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Validation of the Brief Version of the Cancer Behavior Inventory in Breast Cancer Portuguese Patients

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Abstract
Self-efficacy is a coping resource with a positive impact on well-being, quality of life, anxiety, and depression in cancer patients, even after treatment. This study focused on the validation of the Cancer Behavior Inventory-Brief Version (CBI-B) in Portuguese patients with breast cancer. The study included 115 patients with breast cancer receiving outpatient chemotherapy in four hospitals located in Portugal. Participants (N = 115) completed the translated version of the CBI-B in Portuguese and measures of quality of life (QLQ- C30), psychological distress (HADS), and illness perceptions (IPQ-B). Confirmatory factor analysis supported the four-factor original structure of the CBI-B. The Portuguese version of the CBI-B showed good psychometric properties as shown by measures of internal consistency (Cronbach's alpha = .88), test–retest reliability (intraclass correlation coefficient = .59), convergent validity with the QLQ-C30 ($r = .43$, $p < .001$), and divergent validity with the HADS ($r = -.60$, $p < .001$) and the IPQ-B ($r = -.51$, $p < .001$). The Portuguese version of the CBI-B is a valid and reliable instrument to evaluate the self-efficacy for coping in Portuguese breast cancer patients. Future studies should validate the CBI-B in patients with other types of cancer.

Keywords Breast cancer · Cancer behavior inventory-brief version · Self-efficacy for coping · Validity

Introduction

Breast cancer is a relevant public health problem, especially in developed countries (Ferlay et al., 2019). Keeping pace with the European trend, Portugal registers a rising incidence of breast cancer (Ferlay et al., 2013, 2018). Concurrently, as a result of earlier diagnosis and more effective treatment modalities, breast cancer mortality is decreasing in European countries (Ferlay et al., 2013), especially Portugal and Spain (Ferlay et al., 2013, 2018), and the life expectancy of breast cancer patients in Europe is increasing.

The cancer diagnosis, the patient's experience with the illness, medical treatment, and fears of relapse can trigger stress reactions. Cognitive appraisal of the sources of stress promotes the development of coping strategies with positive or negative implications for quality of life (QoL) (Glanz & Schwartz, 2008). According to Lazarus and Folkman's (1987) transactional model of stress and coping, when confronted with a stressor, the individual performs a primary assessment, evaluating whether the event is irrelevant, benign, positive, or stressful. Given the perceived threat, a secondary appraisal serves to assess the available coping options, based on the individual's capabilities and resources to handle the threat (Lazarus & Folkman, 1987). This secondary appraisal reflects the individual's self-efficacy, also described in Bandura's social cognitive theory. Individuals with a high expectation of self-efficacy are more able to manage their personal behavior and the innumerable environmental demands caused by stressful events (Bandura, 1997).

Self-efficacy positively influences well-being (Rottmann et al., 2010) and QoL, and reduces anxiety and depression (Chirico et al., 2017). Self-efficacy in breast cancer patients tends to increase over time after diagnosis (Nejad et al., 2015). Self-efficacy in cancer has been shown to mediate the relationship between perceived social constraints and symptoms among long-term breast cancer survivors (Adams

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et al., 2016) and to moderate the relationship between coping and affect, in patient–caregiver dyads (Kroemeke & Sobczyk-Kruszelnicka, 2019). Self-efficacy also appears to moderate the relationship between distress and quality of life, in palliative cancer care (Chirico et al., 2017) and between illness perceptions and fear of progression, in breast cancer (Shim et al., 2018). Women who perceived cancer as a threat and were not confident in their ability to handle the disease reported high levels of depression (Bigatti et al., 2012). The study of self-efficacy, in the oncological context, is particularly relevant, since patients need to adapt themselves to this new phase of life, challenging their ability to handle the physical and psychological difficulties imposed by cancer.

One of the most widely used tools for assessing self-efficacy for coping, in cancer, is the Cancer Behavior Inventory (CBI) (Merluzzi & Martinez Sanchez, 1997). The longer version, the Cancer Behavior Inventory-Long Version (CBI-L), has 33 items and two revisions (Merluzzi & Martinez Sanchez, 1997; Merluzzi et al., 2001). Subsequently, Heitzmann et al. (2011) published a brief version of the CBI (CBI-B). This brief version contains 12 items that are highly representative of the CBI-L factors, and was developed to make the instrument more feasible for clinical use without compromising the psychometric qualities of the original instrument. For the validation of the brief version, three samples were collected: 735 patients (predominantly European-American) from a clinical oncology program in New York, 199 from a community program of Indian cancer patients, and 370 from a national representative sample from the U.S.A. (Heitzmann et al., 2011). The samples were mixed regarding the initial cancer diagnosis. Exploratory factor analysis, with oblique rotation, produced four factors in the first sample: (1) Maintaining independence and a positive attitude; (2) Participation in medical care; (3) Coping and stress management; and (4) Affect management. These exploratory factors were later corroborated by confirmatory factorial analysis in subsequent samples (Heitzmann et al., 2011). The results provided evidence of good internal consistency, and the correlation of CBI-B and CBI-L was high (Heitzmann et al., 2011). Positive correlations with measures of QoL and optimism, and negative correlations with measures of depression and disease impact, supported the validity of the CBI-B. The CBI-B was later adapted and validated in Turkey (Iyigun et al., 2017) and Italy (Serpentini et al., 2019). More recently, in 2018. Merluzzi et al. validated a third version of the CBI-L (CBI-V3.0) that included 27 items and consisted of 7 factors with the addition of a factor called Spiritual Coping. The psychometric properties were strong for this review (Merluzzi et al., 2018) (cf. Table 1).

