancer to check the clarity of instructions and language whether there were ambiguities to interpret the questions. All patients agreed that the 20 questions could be clearly understood and indicated that no amendment was required.

Stage II: scale validation

A previous study has suggested that pre-frail and frail states should be emphasized in the middle-aged breast cancer population [6]. Therefore, the inclusion criteria for this study were women who were diagnosed with breast carcinoma after 40 years of age at least and who had accepted at least one cancer-related therapy and who could communicate in Chinese. Since previous diseases of the cerebrovascular accident [26], heart failure [27] and dementia [28] had prognostic impact on the prevalence of frailty, we excluded women with these characteristics from the study. The investigator would explain the purpose of the study and the inclusion and exclusion criteria criteria to the medical team at the breast medical center in the research hospital. The attending physician at the hospital would make an initial verbal inquiry to eligible cases about their interest in participating in the study. If the patient has an initial interest, she would be referred to the investigator. After the study was explained in detail to all eligible women, these participants would receive a paper copy of the questionnaire. Those women interested in participating in the study could complete and return the questionnaire and accept both of grip strength examination and five times sit to stand test. Based on the report of Tinsley & Tinsley [29] regarding sample sizes (a ratio of 10 participants per item), the sample size was calculated as 200.

We used descriptive statistics (mean, standard deviation, frequency, and percentage) to describe the socio-demographic characteristics of the sample (age, education, marital status, chronic disease, and occupation) as well as to analyse item scores. The independent t-test was used to examine whether the difference between the highest (top 27) and lowest percentile (lowest 27) groups differed statistically ($p < 0.05$). Both the critical ratio (CR) of more than 3.5 and item total correlations of less than 0.40 were applied to reduce the number of items and discriminate the adequacy of each item from the subject response [30].

Exploratory factor analysis (EFA) was used to identify the underlying components among the BCCFS items. The main methods were principal components analysis with direct oblimin rotation and varimax rotation. A scree plot, eigenvalues greater than 1, percent of variance explained, and component loadings greater than 0.40 were used to evaluate the final component structure. Construct validity was assessed through confirmatory factor analysis (CFA). CFA analyses were performed using IBM SPSS Amos 21.0. CFA was performed using the robust maximum likelihood estimator method (MLR). Based on Hoyle's recommendations [31] and a multifaceted approach to the assessment of model fit [32], chi-square ($\chi 2$), normed chi-square (CMIN/DF ≈ 2), comparative fit index (CFI; values ≥ 0.90), the Tuker and Lewis Index (TLI; values ≥ 0.90), the standardized root mean square residual (SRMR; values < 0.08), and the root mean square error of approximation (RMSEA;

0.05 ≤ values ≤ 0.08 indicate a good fit) are typically considered to indicate goodness of the model fit.

The criterion-related validity was also assessed by investigating its difference between non-frail and frail groups based on five times sit to stand test [13]. We expected that a higher BCCFS score at the frail group compared with the non-frail group. Further, areas under the receiver-operating characteristic (AUROC) curve were calculated to determine model discrimination [33]. Diagnostic performance of screening tools G8 includes 8 items. Total G8 scores range from 0 to 17, a cutoff score of ≤ 14 defined as frail [34, 35]. The cut point of ROC analysis provided BCCFS as a classification of frail or not. For the known-groups validity, we further examined whether there was a significant difference in two-hand grip strength between the two groups [12].

The reliability of the BCCFS was evaluated using Cronbach's alpha to assess the internal consistency of each factor and the overall scale. A coefficient greater than 0.70 was considered to indicate acceptable internal consistency, and coefficients greater than 0.80 were considered to indicate good internal consistency [36]. Thirty of the study participants were assigned to a test-retest group and were additionally asked to complete the BCCFS a second time within 1 months of the initial survey.

