Psychometric Evaluation of the Brief Cancer Impact Assessment among Breast Cancer Survivors

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Key Words

Cancer survivors · Factor analysis · Impact of cancer · Psychometric testing · Quality of life

Abstract

Objectives: The increasing number of cancer survivors brings greater attention to the biopsychosocial impact of surviving cancer. Instruments exist that measure quality of life (QOL), symptoms, and specific types of functioning after cancer; however, a reliable and valid assessment of the perceived impact of cancer (IOC) on the life plans and activities of cancer survivors has been missing. This study evaluated the psychometric properties of the 16-item Brief Cancer Impact Assessment (BCIA). **Methods:** Factor analysis with Promax oblique rotation established the factor structure of the BCIA in 783 ethnically diverse breast cancer survivors, ≥ 2 years after diagnosis. Construct validity was assessed by compar-

ing factor-based scale means by demographic and treatment characteristics, and correlating scales with psychosocial and health-related QOL scales. **Results:** Factor analysis revealed four factors measuring the IOC on caregiving and finances, exercise and diet behaviors, social and emotional functioning, and religiosity. Scale scores differed by demographic and treatment characteristics according to expectations, and the pattern of correlations with psychosocial and health-related QOL generally supported the construct validity of the scales. **Conclusion:** Including the BCIA with measures of QOL, symptoms, and functioning will allow researchers to gain a more comprehensive assessment of the biopsychosocial IOC in survivors.

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Introduction

In 2005, the National Cancer Institute (NCI) estimated there were 10.1 million cancer survivors in the United States [1]. Female breast cancer survivors comprise the largest group of cancer survivors, including 22% of all

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cancer survivors and 40% of all female cancer survivors [1]. With advances in early detection and treatment, the number of cancer survivors, especially breast cancer survivors, will continue to increase. This increase in the number of cancer survivors necessitates an increase in research and clinical attention to the biopsychosocial impact that surviving cancer can have, including the IOC on domains of functional status, quality of life (QOL), and on life plans and activities. A review of this growing body of literature documents that the interrelated web of adverse medical, psychosocial, and economic issues faced by cancer survivors carries great potential for physical and psychosocial morbidity [2]. In addition to having a *negative* impact on physical and psychosocial functioning and QOL, cancer can also have a *positive* impact on a person's life. Many cancer patients report finding benefit or meaning in the cancer experience [3, 4]. Cancer may also have a positive impact on health behaviors [5] and spirituality [6].

With the growing number of research studies in cancer survivorship, reliable and valid measurement tools are needed to assess these multiple facets of the negative and positive IOC in survivors. Several reliable and valid instruments exist that assess general functional status in cancer survivors (e.g. SF-36 [7]), as well as QOL or specific types of functioning (e.g. the Functional Assessment of Cancer Therapy Scales [8], the European Organization for Research and Treatment of Cancer QLQ-C30 [9], the Functional Living Index-Cancer [10], and the Ferrans-Powers QOL-Cancer Version [11]), including two instruments that are specific to survivors who have concluded primary treatment (the Long-Term QOL Scale [12] and the QOL-Cancer Survivors [13]). There are also measures that assess specific symptoms (depression, distress, and fatigue) that are impacted by cancer and treatment. What has been missing is an instrument designed to assess the perceived IOC on the life plans and activities of cancer survivors, encompassing caregiving abilities, finances, educational or retirement plans, exercise and diet behaviors, social and family plans, and religiosity. Including a measure like this along with measures of QOL, symptoms, and functioning will allow researchers to gain a more comprehensive assessment of the biopsychosocial IOC.

We know of one such instrument, the IOC Scale, a recently developed measure of the IOC on ten domains, including health awareness, body changes, health worries, positive and negative self-evaluation, positive and negative life outlook, social life interferences, relationships, and meaning of cancer [14]. While this is a comprehensive and promising instrument, administration of its 41

items may not be feasible in clinical trials or studies where participant burden is a pressing issue. A shorter measure is needed for these studies. The Brief Cancer Impact Assessment (BCIA) may fill this gap.

The BCIA is a 16-item instrument that was developed previously by Ganz et al. [15] and used in studies of long-term survivors of breast cancer. The scale was developed to measure the perceived impact, both negative and positive, of breast cancer on 16 areas of various life plans and activities that were considered to be relevant to long-term survivors. Domains assessed include caregiving, social and love life, family plans, financial and insurance concerns, exercise, diet, education, work, emotional needs, and religiosity. Detailed psychometric evaluation of this scale was not undertaken by Ganz et al. [15]. In the present study, we aimed to establish the psychometric properties of this instrument in a large multiethnic sample of breast cancer survivors so that it may be used in future research. We present the results of a factor analysis identifying groups of items that provide separate cancer impact scales, internal consistency reliability estimates for these scales, and cancer impact scale scores within subgroups of women defined by demographic and breast cancer treatment characteristics. We also present associations between these cancer impact scales and reliable and valid scales measuring related or unrelated constructs to demonstrate convergent or discriminant validity, including optimism, fear of recurrence (FOR), perceived stress, post-traumatic growth, and health-related QOL subscales. We hypothesized that (1) cancer impact scores on factors measuring financial concerns would be more negative (greater negative impact) among participants with lower incomes and those who were unemployed and looking for work, given the likelihood that these survivors would be more vulnerable to the financial burden of cancer; (2) scores on factors measuring positive changes in diet or exercise behaviors would be higher among participants who were married, not working outside the home, or had higher household incomes, who would likely have the time and resources to positively change their health behaviors; (3) scores on factors measuring emotional well-being or social functioning would be more positively correlated with the mental health than the physical health scales of the SF-36, given their conceptual similarity, and (4) scores on factors measuring changes in religious experiences would be positively correlated with post-traumatic growth scales, especially with the subscale measuring spiritual change, given their conceptual similarity.