Given the incidence of breast cancer in Europe and in the world, and the need to design and assess interventions to promote and further develop patients' self-efficacy, the

Table 1 Summary of cancer behavior inventory (CBI) versions

Instrument name and abbreviation	Authors and year	Number of items	Number of factors	Psychometric data
Cancer behavior inventory-long version (CBI-L)—Version 1.0	Merluzzi and Martinez Sanchez, (1997)	51 Items	6 Factors	The Cronbach's alpha for the total CBI was 0.96 and for the 6 subscales ranged from .89 to .75, and correlations with other measures supported its validity
CBI-L—Version 2.0	Merluzzi et al., (2001)	33 Items	7 Factors	The Cronbach's alpha for the total CBI and for the 7 subscales ranged from .80 to .88, the test–retest (1 week) reliability coefficient was 0.74, and correlations with measures of quality of life and coping supported its validity
Cancer behavior inventory-brief version (CBI-B)	Heitzmann et al., (2011)	12 Items	4 Factors	The Cronbach's alpha for the total CBI ranged from 0.84 to 0.88 (different samples), and positive correlations with measures of quality of life and optimism, and negative correlations with measures of depression and sickness impact supported its validity
CBI-L—third revision	Merluzzi et al., (2018)	27 Items	7 Factors	The Cronbach's alpha for the total CBI was .95, the test–retest (four months) reliability coefficient was 0.89, and correlations with variety measures indicated strong psychometric properties

present study aims to adapt and validate the brief version of the Inventory of Cancer Behavior (CBI-B), developed by Heitzmann et al. (2011), in a Portuguese sample of breast cancer patients.

Methods

Participants and Procedure

A total of 134 breast cancer patients were screened, but only 115 met all eligibility criteria (6 declined to participate and 13 did not meet the inclusion criteria). Data collection took place between February 2017 and April 2019, in the clinical oncology services from four main hospitals in Portugal. Participants included women who were planning to receive adjuvant chemotherapy after breast surgery. The inclusion criteria were: (i) women with T1–T2 breast cancer staging; (ii) at least 18 years old; (iii) Eastern Cooperative Oncology Group (ECOG) performance status equal or less than 2; (iv) adjuvant chemotherapy treatment scheduled. Exclusion criteria were: psychiatric illness or cognitive deficit reported in the patient's medical chart. Participants were recruited at the time of the oncology consultation, which took place, on average, three weeks after breast surgery. Participation was voluntary and all the procedures were consistent with ethical standards of the Hospital Ethics Committees and the Declaration of Helsinki of 1964. The CBI was administered at the time of recruitment and at the second and third chemotherapy treatments, with 3 weeks between treatments, in order to evaluate the intraclass correlation coefficient (ICC).

Measures/Instruments

Sociodemographic and Clinical Questionnaire. This instrument includes 10 items and was developed specifically for this study to assess sociodemographic variables, such as age, marital status, education and professional status (answered by the participants), and clinical variables such as type of surgery, tumor degree, cancer stage, number of chemotherapy cycles, sentinel lymph node and molecular markers (answered by oncologists).

ECOG Performance Status (Oken et al., 1982). The ECOG Scale of Performance Status evaluates patients' performance status, where 0 indicates a fully functional and asymptomatic patient and 5 refers to dead. In this study, only patients with a scoring equal to or lower than 2 ("Ambulatory and capable of all self-care but unable to carry out any work activities; up and about more than 50% of waking hours") were considered, in order to include patients able to answer the instruments.

Cancer Behavior Inventory-Brief Version (CBI-B) (Heitzmann et al., 2011).

This 12-item instrument asks respondents to rate their confidence in their ability to perform several behaviors during and after cancer treatment (e.g., "Maintaining independence," "Expressing negative feelings about cancer," "Actively participating in treatment decisions"). Response options include a Likert-type scale from 1 (not at all confident) to 9 (totally confident). The CBI-B score is the sum of the 12 items. High scores indicate higher self-efficacy. In the original version, the Cronbach alpha was 0.84 and, in the present study, was 0.88.