Table 1 Characteristics of the study participants ($n = 205$)

Characteristic	*n*	%
Age (years)		
41–50	71	34.6
51–60	67	32.7
61–70	53	25.9
≥ 71	14	6.8
Education		
Elementary school or junior high school	18	8.8
Senior high school	58	28.3
College at least	129	62.9
Marital status [a]		
Single	39	19.0
Married	136	66.3
Divorced or widowed	29	14.2
Diabetes		
Yes	18	8.8
No	187	91.2
Hypertension		
Yes	41	20.0
No	164	80.0
Currently working		
Yes	120	58.5
No	85	41.5
Cancer Stage		
I	69	33.7
II	75	36.6
III	42	20.5
IV	19	9.3
Cancer location		
Right	84	41.0
Left	101	49.3
Bilateral	20	9.8
Surgery		
Yes	126	61.5
No	79	38.5
Chemotherapy		
Yes	123	60.0
No	82	40.0
Radiotherapy		
Yes	43	21.0
No	162	79.0

[a]Missing data $n = 1$

Results

Sample characteristics

During the study period, 245 women met the inclusion criteria. Of these, 40 refused to participate because they were tired or not interested. The recovery rate was 86.37%. The 205 respondents ranged in age from 40 to 79 years (55.89 ± 9.19 years), and 66.3% are married. Table 1 shows their demographic details.

Validity

According to the item-level analyses, statistically significant items with critical ratio absolute values less than 3.50 or item total correlations below 0.4 or above 0.85 were eliminated to reduce the number of items. Sixteen items were kept and further analysed in the exploratory factor analysis (Table 2). Only three factors should be extracted based on the screen plot result (KMO = 0.85; Bartlett's Test of Sphericity: $\chi 2 = 2881.34$, $p < 0.001$; Table 3). Both data of direct oblimin and varimax rotation showed a three-factor solution and a clear loading pattern. The result identified three factors that explained 58.57% of the total variance, with an eigenvalue greater than 1. Further, we conducted confirmatory factor analysis. The model had the best model fit (chi-square = 234.498, $p < 0.01$, normed chi-square = 2.322, standardized root mean square residual = 0.055, root mean square error of approximation = 0.08, comparative fit index = 0.930, and Tuker and Lewis index = 0.917; Table 4). The model result suggest that the three-dimensional model was the best model to be cross validated via confirmatory factor analysis (Fig. 1; supplementary material 2).

For five times sit to stand test, our results showed that people with time greater than 10 s (frail group) had higher total BCCFS scores than those with time less than 10 s (non-frail vs. frail group: 26.42 ± 8.89 vs. 31.94 ± 10.99, t = -3.69, $p < 0.01$). Those with time greater than 12 s at the five times sit to stand test (frail group) also had higher total BCCFS scores than those with time less than 12 s (non-frail vs. frail group: 27.31 ± 8.85 vs.

Table 2 Item analysis of breast Cancer Comprehensive Frailty Scale ($n = 205$)

No.	Items	Mean Difference	95% CI lower, upper	Critical Ratio	Corrected Item-Total Correlation
1	My ability to perform daily tasks has become poor	-1.66	-1.99, -1.34	-10.10	0.58
2	I have nutrition-related health problems (e.g., loss of appetite, nausea, vomiting)	-1.42	-1.79, -1.06	-7.71	0.46
3	I have sleep-related problems (e.g., difficulty falling asleep, restless sleep, or excessive sleep)	-1.92	-2.35, -1.48	-8.79	0.52
4	I feel tired or have no energy	-2.27	-2.58, -1.96	-14.57	0.71
5	I have more diseases or health problems than people of the same age (e.g., chronic illness, pain, hearing loss, or poor vision)	-1.85	-2.20, -1.50	-10.39	0.57
6	I feel nervous, anxious or on edge	-1.81	-2.15, -1.48	-10.74	0.64
7	I can't stop or control worrying	-1.58	-1.88, -1.27	-10.12	0.66
8	I had little interest or pleasure in doing things	-1.68	-1.96, -1.39	-11.58	0.71
9	I feel down, depressed, or hopeless	-1.64	-1.93, -1.36	-11.56	0.66
10	I am a failure or have let yourself or your family down?	-1.47	-1.77, -1.18	-9.87	0.65
11	I can't tell the date, name of a person or place	-0.95	-1.27, -0.63	-5.92	0.53
12	I have trouble concentrating on things, such as reading the newspaper or watching television	-1.03	-1.32, -0.75	-7.09	0.56
13	I have trouble adding or subtracting calculations	-1.00	-1.32, -0.68	-6.12	0.56
14	I often have trouble understanding what people are saying	-0.83	-1.12, -0.54	-5.70	0.53
15	I feel that my memory is not as good as it should be	-1.49	-1.86, -1.12	-8.05	0.54
16	I go out less often than I did the year before	-2.08	-2.50, -1.67	-9.99	0.52
17	I go to visit friends.[#]	-1.59	-2.11, -1.08	-6.15	0.32
18	I feel that I am helpful to friends or family. [#]	-1.54	-1.94, -1.14	-7.62	0.32
19	I talk to people every day (including on the phone or video). [#]	-1.31	-1.74, -0.87	-6.00	0.18
20	I often live alone. [#]	-0.76	-1.17, -0.35	-3.67	0.16