Methods

Study Overview

Participants in this study are women enrolled in the Health, Eating, Activity, and Lifestyle (HEAL) Study, a population-based, multicenter, multiethnic, prospective study of women newly diagnosed with in situ or stage I–IIIA breast cancer. HEAL study participants are being followed to determine the impact of weight, physical activity, diet, hormones, and other exposures on breast cancer prognosis. Written or documented verbal informed consent was obtained from each participant for participation in the original HEAL Study and at each subsequent assessment. All study protocols were approved by the Institutional Review Boards of each participating center.

Eligibility and Recruitment

Eligibility and recruitment into HEAL are described in detail elsewhere [16]. Briefly, patients diagnosed with their first primary breast cancer were recruited from National Cancer Institute-sponsored Surveillance Epidemiology and End Results (SEER) registries in three geographic regions of the United States: New Mexico, Western Washington, and Los Angeles County, California. A total of 1,183 participants completed the baseline survey including 615 from New Mexico, 202 from Western Washington, and 366 from Los Angeles County. Of those women who completed the baseline survey, 944 (80%) participated in the 24-month assessment and 858 (73%) participated in the QOL follow-up. For these analyses of QOL outcomes, we excluded 53 women diagnosed with recurrent breast cancer or a new primary breast cancer by the date of the QOL assessment and 2 women who had unconfirmed cases of new breast disease at the time of these analyses. This defined a QOL cohort of 805 women. For the analyses presented here, we also excluded an additional 22 participants because they did not have complete data for the BCIA questions. The final sample size for the factor analysis was 783 women.

Data Collection

Data for the current study derive from three data collection points; the baseline interview (on average 6.1 months following diagnosis), a second interview on average 24.4 months later, and a third assessment consisting of the QOL survey (on average 34.5 months after baseline). The baseline and 24-month assessments were conducted via in-person interview or self-completed questionnaire at all three sites and included information on demographic and clinical variables. The QOL assessment was administered by telephone interview and mailed questionnaire in New Mexico, by mailed questionnaire plus telephone follow-up in Washington, and by telephone interview in Los Angeles County. The same QOL assessment, a standardized questionnaire that included information on hormone-related symptoms, physical functioning, mental health, and QOL measures, was used at all sites.

Measures

Brief Cancer Impact Assessment. The BCIA was originally developed by Ganz et al. [15] for a multisite study examining QOL among 817 breast cancer survivors 5–10 years after diagnosis. The scale was created to examine the perceived negative and positive impact of breast cancer on 16 areas of functioning and activities that were considered to be relevant to long-term survivors. Participants were asked to look back over the time since their breast

cancer diagnosis and report how much of an impact their cancer experiences had on a number of different areas of their life overall. Domains assessed include caregiving, social and love life, family plans, financial and insurance concerns, exercise, diet, education, work, and religiosity.

For the present study, two items were added to the instrument used in the study by Ganz et al. [15] because of their perceived relevance to breast cancer survivors and absence in the original instrument: ‘Your ability to retain or change your health care insurance’, and ‘your emotional and psychological needs’. The scale was given the title ‘Brief Cancer Impact Assessment’ both to differentiate it from the new Impact of Cancer Scale developed by Zebrack et al. [14] and to emphasize a major advantage of the scale: its brevity. Thus, the BCIA evaluated here included 18 items available for psychometric analysis. Response options were –2 (‘very negative impact’), –1 (‘somewhat negative impact’), 0 (‘no impact’), 1 (‘somewhat positive impact’), and 2 (‘very positive impact’). This scoring is the same as that used by Ganz in her earlier study [15]; however, when the results were reported in that study, the scores of individual items were reported collapsing into three response levels (‘negative’, ‘no impact’, or ‘positive’). Therefore, this analysis performs scaling of the multi-item instrument, and uses the full response range in scoring.

Optimism-Pessimism. The Life Orientation Test-Revised (LOT-R) was used to assess dispositional optimism. In standard applications, the LOT-R has ten items, six active items and four fillers. However, in this study, only the six active items were used. Examples of items include ‘In uncertain times, I usually expect the best’ and ‘If something can go wrong for me it will’. The response options were coded to range from 0 (‘I strongly disagree’) to 4 (‘I strongly agree’). The LOT-R yields an overall score of summed responses ranging from 0 to 24 with higher values implying greater optimism. The LOT-R has good internal consistency with Cronbach’s α in the high 0.70s to low 0.80s [17]. In the present sample α was 0.77.

Perceived Stress. A four-item version of the Perceived Stress Scale (PSS) [18] was used to subjectively measure the degree to which participants experienced stress. Items were rated on 5-point Likert-type response scales and were coded to range from 0 (‘never’) to 4 (‘very often’). PSS items directly assessed perceptions of feeling stressed, as well as the degree to which events are appraised as unpredictable, uncontrollable, and overloading. All four items were summed to produce a single score ranging from 0 to 16, with higher values indicating greater perceived stress. Internal and test-retest reliabilities as well as convergent and discriminant validities were reported to be adequate [18]. In the present sample Cronbach’s α was 0.77.

Fear of Recurrence. The FOR questionnaire is based on a 22-item instrument used to measure FOR for cancer patients in remission. The FOR questionnaire has been reported to have good internal consistency in other studies with breast cancer patients [19, 20]. For the current study we used a 5-item version of the FOR questionnaire which has not been validated previously. Participants were asked to indicate how much they agree or disagree to statements that express concerns, e.g. ‘I would like to feel more certain about my health’ and ‘I worry that my cancer will return’. Response options were rated on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The total FOR score was computed by summing the scores for a participant ranging from 5 to 25, with higher scores suggesting greater FOR. Confirmatory factor analysis

indicated that all items loaded onto one common factor which accounted for 66% of the scale variance. Cronbach's α was 0.82 in the present sample and item-total score correlations ranged from 0.48 to 0.76 indicating moderate/high factor loadings for all items.