Quality of Life of the European Organization for Research and Treatment of Cancer (EORTC QLQ-C30) (Aaronson et al., 1993; Portuguese version by Pais-Ribeiro et al., 2008). This instrument consists of 30 questions and was developed to assess the health-related QoL in patients with cancer. The questionnaire comprises five functional scales: physical (e.g., "Do you need to stay in bed or a chair during the day?"), social (e.g., "Has your physical condition or medical treatment interfered with your family life?"), emotional (e.g., "Did you feel irritable?"), cognitive (e.g., "Have you had difficulty remembering things?"), and role functioning (e.g., "Were you limited in doing either your work or other daily activities?"). The instrument also integrates three symptom scales: fatigue (e.g., "Were you tired?"), pain (e.g., "Have you had pain?"), nausea/vomiting (e.g., "Have you felt nauseated?"), and a global health status/QoL scale (e.g., "How would you rate your overall health during the past week?"). This instrument also includes six single-item scales. The items are assessed using a 4-point Likert scale (1 is "not at all" and 4 "very much"), except two items in the 7-point Global Health and QoL subscale (from 1, "poor" to 7, "excellent"). High scores indicate good QoL. In the total scale, Cronbach's alpha was 0.94 (Hinz et al., 2012) and, in the present study, was 0.91.

Illness Perception Questionnaire (IPQ-Brief) (Broadbent et al., 2006; Portuguese Version of Figueiras et al., 2010). This instrument aims at assessing patients' cognitive and emotional representations of the disease. The questionnaire is composed of nine items and the answers are scored on a scale of 0–10. This instrument assesses cognitive representations, such as consequences, timeline, personal control, treatment control, and identity (e.g., "How much do you think your treatment can help your illness?"); emotional representations: concern and emotions (e.g., "How much does your illness affect you emotionally? Does it make you angry, scared, upset or depressed?). One item assesses the respondent's understanding of the disease (e.g., "How well do you feel you understand your illness?"). In the present study, only the total score was used. A high score indicates more threatening illness perceptions. In the original scale, the test–retest reliability was good (Pearson correlations

0.24–0.73) (Broadbent et al., 2006). The Cronbach's alpha in this study was 0.69.

Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983; Portuguese version by Pais-Ribeiro et al., 2007). This instrument consists of 14 items distributed in two subscales: anxiety (e.g., "I feel tense or 'wound up'," "Worrying thoughts go through my mind") and depression (e.g., "I still enjoy the things I used to enjoy," "I feel as if I am slowed down"). High scores indicate greater psychological distress. In a validation study of cancer patients, Cronbach's alpha was 0.93 for the anxiety subscale and 0.90 for the depression subscale. In this study, only the total scale was used with a Cronbach's alpha of 0.91.

Translation Procedure

The instrument was translated following the Guidelines for the Process of Cross-Cultural Adaptation of Self-Report Measures by Beaton et al. (2000). The original CBI-B questionnaire was translated from English into Portuguese by two knowledgeable and independent cancer experts: a psychologist and an oncologist. Subsequently, a third researcher evaluated the discrepancies, compiling it into a single version. The Portuguese version of the inventory was afterwards translated into English by the two independent experts. Finally, a third researcher compared both versions, and following a brief discussion on the subtle discrepancies, the final version was defined. A cognitive interview was performed on this final version with cancer patients from the four hospitals to assess patients' understanding of the Portuguese version of the CBI-B inventory. No changes were required, since the inventory was clear and easily understood by patients.

Data Analysis

Descriptive analyses, to describe the sociodemographic and clinical characteristics of patients, were used. To obtain the final factor solution of the Portuguese CBI-B version, principal component analysis (PCA), exploratory factor analysis (EFA), and confirmatory factor analysis (CFA) were applied in SPSS (software version 25.0) and Jamovi (Version 1.0). The EFA was used to understand the underlying factor structure of the CBI-B. Through SPSS, and to reduce error variance, 100 random samples from 62 participants were created, based on the total sample of 115 participants. The purpose was to find the factorial structure out of the more frequent structures in the 100 random samples. The Kaiser–Meyer–Olkin test (KMO) was used to evaluate the adequacy of the sample size, and it was greater than 0.50 (Field, 2018). An extraction of 4 factors was performed using the oblimin direct rotation method. The CFA was performed using structural equation modeling (SEM), following the validation study procedures of the original authors (Heitzmann et al., 2011), and according to the EFA results of the 100 samples, with correlated factors and without error correlations. To evaluate model adequacy, the following fit indices were considered: the ratio of chi-square over the number of degrees of freedom (χ^2/df) (ratios 3:1 or less are associated with good fit); the root mean square error of approximation (RMSEA, values under 0.08 are acceptable); standardized root mean square residual (SRMR, values less than 0.05 are good); Tucker–Lewis Index (TLI), and the comparative fit index (CFI) (values ≥ 0.95 reflect a good fit) (e.g., Hair et al., 2010). To compare models, the Akaike Information Criterion (AIC) was used, with low values indicating good fit (Busemeyer & Diederich, 2014). Modification indices of the model suggested some correlations between item errors, but were not taken into consideration. Residual covariance and the factor loadings, based on the modifications indices, were taken into consideration, to allocate each item to its respective factor (Brown, 2015).