CI: confidence interval; *$p < 0.05$; [#] Deleted item: Statistically significant items with critical ratio absolute values less than 3.50 or item total correlations below 0.4 or above 0.85 were eliminated to reduce the number of items

32.98 ± 112.19, t = -3.48, $p < 0.01$). Using the G8 screening tool as a standard indicator of frailty, analysis of receiver operating characteristic curve showed that 31.5 was the best cut point (area under curve = 0. 816, 95% confidence interval 0.757 to 0.874, Fig. 2), with a sensitivity of 63.5% and specificity of 84.4%. For the known-groups validity, grip strength was significantly worse at the frail group (BCCFS score ≥ 32) than at the non-frail group in both the left and right hands (non-frail vs. frail group: 20.84 ± 5.27 vs. 18.20 ± 5.83, t = 3.22, $p < 0.01$ in right hand; 19.59 ± 5.08 vs. 16.88 ± 5.51, t = 3.44, $p < 0.01$ in left hand).

The content validity index (CVI) of the BCCFS across expert scores was 0.95 for relevance, 0.96 for importance and 0. 945 for appropriate. None of the final BCCFS items was scored as irrelevant, or unimportant, inappropriate by the 10 experts. The CVI results were higher than the standard reported by Davis-a minimum CVI of 0.80 [37]. The findings indicate acceptance of the BCCFS.

Reliability

Reliability assessments included internal consistency and test-retest reliability. The Cronbach's α coefficient for the 16-item BCCFS was 0.91 (95% confidence interval 0.89 to 0.93). Among the three factors, the Cronbach's α coefficients ranged from 0.82 to 0.92 (Table 3). The factor-total correlations ranged from 0.76 to 0.90 ($p < 0.01$). The test-retest reliability coefficient for the BCCFS was 0.60 ($p < 0.01$).

Discussion

Our study showed four main concepts with 20 items were pooled in initial BCCFS at the stage of scale development. At the stage of scale validation, EFA identified the underlying items and kept final BCCFS with 16 items. Compared to previous frailty instruments [20–25], we performed the validation study through confirmatory factor analysis, known-groups validity, discriminant validity with AUROC, and criterion validity based on our theoretical framework. Our results show that all three factors are representative and, hence, the newly designed Breast Cancer Comprehensive Frailty Scale has a good construct and criterion validity, indicating that it can allow women to easily identify the degree of frailty and can reduce the difficulty of healthcare providers in assessing the frailty of breast cancer women. Internal consistency and test-retest reliability were used to assess reliability. The findings show the new BCCFS demonstrated good consistency of results across items. Therefore, results from our study indicate that the BCCFS possesses a substantial reliability and validity for assessing the holistic frailty of cancer women.