Post-Traumatic Growth. We used the Post-Traumatic Growth Inventory developed by Tedeschi and Calhoun [21] as a reliable and valid measure of perceived positive outcomes resulting from having a trauma (here defined as cancer). The Post-Traumatic Growth Inventory is a 21-item measure with five subscales, measuring positive changes in domains of new possibilities, relating to others, personal strength, spiritual change, and appreciation of life. The response scale is a 6-point Likert format ranging from 0 (no change) to 5 (very great change). The subscales are computed by summing the individual items in each scale and range from 0 to 25 (new possibilities), 0–35 (relating to others), 0–20 (personal strength), 0–10 (spiritual change), and 0–15 (appreciation of life). Internal consistency estimates and test-retest reliability are considered to be acceptable [21]. Cronbach's α ranged from 0.87 to 0.92 in the present sample.

Health-Related QOL. We used the SF-36 Health Status measure created to measure health-related QOL in healthy populations [22]. This widely used measure includes 36 items, scored into eight subscales: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health, summarized into a physical component and a mental component summary scale. All SF-36 subscales ranged from 0 to 100 with increasing scores indicating better health-related QOL, per standard coding protocol. Also per protocol, the two component summary measures have a mean of 50 and a standard deviation of 10. Considerable psychometric analyses have been published on the SF-36 and its summary components (e.g. [7]), and our own analyses indicate high internal consistency among items in the subscales (Cronbach's α ranged from 0.78 to 0.91).

Demographic Variables. We used simple standard measures of age in years, education, and race/ethnicity, collected on the baseline survey for the HEAL study, and income, marital status, and employment collected on the 24-month follow-up survey. Menopausal status was determined at the 24-month assessment using an algorithm that assigned women into pre-, post-, or unclassifiable menopausal status. Details on this algorithm are provided elsewhere [16]. Briefly, this algorithm was based on the following questionnaire data: age, date of last menstruation, and hysterectomy and oophorectomy status. Menopausal status is missing for women in the QOL study who did not complete a 24-month follow-up assessment ($n = 27$).

Stage of Breast Cancer and Treatment. Stage of disease was based on SEER data. Treatment data were obtained from medical record abstraction and SEER registry records. We abstracted details of surgeries, radiation therapy, chemotherapy, and use of tamoxifen therapy. Treatment data were recoded as: surgery only; surgery with chemotherapy; surgery with radiation, or the combination of all three treatments. These variables were abstracted before or concurrent with the 24-month assessment. Use of tamoxifen was collected by a combination of medical abstraction and self-reported use at baseline and at the 24-month assessment. We used these data to create a three-level variable of tamoxifen use: use between baseline and 24 months, use at or before baseline only, and no use during the study period.

Antidepressant Use. Self-reported use of antidepressant medication was collected at the 24-month assessment. Participants were

asked whether they were currently taking any prescription medications. If yes, participants enumerated each medication name, the dose, and how often they took the medication. We coded these data to form a dichotomous variable indicating current use (currently taking at the 24-month follow-up) versus no current use (not currently taking at the 24-month follow-up).

Overview of Analysis

The analyses presented in this paper use data collected through November 18th, 2004. In the present study, fewer than 35% of the participants responded to one of the original items used in Ganz, 2002 [15] ('other changes'). This item was dropped from further psychometric evaluation, and responses for the remaining 17 items were subjected to an exploratory factor analysis using weighted least-square parameter estimates. Exploratory factor analysis was deemed the most appropriate technique because we had no a priori notions regarding the number or specification of the underlying latent variables. The components were extracted via the principal factor method followed by Promax (oblique) rotation in order to yield optimal results given our belief that the underlying factors would be correlated. For interpretation of the rotated factor pattern, an item was said to load on a given component if the factor loading was at least 0.30 for that component and had factor loadings less than 0.30 for all other components. The factor analysis was conducted using Mplus, software that allows for analysis of ordinal level data [23]. Determination of the number of factors to retain in the final solution was based on a number of indices. The magnitude of the eigenvalues was examined by looking at the percent of variance explained by each factor and also the resulting scree plot. The root mean square error of approximation was examined with 0.06 serving as a rule of thumb for good model fit [24].

To investigate convergent and discriminant validity, we created factor-based scale scores on each of the resulting scales for each participant by taking the mean of the items that loaded highly on that component. We then used analysis of variance to test differences in cancer impact scale scores based on age, cancer treatment type, months from diagnosis to the QOL interview, marital status, current employment, and income. Least-square means from these models adjust for the following covariates: breast cancer stage at diagnosis, antidepressant use, and treatment type (except for analyses of treatment type). Individual contrasts were explored against the defined reference group of that characteristic where the omnibus test of effect was significant at $p \leq 0.05$. Because the distribution for the religiosity scale was substantially and positively skewed, we repeated the analyses of variance using bootstrap methods, which test the same means but account for the skewed distribution when estimating p values [25]. The bootstrap method produced similar results to those produced by our standard analysis of variance.

To further test the construct validity of the scale scores, we tested correlations between the four BCIA scale scores and other psychosocial and health-related QOL instruments available to us, thought to be conceptually related or unrelated to the BCIA scales, including optimism, FOR, perceived stress, post-traumatic growth, and SF-36 scales. These analyses were conducted using SAS/STAT® software (version 9 of the SAS System for Windows, 2002, SAS Institute).

Table 1. Baseline demographic and clinical characteristics of HEAL participants in the present study (n = 783)

Baseline characteristics	n	%
Age		
29–49 years	231	29.5
50–59 years	290	37.0
60–69 years	176	22.5
≥ 70 years	86	11.0
Mean ± SD	55.6 ± 10.4	
Education		
High school or less	201	25.7
Some college	287	36.7
College graduate	149	19.1
Graduate school	145	18.5
Missing	1	
Race/ethnicity		
Non-Hispanic White	484	61.8
Black	180	23.0
Hispanic	95	12.1
Other	24	3.1
Stage at diagnosis		
In situ	170	21.7
Localized	446	57.0
Regional/distant	167	21.3
Breast cancer treatment		
Surgery only	248	31.7
Surgery + radiation only	292	37.3
Surgery + chemotherapy only	72	9.2
Surgery + radiation + chemotherapy	171	21.8
Registry		
Western Washington	166	21.2
New Mexico	438	55.9
Los Angeles	179	22.9

Results

Sample Characteristics

Table 1 presents the baseline and table 2 the 24-month follow-up demographic characteristics of the sample. Where demographic characteristics may have changed from the baseline survey to the follow-up survey, we present the data from the 24-month follow-up survey. At baseline, participants ranged in age from 29 to 86 years with a mean age of 55.6 years. The sample was predominantly White with 23% Black participants and 12% Hispanic participants. Most participants had been diagnosed with localized cancers. At the 24-month follow-up, participants were generally post-menopausal, married, college educated, and currently employed with a wide range of incomes. When the BCIA was assessed, participants ranged in age from 32 to 89 years, with a mean age of 58.4 years, and were on average 40.5 months after diagnosis.