Reliability of the CBI-B was examined using Cronbach's alpha, with coefficients ≥ 0.7 suggesting good factor reliability (Hair et al., 2010), and using the corrected item-total correlation, with values above 0.30 suggesting good inter-item correlation (Nunnally & Bernstein, 1994). The test–retest reliability analysis of CBI-B was evaluated through the ICC at three different times (before chemotherapy, at the 2nd and 3rd cycles of chemotherapy), using a single-measurement, absolute-agreement, 2-way mixed-effects model (Koo & Li, 2016). Subsequently, convergent and divergent validity evidence was assessed using Pearson correlations between the CBI-B score and scores on measures of illness perceptions, QoL, and psychological distress, respectively. Finally, one-way analyses of variance were performed to determine differences in the patients' self-efficacy for coping, based on sociodemographic and clinical variables. When the homogeneity of the variance was violated, the Welch F test and the Games Howell post hoc test were performed.

Results

Sample Characteristics

The sample included 115 breast cancer patients. Participant characteristics are shown in Table 2.

Differences in CBI-B According to Patients' Age, Education, Cancer Grade, Stage, Number of Chemotherapy Cycles, and Axillary Lymph Node

In general, women with breast cancer showed only significant differences in CBI-B scores according to their education level, $F\,(2,33.3) = 5.78$, $p = 0.007$. The Games Howell post hoc test revealed that women with higher levels of education presented higher self-efficacy for coping with cancer

Table 2 Sociodemographic and clinical characteristics of breast cancer patients

		Patients *n* (%) / M ± SD	 *F* (df)	*p*
Age		52.71 ± 10.21 Min. (27)/Max. (73)		
Age group	≤ 45	34 (28.7)	*F* (3,111) = .873	.457
	46–53	29 (25.2)		
	54–62	28 (24.3)		
	≥ 73	25 (21.7)		
Marital status				
	Single	11 (9.6)		
	Married/common law marriage	91 (78.3)		
	Divorced	8 (7.0)		
	Widow	6 (5.2)		
Professional situation				
	Employed	4 (3.5)		
	Sick leave	71 (60.9)		
	Unemployed	9 (7.8)		
	Retired	22 (19.1)		
	Domestic	10 (8.7)		
Education				
	≤ Primary education	77 (66.1)	*F* (2,33.3) = 5.78	**.007****
	≤ Secondary education	22 (19.1)		
	≤ University education	17 (14.8)		
Tumor grade				
	I	13 (11.3)	*F* (2,42.7) = .163	.850
	II	76 (65.2)		
	III	27 (23.5)		
Cancer stage				
	T1	47 (40.0)	*t* (113) = .792	.430
	T2	69 (60.0)		
Type of surgery[a]				
	Breast conserving	93 (80.0)		
	Mastectomy	7 (20.0)		
Number of chemotherapy cycles scheduled[b]				
	4 cycles (AC)	38 (33.0)	F(3,37.7) = 1.30	.289
	6 cycles (FEC-D)	24 (20.9)		
	8 cycles (AC-D)	11 (9.6)		
	16 cycles (AC-P)	43 (36.5)		
Sentinel lymph node				
	Positive	55 (47.0)	t(113) = .192	.848
	Negative	61 (53.0)		
Molecular markers				
	Luminal A	6 (5.2)		
	Luminal B HER2 negative	57 (49.6)		
	Luminal B HER2 positive	33 (28.7)		
	HER2 positive	9 (7.0)		
	Triple negative	11 (9.6)		

$N = 115$. $^{**}p < .01$. *Min* minimum and *Max* maximum

[a]Included 6.1% unilateral mastectomy, 1.7% bilateral mastectomy, and 12.2% modified radical mastectomy

[b]*AC* adriamycin-cyclophosphamide; *FEC-D* 5-fluorouracil/epirubicin/cyclophosphamide followed by docetaxel; *AC-D* adriamycin-cyclophosphamide followed by docetaxel; *AC-P* adriamycin-cyclophosphamide followed by paclitaxel

(85.5 ± 10.8) when compared to women with lower levels of education (75.80 ± 10.9), $p = 0.007$. There was no statistically significant difference between primary and secondary education ($p = 0.412$), or between secondary and university education ($p = 0.281$). The results did not reveal significant differences, in CBI-B scores, based on age, breast cancer grade, stage, number of cycles, or axillary lymph node.