Table 3 Factor-loaded values and descriptions of breast Cancer Comprehensive Frailty Scale ($n = 205$)

Item	Loading	Corrected item-total correlation	Cronbach's α (95% CI)
Factor 1: Deterioration of body and mobility			0.82 (0.78, 0.85)
My ability to perform daily tasks has become poor	0.71	0.60	
I have nutrition-related health problems (e.g., loss of appetite, nausea, vomiting)	0.61	0.49	
I have sleep-related problems (e.g., difficulty falling asleep, restless sleep, or excessive sleep)	0.63	0.55	
I feel tired or have no energy	0.88	0.74	
I have more diseases or health problems than people of the same age (e.g., chronic illness, pain, hearing loss, or poor vision)	0.58	0.57	
I go out less often than I did the year before	0.54	0.53	
Factor 2: Negative emotions			0.92 (0.90, 0.94)
I feel nervous, anxious or on edge	0.79	0.68	
I can't stop or control worrying	0.87	0.68	
I had little interest or pleasure in doing things	0.83	0.73	
I feel down, depressed, or hopeless	0.92	0.70	
I am a failure or have let yourself or your family down?	0.79	0.65	
Factor 3: Cognitive impairment			0.87 (0.84, 0.89)
I can't tell the date, name of a person or place	0.65	0.54	
I have trouble concentrating on things, such as reading the newspaper or watching television	0.75	0.58	
I have trouble adding or subtracting calculations	0.89	0.59	
I often have trouble understanding what people are saying	0.83	0.56	
I feel that my memory is not as good as it should be	0.71	0.57	

CI: confidence interval

Table 4 Confirmatory Factor Analysis (CFA) fit indexes ($N = 205$)

	CFA index standard	Model
Chi-square		234.498
DF		101
Normed chi-square (CMIN/DF)	≈ 2	2.322
RMSEA	< 0.08	0.08
SRMR	< 0.08	0.055
CFI	≥ 0.90	0.930
TLI	≥ 0.90	0.917

Abbreviation: CFI, comparative fit index; DF, degree of freedom; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; TLI, Tuker and Lewis Index

The 16-item BCCFS based on our results comprised three factors: (1) deterioration of body and mobility, (2) negative emotions, and (3) cognitive impairment. Previous studies have reported that the main frailty may be divided into regarding physical, psychological, cognitive, and social frailty [10]. Mohile et al. [38] have suggested that chemotherapy toxicity be included in debilitating assessments. A previous study of breast cancer has also shown that pre-debilitated/debilitated individuals have worse physical functioning, more fatigue, and sleep disturbances than able-bodied individuals [38]. One factor called "deterioration of body and mobility" in BCCFS incorporated physical and social frailty questions, including questions on nutritional problems caused by chemotherapy, sleep disturbance, fatigue, and the ability to walk and perform daily life activities, which was consistent with previous scholars [38, 39]. Previous research scholars have defined cancer women as socially frail if they meet two or more criteria, such as not going out often, rarely visiting friends, feeling unhelpful to friends or family, living alone, and not talking to someone every day [40]. Although deteriorating social environmental factors are significantly associated with poor health outcomes in cancer women [41, 42], all four of the deleted questions in this study were related to social interactions and support. This may be attributed to the social patterns and health welfare in Taiwan. Whether the adoption of national health insurance in Taiwan has reduced the social frailty of cancer patients deserves more future research.

Our study found five items measured the factor of negative emotions in BCCFS, which assessed psychological states such as anxiety and depression. This is consistent with the fact that most indicators of psychological frailty in cancer women have measured the risk of depression or anxiety [43, 44], and almost half (46%) of breast cancer women who metastasized had symptoms of depression [45]. Those items are also similar to those of the Patient Health Questionnaire-4 and could be used for early detection of psychological deficit in breast cancer survivors.

Five items measured the factor of cognitive impairment in BCCFS, which assessed orientation, concentration,