Table 2. Follow-up demographic and clinical characteristics of HEAL participants in the present study (n = 783)

24-Month follow-up characteristics	n	%
Months from diagnosis to QOL interview		
23–35	192	24.5
36–41	264	33.7
42–47	201	25.7
48–63	126	16.1
Mean ± SD	40.5 ± 6.5	
Marital status		
Married or living with a partner	441	58.6
Widowed/divorced/separated	266	35.3
Never married	46	6.1
Missing	30	
Employment status		
Currently working	436	57.8
Unemployed (on leave, looking for work)	25	3.3
Not working outside the home/retired/disabled	293	38.9
Missing	29	
Income		
≤ 10,000 USD	53	7.5
>10,000–20,000 USD	84	11.9
>20,000–30,000 USD	88	12.5
>30,000–50,000 USD	165	23.4
>50,000–70,000 USD	207	29.4
>70,000 USD	108	15.3
Missing	78	
Menopausal status		
Pre-menopausal	139	18.4
Post-menopausal	576	76.2
Unable to categorize	41	5.4
Missing	27	
Tamoxifen		
Use between baseline and 24 months	340	45.0
Use at or before baseline only	69	9.1
No use during the study period	347	45.9
Missing	27	
Antidepressants		
Currently taking at 24 months	116	15.3
Not currently taking at 24 months	640	84.7
Missing	27	

‘Missing’ includes women with baseline and QOL data who did not complete a 24-month assessment (n = 27).

Mean Scores for the Brief Cancer Impact Assessment

Table 3 reports the mean scores for the 17 items of the BCIA instrument under evaluation, listed in ranked order from most positive impact to most negative impact. In general, the mean item scores were between –1 and 1, suggesting relatively minor levels of impact. In the present sample, breast cancer had the greatest positive impact on religiosity. The item ‘your religious beliefs (e.g. belief in a

Table 3. Item means from the BCIA, ranked from most positive to most negative impact, as reported by 783 breast cancer survivors

Item	Mean $\pm$ SD ^a
Your religious beliefs (e.g. belief in a higher power)	0.79 $\pm$ 0.87
Your diet	0.51 $\pm$ 0.95
Other activities related to spirituality (e.g. meditation)	0.51 $\pm$ 0.79
Your religious activities (e.g. affiliation with a religious institution, participation in religious activities)	0.40 $\pm$ 0.77
Your exercise activities	0.20 $\pm$ 0.96
Your social life (friendships, social activities)	0.19 $\pm$ 0.85
Your retirement plans	0.07 $\pm$ 0.73
Your ability to be a caregiver to others (e.g. aging parents, sick spouse)	0.04 $\pm$ 0.69
Your educational plans (e.g. classes completed, degrees earned, goals achieved) ^b	0.03 $\pm$ 0.59
Your family plans (e.g. finding a partner, divorce, marriage, having children)	0.01 $\pm$ 0.72
Your ability to care or provide for your children	0.01 $\pm$ 0.53
Your living arrangements (e.g. moving in with relatives, selling a house)	0.00 $\pm$ 0.51
Your work life or career (e.g. promotion, mobility, work environment)	-0.02 $\pm$ 0.79
Your emotional or psychological needs	-0.09 $\pm$ 0.96
Your love life	-0.13 $\pm$ 0.85
Your ability to retain or to change your health care insurance	-0.17 $\pm$ 0.71
Your financial situation	-0.19 $\pm$ 0.70

One item ('other changes') has been omitted here and in subsequent analysis due to no response from over 65% of the 783 participants.

^a Item responses coded from -2 (very negative impact) to +2 (very positive impact) and are centered at 0 (no impact).

^b Item deleted from final factor analysis solution due to high loadings on two factors.

higher power)' garnered the highest positive score, 0.79, which most closely corresponds to the response 'somewhat positive impact'. Three out of the top four items on the positively affected end of the spectrum concerned religiosity with scores ranging from 0.40 to 0.79. On the negative end of the spectrum, finances, insurance coverage, and love life appeared to be affected the most; however the impact was not as great. The lowest score, indicating the greatest negative impact, was a score of -0.19 for the item 'your financial situation'. This score corresponds most closely to the response 'no impact'. The next most negative scores were -0.17 for the item 'your ability to retain or change your health care insurance', and -0.13 for the item 'your love life'.

Factor Structure

Principal factor analysis with Promax rotation revealed a four-factor structure accounting for 64.2% of the common variance in our BCIA data. This four-factor solution satisfied all of the criteria for establishing meaningful components: Results of a scree test suggested that there were four meaningful components, and these four components individually accounted for between 38.7 and

6.1% of the common variance in the data. The root mean square error of approximation for the four-factor solution was 0.07, indicating good model fit. The mean correlation among the four factors was 0.47, with a range from 0.32 to 0.66. Finally, the four-factor structure demonstrated good interpretability (table 4: factor loadings used to interpret the meaning of each factor are indicated in bold).