Overview of Structural Models

The EFA of 100 random samples from the 62 participants revealed six most frequent factorial structures (models 1, 2, 3, 4, 5, and 6). EFA was performed based on three criteria: (a) direct oblimin rotation (correlations between factors were higher than 0.30); (b) principal axis factoring method (when the multivariate normality assumption is not fulfilled, for example Fabrigar et al., 1999); and (c) extraction criteria (all factors with eigenvalues > 1 versus only the first four factors). Saturation of 0.30 was used as the cut-off point.

Principal Component Analysis (PCA)

To assess the adequacy of the sample, PCA was performed. According to the KMO (0.805) and the results of Bartlett's test of sphericity ($p < 0.000$), the sample of this study was appropriate for the exploratory analysis. According to the eigenvalues or Kaiser's criterion (above 1.0 good indicator of latent factors) and the scree plot (Pallant, 2016), a solution of four factors was found (Table 3). A solution with three factors was also considered, but after the evaluation of the factor loadings in an oblimin rotation, a model fitting the data was not established. Table 4 presents the results obtained by the CFA, using the six most frequent factor structures, according to EFA.

The analyses of the six factor structures strongly suggested that Models 1 and 6 were the ones in which the CFA showed the best fit. Nonetheless, according to the data presented in Table 3 and 4, item 4 was a problematic item. As a result, the models were tested again, using CFA, but excluding item 4. The results are shown in Table 5. It is important to note that by eliminating item 4, models 1 and 6 were merged, as well as models 3 and 4, with differences only in factors 3 and 4.

Table 3 Factor analysis of the cancer behavior inventory—brief version (CBI-B) with model 6

Items	Mean	SD	Factors of the CBI-B			
			1	2	3	4
Factor 1: maintaining independence and positive attitude						
1. Maintaining independence	7.39	1.30	**0.44**			
2. Maintaining a positive attitude	7.11	1.55	**0.90**			
3. Maintaining a sense of humor	7.13	1.63	**0.47**			
Factor 2: participating in medical care						
8. Actively participating in treatment decisions	8.03	1.38		**0.84**		
9. Asking physicians questions	8.15	1.52		**0.95**		
Factor 3: coping and stress management						
6. Maintaining work activity	7.18	1.62			**0.73**	
7. Remaining relaxed throughout treatments and not allowing scary thoughts to upset me	7.24	1.46			**0.82**	
12. Managing nausea and vomiting	6.27	1.55			**0.48**	
13. Coping with physical changes	6.71	1.43			**0.72**	
Factor 4: managing affect						
4. Expressing negative feelings about cancer	6.77	2.27				**0.59**
10. Seeking consolation	7.06	1.91				**0.42**
11. Sharing feelings of concern	6.06	2.02				**0.73**
Mean inter-item correlation:	.40 Min. (.11)/Max. (.82)					
Eigenvalues:			5.45	1.65	1.26	0.83
Total percentage and cumulative addition			45.43%	13.74%	10.53%	6.91%
Total percentage of the model			76.61%			

$N = 62$. The extraction method was principal axis factoring with an oblique (*direct oblimin*) rotation. Factor loadings above .30 are in bold