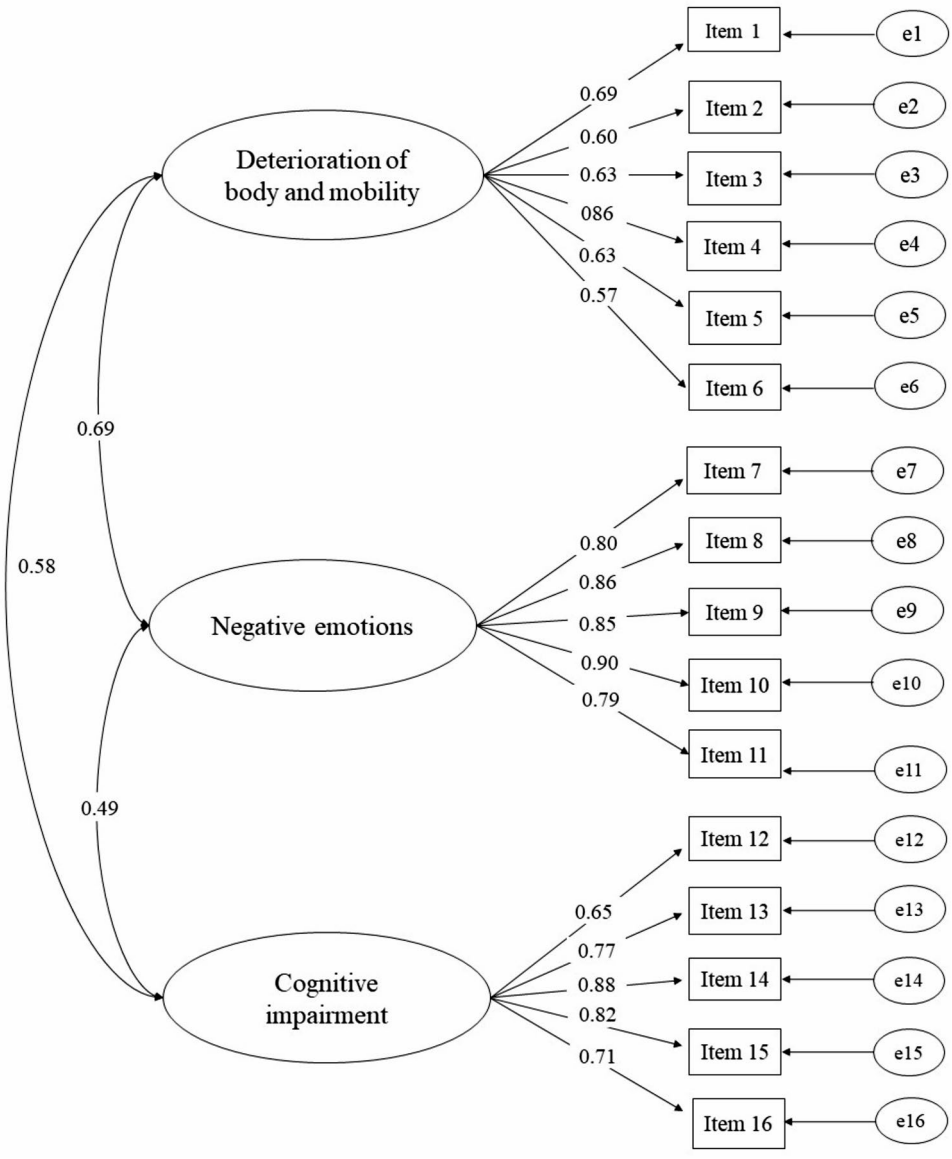

Fig. 1 Confirmatory factor analysis of comprehensive frailty scale for breast cancer

numeracy, comprehension, and memory, providing a complete assessment of all aspects of cognitive ability in breast cancer women. Cognitive frailty may be relevant to cancer and its associated treatments [22, 46, 47]. Mandelblatt et al. [46] mentioned that the processes of cancer progression, cognitive decline and frailty have biologically co-existing underlying pathways, including hormonal changes, inflammation, oxidation, DNA damage repair of damaged DNA, genetic susceptibility, reduced cerebral blood flow, direct neurotoxicity, cell aging, etc. Approximately 15.0% of breast cancer survivors reported cognitive problems prior to initiating treatment [22], and longitudinal studies have shown that cognition is associated with physical decline that worsens over time with chemotherapy [47]. Future studies are recommended to focus on cognitive changes in women with breast cancer from the diagnostic stage onwards.