The first factor represented the IOC on caregiving and finances and included six items concerning one's ability to care or provide for children, the ability to be a caregiver to others, retirement plans, financial situation, ability to retain or change health insurance, and work life or career. This factor accounted for 38.7% of the common variance in the BCIA scores. The item 'your educational plans (e.g. classes completed, degrees earned, and goals achieved)' loaded on this factor (original factor loading = 0.34) as well but was excluded from the final factor analysis model since it also loaded highly on factor 3 (original factor loading here = 0.27) and did not intuitively fit with the other items used to interpret factor 1. The second factor represented the IOC on exercise and diet activities and included two items, one concerning diet and the other concerning exercise. This factor accounted for 11.6% of

Table 4. Promax (oblique) rotated factor pattern from factor analysis of the BCIA (n = 783)

Item	Factor 1 Caregiving/ Finances	Factor 2 Exercise/ Diet	Factor 3 Social/ Emotional	Factor 4 Religiosity
Your ability to care or provide for your children	0.90	-0.04	-0.10	0.11
Your ability to be a caregiver to others	0.82	0.03	-0.13	0.12
Your retirement plans	0.56	0.13	0.07	-0.09
Your financial situation	0.52	0.12	0.21	-0.27
You ability to retain or to change your health care insurance	0.50	-0.16	0.12	0.06
Your work life or career	0.39	0.03	0.28	0.04
Your exercise activities	0.10	0.88	-0.10	-0.01
Your diet	-0.12	0.52	0.14	0.15
Your family plans	-0.14	-0.16	0.89	0.10
Your love life	-0.05	0.03	0.73	-0.14
Your emotional or psychological needs	0.23	0.01	0.50	0.03
Your social life	0.07	0.14	0.50	0.15
Your living arrangements	0.14	0.03	0.49	0.04
Your religious activities	0.14	-0.03	-0.02	0.81
Your religious beliefs	0.02	0.03	0.03	0.81
Other activities related to spirituality	-0.03	0.04	0.08	0.78

Factor loadings used to interpret the meaning of each factor are in bold. The education item ('your educational plans') was dropped from the final factor analysis model due to high loadings on factors 1 and 3.

the common variance in the BCIA scores. The third factor represented the IOC on social and emotional functioning and included five items concerning family plans, love life, emotional or psychological needs, social life, and living arrangements. This factor accounted for 7.8% of the common variance in the BCIA scores. The fourth factor that emerged involved the IOC on religiosity and included three items on religious activities, religious beliefs, and other activities related to spirituality. This factor accounted for 6.1% of the common variance in the BCIA scores.

Internal Consistency Reliability

We next assessed the item-total correlation coefficients and Cronbach's α coefficients for the four-factor-based scales created from the BCIA in order to establish internal consistency reliability. For each scale, the correlation between each item and the sum of the remaining items that constitute the scale were satisfactory, indicating all items were reasonably homogenous. Item-total correlations for the Caregiving/Finances Scale ranged from 0.41 to 0.59; for the Exercise/Diet Scale, both correlations equaled 0.46; for the Social/Emotional Scale, correlations ranged from 0.43 to 0.57, and for the Religiosity scale, correlations ranged from 0.64 to 0.66. Internal consistency coefficients were generally high across the scales. Cronbach's

α estimates by scale were: Caregiving/Finances, 0.77; Exercise/Diet, 0.63; Social/Emotional, 0.75, and Religiosity, 0.81.

Factor-Based Scale Scores

Factor-based scores were computed by taking the mean of the participant's responses to items that loaded highly within each factor component. Intercorrelations among the scale scores for the four different BCIA scales were statistically significant ($p < 0.001$, respectively); however, the correlations were low to moderate, and ranged from 0.32 (Caregiving/Finances and Religiosity Scales) to 0.60 (Caregiving/Finances and Social/Emotional Scales).

Table 5 presents the overall mean scale scores for the four BCIA Scales. The mean scale score for Religiosity was highest (0.57), followed by Exercise/Diet (0.35), Social/Emotional (-0.01), and Caregiving/Finances (-0.04). Table 5 also presents the BCIA Scale unadjusted means by demographic and treatment characteristics, as well as results of the analyses of variance models testing demographic and treatment group differences in the adjusted least-square means. The level of statistical significance for each contrast level versus the referent level is denoted in table 5 (^a $p < 0.05$, ^b $p < 0.01$ and ^c $p < 0.001$). p values for tests described below were $p < 0.05$ unless otherwise noted.