SD standard deviation; *Min* minimum and *Max* maximum

Table 4 Rotated factor loadings from the EFA and model fit from the CFA

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Factor 1	1,2,3,4	2,3,4,6,7	1,2,3,4,6,7	1,2,3,6,7	1,2,3,6	1,2,3
Factor 2	8,9	1,8,9	8,9	8,9	8,9	8,9
Factor 3	10,11	12,13	10,11	12,13	4,10,11,12	6,7,12,13
Factor 4	12,13,6,7	10,11	12,13	4,10,11	13,7	4,10,11
$\chi 2$/df	2.06	3.27	2.44	2.31	2.17	1.97
RMSEA	.096, 90% CI [.069, .123]	.140 90% CI [.116, .165]	.112 90% CI [.086, .138]	.106 90% CI [.080, .133]	.101 90% CI [.075, .128]	.090 90% CI [.064, .119]
SRMR	.056	.107	.058	.058	.059	.054
CFI	.928	.847	.903	.912	.921	.934
TLI	.902	.790	.870	.88	.89	.910
AIC	4613	4671	4631	4625	4619	4609
BIC	4728	4786	4746	4740	4734	4724
Factor loadings	.55 to .95	.51 to .92	.60 to .95	.67 to .95	.48 to .95	.47 to .95
Correlation between the factors	$r = .45$ to $r = .86$ except factor 2 and factor 3 ($r = .37$)	$r = .41$ to $r = .74$	$r = .40$ to $r = .75$ except factor 2 and factor 4 ($r = .37$)	$r = .40$ to $r = .74$ except factor 2 and factor 4 ($r = .35$)	$r = .45$ to $r = .82$ except factor 2 and factor 3 ($r = .36$)	$r = .45$ to $r = .86$ except factor 2 and factor 4 ($r = .35$)
Residual covariances—modification indices	$d4,11 = 14.13$	$d4,11 = 15.20$ $d8,9 = 36.28$	$d4,11 = 15.08$ $d7,13 = 16.04$	$d3,4 = 12.71$ $d7,13 = 14.86$	$d3,4 = 13.34$ $d13,12 = 15.37$	$d3,4 = 11.49$
Residual for observed correlations matrix	$r4,11 = .23$	$r4,11 = .25$; $r1,2 = .37$; $r1,3 = .34$; $r1,4 = .28$; $r1,6 = .33$ $r1,7 = .36$	$r7,13 = .17$ $r4,11 = .25$	$r7,13 = .14$ $r12,10 = .15$	$r6,13 = .15$	$r;9,10 = .14$ $r12,13 = .14$ $r12,4 = .14$
Factor loadings—modification indices	Item 13 should saturate at factor 1 (10.09)	Item 1 should saturate at factor 1 (38.39) and Item 7 should saturate at factor 3 (18.55)	Item 7 should saturate at factor 4 (17.27)	Item 7 should saturate at factor 3 (16.10)	Item 6 (9.58) and 12 (6.93) should saturate at factor 4	Item 13 should saturate at factor 1 (10.27)

In this validation, the base structure of the original article was used, although item 5 and item 14 were not included in the analysis, according to the original article. In this sense, the correspondence of the items is similar to the original article (see Table 3)

Table 5 Rotated factor loadings from the EFA and model fit from the CFA, without item 4

	Model 1 and model 6	Model 2	Model 3 and model 4	Model 5
Factor 1	1,2,3	2,3,6,7	1,2,3,6,7	1,2,3,6
Factor 2	8,9	1,8,9	8,9	8,9
Factor 3[a]	12,13,6,7	12,13	10,11	10,11,12
Factor 4[a]	10,11	10,11	12,13	13,7
χ2/df	1.47	2.87	1.83	1.78
RMSEA	.06 90% CI [.020; .098]	.127 90% CI [.010; .156]	.08 90% CI [.052; .116]	.08 90% CI [.049;.114]
SRMR	.04	.101	.05	.05
CFI	.97	.89	.95	.95
TLI	.96	.84	.93	.93
AIC	4170	4223	4184	4182
BIC	4277	4330	4291	4289
Factor Loads	.54 to .95	.51 to .90	.61 to .95	.55 to .94
Correlation between the factors	$r = .45$ to $r = .86$ except factor 2 and factor 3 (model 1) or factor 4 (model 6) ($r = .38$)	$r = .42$ to $r = .76$	$r = .40$ to $r = .76$ except factor 2 and factor 3 (model 3) or factor 4 (model 4) ($r = .37$)	$r = .41$ to $r = .84$
Residual covariances—modification indices	$d12,13 = 7.58$	$d8,9 = 36.11$	$d2,3 = 16.69$ $d7,13 = 13.23$ $d3,13 = 11.93$	$d12,13 = 11.62$ $d2,3 = 7.93$
Residual for observed correlations matrix	$r1,9 = .14$ $r12,13 = .13$	$r2,1 = .37$; $r3,1 = .34$; $r6,1 = .33$ $r7,1 = .36$	$r7,13 = .15$ $r1,9 = .13$	$r1,9 = .13$ $r6,13 = .13$
Factor loadings—modification indices	Item 13 should saturate at factor 1 (8.34)	Item 1 should saturate at factor 1 (37.95)	Item 7 should saturate at factor 4 or factor 3 (15.88), depending on the model	Item 6 (8.91) and item 12 (10.52) should saturate at factor 4

[a]With the elimination of item 4, model 1 and model 6 merged, as well as model 3 and 4; however, factors 3 and 4 in these models have the items switched. For this reason, the correlation between the factors makes this distinction

Without item 4, the analyses of the six factorial structures strongly suggest that the merged models 1 and 6 provide the best solution. All models, in general, improved their adjustment with the elimination of item 4, thus strongly supporting a final model without item 4, as shown in Fig. 1.

Reliability

The analysis of the corrected item-total correlations showed acceptable values (from 0.43 to 0.77). The Cronbach's alpha was 0.88, indicating a high internal consistency. Cronbach's alpha was 0.86 for Factor 1, 0.83 for Factor 2, 0.83 for Factor 3, and 0.61 for Factor 4. The ICC was 0.59, 95% CI [0.49; 0.68], $p < 0.001$, indicating that the test–retest reliability of the Portuguese version of the CBI-B was moderate.