This newly developed scale is a specific instrument designed to measure women' health to meet various domains of frailty involving in breast cancer and related treatment. The strength of this study is that the initial items were developed using a literature review and the modified Delphi method with professionals in Taiwan. This study has some limitations which must be considered. All participants were enrolled from one hospital in Taipei. We did not investigate breast cancer women at other facilities. This sampling bias might undermine the external validity of the results and cause selection bias. Only three patients with breast cancer were invited to check the clarity of instructions and language whether

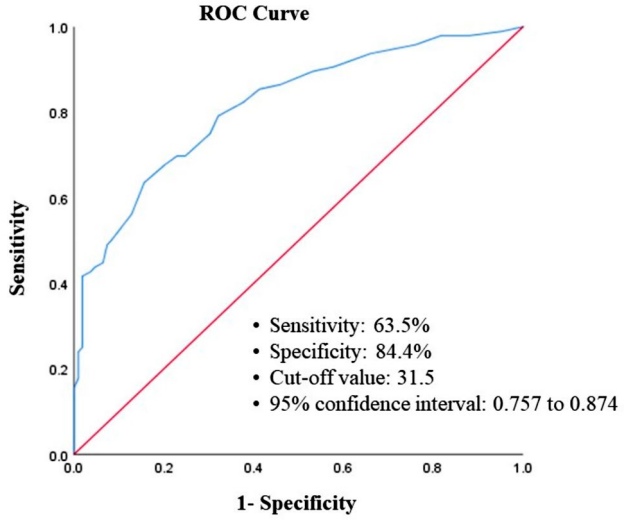

Fig. 2 Receiver operating characteristic curve for predicting Geriatric 8 health status

there were ambiguities to interpret the items at scale development stage. Although those patients agreed that they could clearly understand the initial 20 questions, objective measures such as face validity index calculation may provide a more refined judgment [48]. Because frailty is a linguistically and culturally sensitive measure, whether or not the identified comprehensive frailty among breast cancer women in Taiwan are consistent with those of other countries merits further studies.

Conclusion

This study contributes to a body of evidence about the psychometric properties of comprehensive frailty in breast cancer care. This validated study shows that the BCCFS is an appropriate tool for measuring and assessing holistic frailty among women with breast cancer in Taiwan. Valid and reliable instruments can accurately measure each patient's self-rated degree of frailty. Misunderstandings about the dimensions or degree of frailty may cause care health care providers to miss opportunities to help women. Our results suggest that this BCCFS scale should be integrated into breast cancer care in Taiwan. Most health care professionals often have difficulty determining whether a patient is debilitated when caring for a breast cancer patient. The BCCFS provides a 31.5-point cut point to help them determine and actively manage a patient's health problems. More precise and specific strategies are needed to reduce the risk of frailty in the future. This scale was developed from the Taiwanese population, and whether it is suitable for other countries or cultures deserves further study.

Abbreviations

AUROC	Areas under the receiver-operating characteristic
BCCFS	Breast cancer comprehensive frailty scale
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CR	Critical ratio
CVI	Content validity index
DF	Degree of freedom
EFA	Exploratory factor analysis
KMO	Kaiser-Meyer-Olkin
RMSEA	Root mean square error of approximation
MLR	Maximum likelihood estimator method.
SRMR	Standardized root mean square residual
TLI	Tuker and Lewis Index

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12905-025-03577-7.

Supplementary Material 1

Supplementary Material 2

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Author contributions

All authors contributed to the study conception and design. Data collection and analysis were performed by Chi-Cheng Huang, Pei-Ju Lien and Su-Chen Fang. The first draft of the manuscript was written by Sheng-Miauh Huang. All authors read and approved the final manuscript.

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Data availability

The data that support the findings of this study are available from the corresponding author, Sheng-Miauh Huang, upon reasonable request.

Declarations

Ethics approval and consent to participate

Approval was granted by the Ethics Committee of Taipei Veterans General Hospital (2022-01-004 C). The study was conducted in accordance with the Declaration of Helsinki. All subjects agreed to participate in the study and signed a consent form.

Consent for publication

All authors and research participants agreed to publish the data in the manuscript.

Competing interests

The authors declare no competing interests.

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