Table 5. Mean BCIA scores, by demographic and treatment characteristics

	Caregiving/Finances	Exercise/Diet	Social/Emotional	Religiosity
Overall mean $\pm$ SD (n = 783)	-0.04 $\pm$ 0.48	0.35 $\pm$ 0.82	-0.01 $\pm$ 0.56	0.57 $\pm$ 0.69
Months from diagnosis to QOL interview (n = 783)	p = 0.50	p = 0.54	p = 0.77	p = 0.41
23–35 (reference)	-0.02 [-0.07]	0.40 [0.23]	0.02 [-0.09]	0.55 [0.51]
36–41	-0.04 [-0.11]	0.36 [0.18]	0.01 [-0.11]	0.57 [0.56]
42–47	-0.07 [-0.14]	0.39 [0.22]	-0.02 [-0.13]	0.54 [0.54]
48–63	-0.04 [-0.11]	0.22 [0.10]	-0.05 [-0.15]	0.62 [0.64]
Age at time of QOL interview	p = 0.47	p = 0.01	p = 0.62	p = 0.03
29–49 years (n = 166)	-0.07 [-0.12]	0.39 [0.24] ^b	-0.03 [-0.13]	0.62 [0.57] ^a
50–59 years (n = 287)	-0.06 [-0.10]	0.36 [0.18] ^b	-0.03 [-0.13]	0.60 [0.55] ^a
60–69 years (n = 213)	-0.05 [-0.10]	0.42 [0.22] ^b	0.05 [-0.07]	0.60 [0.58] ^b
$\geq$ 70 years (n = 117) (reference)	0.04 [-0.03]	0.16 [-0.09]	-0.00 [-0.14]	0.36 [0.35]
Marital status (n = 753)	p = 0.19	p = 0.02	p = 0.11	p = 0.59
Married	-0.02 [-0.08]	0.43 [0.25] ^a	0.04 [-0.08]	0.59 [0.57]
Widow/divorced/separated	-0.08 [-0.13]	0.29 [0.13]	-0.06 [-0.17]	0.54 [0.52]
Never married (reference)	-0.10 [-0.17]	0.12 [-0.04]	0.03 [-0.10]	0.62 [0.61]
Current employment (n = 754)	p < 0.01	p = 0.05	p = 0.03	p = 0.08
Currently working (reference)	-0.02 [-0.08]	0.41 [0.23]	0.03 [-0.09]	0.62 [0.59]
Unemployed (on leave, looking for work)	-0.36 [-0.44] ^c	0.56 [0.34]	-0.21 [-0.35] ^a	0.53 [0.49]
Not working outside the home/retired/disabled	-0.06 [-0.12]	0.27 [0.09] ^a	-0.03 [-0.16]	0.49 [0.47]
Income (n = 705)	p = 0.11	p = 0.08	p = 0.24	p = 0.05
$\leq$ 10,000 USD (reference)	-0.19 [-0.25]	0.07 [-0.03]	-0.16 [-0.26]	0.34 [0.35]
>10,000–20,000 USD	-0.12 [-0.18]	0.26 [0.06]	0.03 [-0.09]	0.54 [0.55]
>20,000–30,000 USD	-0.04 [-0.10]	0.30 [0.14]	-0.08 [-0.19]	0.49 [0.49]
>30,000–50,000 USD	0.01 [-0.05]	0.41 [0.24]	0.04 [-0.08]	0.65 [0.65] ^b
>50,000–70,000 USD	-0.03 [-0.08]	0.40 [0.21]	0.02 [-0.09]	0.57 [0.56] ^a
>70,000 USD	-0.04 [-0.09]	0.50 [0.32]	0.03 [-0.08]	0.68 [0.68] ^b
Breast cancer treatment (n = 783)	p = 0.60	p = 0.07	p = 0.01	p = 0.07
Surgery only	-0.03 [-0.07]	0.40 [0.21]	0.00 [-0.07] ^b	0.50 [0.47]
Surgery + radiation	-0.04 [-0.08]	0.38 [0.17]	0.04 [-0.04] ^b	0.53 [0.48]
Surgery + chemotherapy (reference)	-0.11 [-0.16]	0.08 [0.05]	-0.21 [-0.29]	0.61 [0.59]
Surgery + radiation + chemotherapy	-0.03 [-0.09]	0.35 [0.34]	-0.01 [-0.07] ^b	0.71 [0.67]

Values are given as means with least-square means [in brackets] adjusted for breast cancer treatment type, breast cancer stage at diagnosis, and antidepressant use at 24-month assessment follow-up. Sample size for individual regression models ranged from 753 to 756 for each characteristic, except for income (n = 705).

BCIA scales were coded from -2 (very negative impact) to +2 (very positive impact) and are centered at 0 (no impact). ^a p $\leq$ 0.05, ^b p < 0.01, ^c p < 0.001 for contrast level tested against reference level.

The *Caregiving/Finances Scale* score varied as a function of current employment status. Participants who were unemployed (on leave or looking for a job) reported greater negative impact (-0.44) compared to those who were working (-0.08). There was a pattern for women with lower incomes to report more negative impact on caregiving and finances; however, this was not statistically significant (p = 0.11).

The *Exercise/Diet Scale* score varied as a function of age, marital status, and current employment, though the effect for employment was marginally significant at p = 0.05. Younger women reported a positive IOC on diet and exercise (0.18–0.24); whereas those aged 70 and older reported

a slightly negative impact on Exercise/Diet (-0.09). Married participants reported a higher mean positive impact on Exercise/Diet (0.25) compared to those who were never married (-0.04). Participants who were not working outside of the home, retired, or disabled reported a lower positive impact on Exercise/Diet (0.09) than participants who were currently working at the time of the 24-month follow-up survey (0.23), or those who were unemployed (0.34). However, there was a small number of people in the unemployed group and this was not statistically significant (p = 0.14). There were also patterns for women with higher incomes and those who were treated with a combination of surgery, radiation, and chemotherapy to report a great-

Table 6. Correlations of BCIA scores with psychosocial and health-related QOL scales

	Caregiving/ Finances	Exercise/ Diet	Social/ Emotional	Religiosity
Optimism	0.17 ^c	0.15 ^c	0.25 ^c	0.17 ^c
Fear of Recurrence (FOR)	-0.21 ^c	-0.10 ^b	-0.23 ^c	-0.05
Perceived Stress Scale (PSS)	-0.25 ^c	-0.21 ^c	-0.30 ^c	-0.05
Post-traumatic growth				
New possibilities	0.22 ^c	0.23 ^c	0.28 ^c	0.45 ^c
Relating to others	0.19 ^c	0.17 ^c	0.23 ^c	0.41 ^c
Personal strength	0.15 ^c	0.17 ^c	0.16 ^c	0.35 ^c
Spiritual change	0.12 ^b	0.16 ^c	0.16 ^c	0.57 ^c
Appreciation of life	0.09 ^a	0.20 ^c	0.15 ^c	0.40 ^c
SF-36				
Physical component summary	0.23 ^c	0.31 ^c	0.19 ^c	0.13 ^c
Mental component summary	0.24 ^c	0.22 ^c	0.30 ^c	0.03
Physical functioning	0.21 ^c	0.31 ^c	0.19 ^c	0.14 ^c
Role-physical	0.25 ^c	0.29 ^c	0.20 ^c	0.07
Bodily pain	0.20 ^c	0.25 ^c	0.17 ^c	0.09 ^a
General health	0.29 ^c	0.32 ^c	0.32 ^c	0.14 ^c
Vitality	0.26 ^c	0.31 ^c	0.28 ^c	0.08 ^a
Social functioning	0.27 ^c	0.27 ^c	0.27 ^c	0.05
Role-emotional	0.19 ^c	0.25 ^c	0.22 ^c	0.04
Mental health	0.28 ^c	0.24 ^c	0.34 ^c	0.07 ^a

n = 783 (782 for optimism, 780 for post-traumatic growth). BCIA scores were centered at 0 (no impact), with values ranging from -2 (very negative impact) to +2 (very positive impact). Optimism (coded 0–24), FOR (coded 5–25), and PSS (coded 0–16) were coded with increasing scores indicating greater optimism, greater concerns about one's future health status including cancer recurrence, and greater perceived stress, respectively. Post-traumatic growth scales were coded with increasing scores indicating increased growth, and ranged from 0 to 25 (new possibilities), 0–35 (relating to others), 0–20 (personal strength), 0–10 (spiritual change), and 0–15 (appreciation of life). SF-36 subscales ranged from 0 to 100, and SF-36 summary component scales have a mean of 50 and a standard deviation of 10, all with increasing scores indicating better functioning. ^a p < 0.05, ^b p < 0.01, ^c p < 0.001.

er positive IOC on diet and exercise behaviors; however, these were not statistically significant (p = 0.08 and 0.07).