Convergent Validity

The Portuguese version of CBI-B (CBI-B/P) including the total scale and factors showed good convergent validity with the QoL scale (QLQ-C30): total scale ($r = 0.40$, $p < 0.001$), Factor 1 ($r = 0.34$, $p < 0.001$), Factor 2 ($r = 0.19$, $p = 0.045$), Factor 3 ($r = 0.43$, $p < 0.001$), and finally Factor 4 ($r = 0.20$, $p = 0.032$).

Divergent Validity

The CBI-B/P scale and factors correlated negatively with measures of psychological distress (HADS) and illness perceptions (IPQ-B). The HADS total score was negatively correlated with the CBI-B total score ($r = -0.60$, $p < 0.001$), Factor 1 ($r = -0.61$, $p < 0.001$), Factor 2 ($r = -0.23$, $p = 0.014$), Factor 3 ($r = -0.63$, $p < 0.001$), and Factor 4 ($r = -0.24$, $p = 0.009$). The IPQ-B was negative correlated with the CBI-B total score ($r = -0.51$, $p < 0.001$), Factor 1 ($r = -0.50$, $p < 0.001$), Factor 2 ($r = -0.24$, $p = 0.010$), Factor 3 ($r = -0.52$, $p < 0.001$), and Factor 4 ($r = -0.23$, $p = 0.013$).

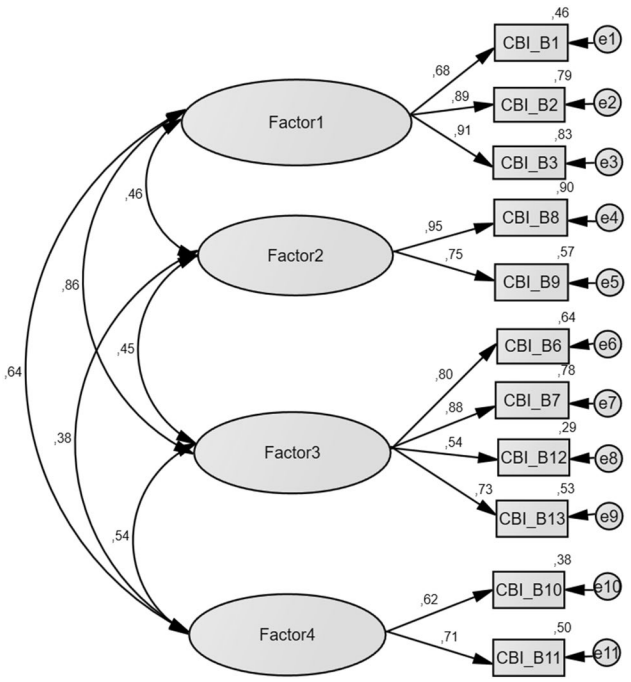

Fig. 1 Path Diagram of the Final Model (model 1 and model 6 merged, without item 4): four-factor structural equation model for the Portuguese Brief Version of the Cancer Behavior Inventory (CBI-B/P). Note: χ^2/DF = 1.47, CFI = 0.97, TLI = 0.96, RMSEA = 0.06, 90% CI [0.020, 0.098]; SRMR = 0.04, AIC = 4170 and BIC = 4277

Discussion

The current study validated the CBI-B in Portuguese breast cancer patients. The results showed that the CBI-B/P was reliable and valid, although the "Managing Affect" factor showed an internal consistency below 0.70, as in a previous validation study (Serpentini et al., 2019). The ICC indicated that the test–retest reliability was moderate. This result is understandable, as self-efficacy refers to the behavior that occurs in the course of a cancer diagnosis and treatments, followed by transition to survival. Therefore, women are required to change behavior and adapt to the course of cancer, which may explain why self-efficacy may increase over time (Nejad et al., 2015). The results revealed that the CBI-B/P presented the same structure as the original version proposed by Heitzmann et al. (2011).

The initial analysis showed that item 4 was problematic in the six models produced by EFA. Therefore, all models without item 4 were tested again. In addition to the statistical data obtained in the CFA, and considering the original validation paper (Heitzmann et al., 2011), the elimination of item 4 was also reinforced by the low loading factor and lower mean when compared to other items, in the CFA model. Without item 4, CFA found that the models improved their adjustment indicating that Model 1 (representing model 1 and 6) was the model with the best adjustment (Brown, 2015). The elimination of item 4 can also be understood from a cultural perspective. Although item 4 content is clear and easy to interpret, it may be problematic due to its relationship with item 11, since both can be interpreted similarly. In fact, item 11 assesses the sharing of feelings of concern in a more general perspective (e.g., work, family, social life, treatment side effects), and item 4 addresses the expression of negative feelings about cancer. Furthermore, the elimination of item 4 may also be explained by cultural issues. In the Portuguese culture, negative emotions are considered a personal/intimate matter. Pereira et al. (2019), within an oncology context in a validation study, found that items addressing emotional/feelings related to cancer (e.g., myeloma) had to be removed.