The *Social/Emotional Scale* score varied as a function of current employment status and type of breast cancer treatment. Participants who were unemployed (on leave or looking for a job) reported a more negative impact on social/emotional functioning (-0.35) compared to participants who were currently working (-0.09). Participants who were treated with surgery and chemotherapy reported, on average, a more negative IOC on their social/emotional functioning (-0.29) compared to women treated with surgery only (-0.07), women treated with surgery and radiation (-0.04), and women treated with surgery, radiation, and chemotherapy (-0.07).

The *Religiosity Scale* score varied by age and income, though the effect for income was marginally significant at p = 0.05. Younger women reported a more positive IOC

on religiosity (0.55–0.58) compared to those aged 70 and older (0.35). Women with higher incomes reported greater positive IOC on religiosity (0.56–0.68) compared to participants with incomes less than USD 10,000 (0.35). There were also patterns for women treated with a combination of surgery, radiation, and chemotherapy, and those who were employed to report a more positive IOC on religiosity; however, these were not statistically significant (p = 0.07 and 0.08).

Convergent and Discriminant Validity of BCIS Scale Scores

To evaluate the convergent and discriminant validity of the BCIA Scale scores, we tested the associations between the four BCIA Scale scores and relevant psychosocial and health-related QOL instruments. Table 6 presents correlation coefficients for the four BCIA Scales with optimism,

FOR, perceived stress, post-traumatic growth, and health-related QOL.

The *Caregiving/Finances Scale* score was positively and significantly, though weakly, correlated with optimism, all post-traumatic growth scales, and all SF-36 subscales and component scales. The Caregiving/Finances Scale score was negatively and significantly correlated with the FOR score and the PSS score, however, these correlations also were relatively low.

The *Exercise/Diet Scale* score was positively and significantly correlated with optimism, all SF-36 subscales and component scales, and with all post-traumatic growth scales. The Exercise/Diet Scale score was negatively and significantly correlated with the FOR score and the PSS score.

The *Social/Emotional Scale* score was positively and significantly correlated with optimism and all SF-36 subscales and component scales, with lower correlations for the Physical Component Summary Scale and physical subscales, and higher correlations for the Mental Component Summary and mental health subscales. Social/Emotional Scale scores were also significantly and positively correlated with all post-traumatic growth scales. The Social/Emotional Scale score was significantly and negatively correlated with the FOR score and the PSS score.

The *Religiosity Scale* score was significantly and positively correlated with optimism, the SF-36 Physical Component Summary score and five of the eight subscales of the SF-36, and all five post-traumatic growth scale scores. The Religiosity Scale score was not significantly associated with either the FOR score or the PSS score.

Discussion

The present study reports on a psychometric evaluation of the BCIA, including identification of factors and creation and validation of factor-based scales, in a sample of 783 breast cancer survivors on average 40 months after diagnosis. Factor analysis revealed four meaningful scales that measure the IOC on caregiving abilities and finances, exercise and diet behaviors, social and emotional functioning, and religiosity. Results indicated that each of the four scales had good internal consistency reliability, the items within each scale were sufficiently highly related but not redundant, and each scale represented a homogeneous construct.

The BCIA Scales identified here only minimally correspond to the scales defined by the factor analysis of the newly created IOC Scale [14]. Change in religious faith or

spirituality is measured both by the Positive Outlook Scale of the IOC and the Religiosity Scale of the BCIA. However, while both the IOC and the BCIA scales assess the IOC on social life, the BCIA Social/Emotional Scale includes domains such as family plans, love life, and living arrangements, whereas the IOC focuses on life interferences and changes in the value of relationships. While the IOC Scale does include three items assessing potential change in employment, these items were not subjected to the factor analysis and so it is not known whether an employment factor would emerge, corresponding to the BCIA Caregiving/Finances Scale. Further, the IOC Scale does not measure impact on exercise or diet behaviors. The psychometric analyses of the BCIA and the IOC, suggest that, apart from commonalities in religiosity/spirituality, the two instruments measure different aspects of the IOC among survivors. Future research is needed to elucidate which domains of well-being are most strongly impacted by cancer.

We computed scale scores for each of the four cancer impact scales. The correlations among these scale scores were generally low, indicating that the scale scores are measuring distinct but related dimensions of the IOC and can be used as separate outcomes in future research. We correlated the four cancer impact scales with psychosocial and health-related QOL measures to establish convergent and discriminant validity. For the most part, these correlations were low. Though the pattern and direction of these correlations generally supported the validity of the cancer impact scales, the low correlations indicate that the four cancer impact scales measure a construct distinct from optimism, FOR, perceived stress, post-traumatic growth, or health-related QOL.

The pattern of results reported here supported the validity of the *Caregiving/Finances Scale*. Consistent with our hypothesis, Caregiving/Finances scores were negative and much greater among those participants who likely have greater financial concerns: those who were unemployed (on leave, or looking for work). The pattern for participants with lower household income to report more negative Caregiving/Finances scores is also consistent. Further support for the validity of the scale can be drawn from the pattern of correlations of the Caregiving/Finances Scale scores with scores for psychosocial and health-related QOL. Participants who scored low on optimism (i.e. pessimists), reported higher FOR and perceived stress, perceived fewer positive growth experiences after cancer, or reported poor physical and emotional functioning were more likely to report a greater negative impact on their caregiving and financial responsibilities. It

makes sense that participants with poor emotional functioning would have a harder time caring for others and would have a tendency to perceive the IOC on the current financial situation more negatively.