Although other CBI-B validations (Iyigun et al., 2017; Serpentini et al., 2019) have kept item 4 based on the results, the final model in the Portuguese sample is similar to the original model, excluding item 4 (Fig. 1).

Concerning convergent and divergent validity, high self-efficacy was related to high QoL, low psychological distress (Chirico et al., 2017), and less threatening illness perceptions (Bigatti et al., 2012; Shim et al., 2018). These results reveal the parallelism between the English version (Heitzmann et al., 2011) and the Portuguese version, since both found similar correlations with the same constructs (emotional distress and QoL). Other instrument validations (e.g., Iyigun et al., 2017; Serpentini et al., 2019) also found positive correlations with QoL and negative correlations with psychological distress (Serpentini et al., 2019), hence reinforcing the results of the Portuguese version.

According to the literature, the physical changes underlying cancer treatment (i.e., limitations in physical functioning, difficulties in daily activities and limited functioning) in patient's roles can trigger changes in the patient's self-confidence to keep their independence (Neo et al., 2017). The limitations have repercussions on QoL (Shafaee et al., 2018), being associated with high distress symptoms (Lee et al., 2011) and threatening illness perceptions, particularly consequences and personal control (Cooper et al., 2012).

Similarly, taking a positive attitude, related to optimism and the sense of control in every day, enhances not only some sense of normalcy in the lives of cancer patients, but also the ability to look at the positive side of life experiences (Wilkes et al., 2003), which may impact the perception of disease severity (Shelby et al., 2008) and the reduction of psychological distress (Cohen, 2002). Participation in medical care is also essential, for the sense of self-efficacy for coping, in cancer patients. However, patient's involvement is related to the nature of the physician–patient relationship (e.g., related to the facilitation of patient's involvement and information throughout the course of the disease) (Dehghan et al., 2018). The physician-patient relationship has been positively associated with QoL (Dehghan et al., 2018), as

well as with health outcomes such as symptoms of psychological distress (Ohaeri et al., 2012) and perceived disease control (Chou, 2019).

Regarding coping and stress management, the literature also reveals that high self-efficacy for coping is related to high involvement in effective coping strategies, and high likelihood to report good QoL and favorable medical outcomes (e.g., less intense symptoms and/or side effects) (Heitzmann et al., 2011).

In terms of emotional management, emotional expression has been associated with a good cancer adaptation (Brandão et al., 2015), confidence in one's social support network, seeking resources and a good emotional functioning in women with breast cancer (Casellas-Grau et al., 2016).

The results of the present study showed significant differences, in CBI scores, according to the patient's education level, such that women with higher education showed higher self-efficacy. This result is in accordance with the literature (BorjAlilu et al., 2017) that showed that being more educated favors a sense of agency. Education can embody a great self-efficacy to access, understand, and use medical information as well as search for social support (Merluzzi et al., 2001) and handle life stress (Rottmann et al., 2010).

Limitations and Conclusion

This study presents some limitations that need to be acknowledged such as the sample size (and the use of a unique independent sample) and the low education level of the sample. However, statistical techniques (EFA in 62 participants and CFA in 115 participants) were used to minimize the error due to the sample size. Future studies should consider larger samples to analyze whether the results found, in this study, can be replicated. Also, this study included a sample of women with breast cancer with a low education level. Therefore, it is important to validate the instrument in other types of cancer patients and with more educated women. Finally, although the ICC was evaluated at three time points, it is important to assess self-efficacy over longer periods of time, in future studies.

The Portuguese version of the CBI-B is representative of the original version, maintaining the four-factor structure, although without item 4 in factor 4. Concerning psychometric characteristics, the CBI-B/P presents itself as a reliable and valid instrument for assessing self-efficacy for coping, in women with early-stage breast cancer. According to the results, it is important to screen and intervene in women with breast cancer, particularly if they present lower education, in order to increase their self-efficacy for coping. Future research should also validate the instrument in other oncological populations including more advanced disease stages.

Authors Contribution MP was responsible for contributed to data acquisition, manuscript preparation and data analysis and interpretation, manuscript review and editing. PI was responsible for manuscript review and editing revising it critically for important intellectual content; MGP was responsible for the study design, data analysis and interpretation, manuscript review and editing revising it critically for important intellectual content.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Human Participants and/or Animals Rights and Informed Consent All procedures performed in studies involving human participants were in accordance with the ethical standards of the Hospital Ethics Committees and the Helsinki Declaration of 1964. Participants who agreed to participate in this study voluntarily signed an informed consent.

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