Support for the validity of the *Exercise/Diet Scale* was demonstrated in several ways. Younger women reported a greater positive IOC on Exercise/Diet compared to those over age 70. Since physical activity has been shown to decline with age [26], it is likely that older participants exercised less before their cancer diagnosis and would be less likely to improve their exercise behavior after cancer. Consistent with our hypothesis, married participants reported higher positive Exercise/Diet Scale scores, and there was a pattern for women with higher incomes to report greater positive changes in exercise and diet behaviors as well. Married and higher-income women may have had better psychosocial adjustment or simply more social support and available resources to support improvement in their diet and exercise behaviors after cancer. Contrary to our hypothesis, women who were not working outside the home reported a less positive IOC on diet and exercise. This may be due in part to the inclusion of retired and disabled women in this employment group. Women who took an early retirement or became disabled as a result of their cancer experience may not have the resources to improve their diet or exercise behaviors. Further, if their retirement or disability reflects a more demanding or negative cancer experience, the positive IOC on diet and exercise may be limited.

Correlations with other health scale scores further supported the validity of the Exercise/Diet Scale. People who reported greater optimism, physical and emotional functioning, and positive growth after cancer, and lower FOR and perceived stress were more likely to report a greater positive impact on their exercise and diet behaviors. Optimists, who by definition have positive future expectancies, should respond to difficulty (i.e. a cancer diagnosis) with continued effort by changing their diet and exercise behaviors, while pessimists (who have negative expectancies) would be more likely to give up [27], and not exercise or change their diet. Better physical and emotional functioning (i.e. low distress) should be associated with greater positive impact on diet and exercise. Previous research has shown that higher levels of distress have been associated with poor diet [28, 29] and depressed mood is frequently associated with lack of physical activity [30].

The pattern of results supported the convergent and discriminant validity of the *Social/Emotional Scale* in several ways. Social/Emotional scores were more negative for participants who were on leave or looking for work, pos-

sibly due to the loss of social support at work. As hypothesized, the Social/Emotional Scale showed good discriminant validity, correlating more strongly with the SF-36 mental component summary scale than with the physical component. Consistent with the concept of better social/emotional adjustment, Social/Emotional Scale scores were positively correlated with optimism and post-traumatic growth, and negatively correlated with FOR and perceived stress. Of note, the IOC on social/emotional functioning was much more negative in women treated with surgery and chemotherapy compared to women who had other combinations of treatments. Post hoc analyses revealed that these women tended to be younger and were more likely to have had a total mastectomy (data not shown). Previous research has shown that women treated with mastectomy may have poorer emotional adjustment, due for example, to negative body image [31]. This finding further supports the validity of the Social/Emotional Impact Scale.

The convergent and discriminant validity of the *Religiosity Scale* score was demonstrated in several ways. As hypothesized, a positive IOC on religiosity was correlated with positive post-traumatic growth on all five Post-Traumatic Growth Inventory Scales, and the correlation with the Spiritual Change Scale was highest. Further, the Religiosity Scale was not correlated with FOR, perceived stress, or physical health on the SF-36. The IOC on religiosity was lower among participants 70 years of age or older and among those with lower household incomes. This could be because of a ceiling effect, as the elderly [32] and lower socio-economic status (SES) individuals [33] tend to report higher levels of religiosity and would have less room for their religiosity to improve through the cancer experience.

The findings with the BCIA in the present multiethnic sample are similar to those with the original scale in a predominately White sample in the study by Ganz et al. [15]. Participants reported the greatest positive impact on exercise, diet, and religiosity items, and the greatest negative impact on love life and financial situation. Further, greater impact was associated with younger age. Also consistent with Ganz and colleagues, the means on many impact scale items corresponded to 'no impact'. Future studies evaluating the IOC with the BCIA should investigate whether there are identifiable subgroups of survivors who report greater positive or negative IOC. For example, studies have shown that although many of the QOL difficulties experienced by survivors in the short term resolve over time, there is a subgroup of approximately 20–25% of women who still report decrements in several as-

pects of QOL up to 4 years after diagnosis [34]. It may be that these survivors would report a greater IOC on the BCIA Scales.

It is interesting that there was no unique effect of time since diagnosis (2–5 years) on any of the BCIA scale scores. On one hand, this is not surprising given that these participants were at least 2 years after diagnosis and most research finds that the many adverse aspects of cancer diagnosis and treatment are experienced over the course of the 1st year [35]. On the other hand, it is interesting that the IOC diagnosis and treatment is still detectable 5 years after diagnosis, and that the positive impact on religiosity and exercise/diet is so durable.

The strengths of this study include its large ethnically and socioeconomically diverse sample of breast cancer survivors and the opportunity to relate BCIA Scales to relevant psychosocial and health-related QOL instruments. The main limitation of this study is the limited number of instruments to use for construct validation. For example, the IOC on diet and exercise behaviors should be validated with actual changes in measures that assess diet and exercise behaviors. More information is also needed on test-retest reliability, face validity, how IOC changes in effect over time (e.g. from diagnosis to 5 or more years after diagnosis), and how the factor struc-

ture presented here relates to these changes. This study relied on retrospective reports of the perceived IOC, a less than ideal approach. Future studies should further evaluate the validity of the BCIA by comparing these retrospective perceived impact scores with changes in scores given on corresponding instruments completed both before and after cancer treatment.

In sum, the evidence presented here suggests that the four scales from the BCIA are reasonably reliable and valid and can be used to assess the IOC among breast cancer survivors who are 2 or more years after diagnosis. Including the BCIA along with measures of QOL, symptoms, and functioning will allow researchers to gain a more comprehensive assessment of the biopsychosocial IOC on survivors. While the BCIA does not measure all the domains of impact captured by the IOC instrument [14], this brief assessment may be useful to future studies in which a longer scale is not feasible, or where researchers are specifically interested in the IOC on caregiving and finances, exercise and diet behaviors, social and emotional functioning, or religiosity. Future studies of the health and well-being of cancer survivors would benefit from reliable and valid assessment of the potential negative and positive impacts of cancer on these domains.

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