

## ORIGINAL ARTICLE

# Use of the International Classification of Functioning, Disability and Health as a Functional Assessment Tool for Breast Cancer Survivors

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**Purpose:** To develop a patient self-completed questionnaire from the items of the Brief Core Set Questionnaire for Breast Cancer (BCSQ-BC) and to investigate the prevalence of specific dysfunctions throughout the course of cancer and treatments. **Methods:** From January 2010 to February 2011, 96 breast cancer patients were evaluated with BCSQ-BC developed for clinical application of International Classification of Functioning, Disability and Health (ICF). Quality of life and upper limb dysfunction using disabilities of arm, shoulder and hand (DASH) were assessed. Content validity was evaluated using correlations between BCSQ-BC and European Organization for Research and Treatment of Cancer (EORTC) QLQ and DASH scores. Construct validity was computed using exploratory factor analysis. Kappa statistics were computed for agreement between test-retest ICF data. The level of significance and odds ratios were reported for individuals with early post-acute and long-term context and with total mastectomy and breast conservative surgery. **Results:** There was consistently good test-retest agreement in patient-completed

questionnaires (kappa value, 0.76). Body function, activity and participation subscales are significantly related with EORTC QLQ and DASH. Problems with activity and participation were strongly associated with physical functional domains of EORTC QLQ ( $r = -0.708, p < 0.001$ ) and DASH ( $r = 0.761, p < 0.001$ ). The prevalence of dysfunctions varied with type of surgery and time after cancer. Immobility of joint (15% vs. 7%) and lymphatic dysfunction (17% vs. 3%) were indexed more frequently in extensive surgery cases than in conservative surgery. Muscle power (16% vs. 8%), exercise tolerance functions (12% vs. 4%) and looking after one's health (10% vs. 2%) were impaired within 1 year after surgery, while sleep dysfunction (8% vs. 14%) was a major problem over 1 year after surgery. **Conclusion:** The BCSQ-BC identifies the problems comprehensively in functioning of patients with breast cancer. We revealed the interaction with the ICF framework adopting a multi-factor understanding of function and disability.

**Key Words:** Breast neoplasms, Function, Rehabilitation, Survivors

## INTRODUCTION

Breast cancer is the most common cancer among women worldwide [1]. The development of new chemotherapeutic agents and regimens for breast cancer has contributed to reduced risk of recurrence and prolonged patient's survival. Therefore, a significantly increased number of cancer patients now spend a large proportion of their lives coping with physical, psychological, and social impairments [2]. Impairments in body functions and body structures including shoulder pain, limitation of range of motion [3], or lymphedema [4] can

negatively affect the individuals' self-image [5], the relationship with the partner and can lead to social isolation [3,4,6]. Over the last years, there has been increasing interest and awareness in the functional impact of cancer treatment on the patient and health-related quality of life has now become a secondary endpoint in the assessment of outcome various scales based on clinical examination have been reported [7].

To optimize interventions aimed at maintaining functioning and minimizing disability, a proper understanding of the patient's functioning and health status is needed. The different aspects of functional outcomes of breast cancer survivors could be evaluated by a wide variety of assessment tools. Clinical observations combined with imaging or laboratory findings can assess the functioning in a rather standardized and reproducible way. On the contrary, the aspects of daily living can be obtained more easily through patient-administered questionnaires. Patient-administered questionnaires collect the subjective patient's perspective directly and without any interpretation through health professional assessment [8]. Even

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though there are several breast cancer specific questionnaires [9,10], there is no gold standard and no widely acceptable indicator of functional outcome that applies across different health professionals, continents and health care systems.

The International Classification of Functioning, Disability and Health (ICF) of the World Health Organization (WHO) provides a useful framework for classifying the components of health and consequences of a disease [11]. The ICF stands alongside the International Classification of Disease (ICD-10). The ICD-10 classifies medical diagnoses, and the ICF classifies patient functioning. The ICF is based on a comprehensive bio-psycho-social framework, including changes in body structures and body functions, the patient's ability to participate in everyday life situations and the influence of environmental and personal factors [9]. However, since the ICF as a whole is composed of more than 1,400 categories, it is not feasible for use in clinical practice. To facilitate the implementation of the ICF into clinical practice, ICF Core Sets for a number of health conditions [12] including breast cancer have been developed. The current version of the Comprehensive ICF Core Set for Breast Cancer includes 80 ICF categories and from this a smaller subset with 40 categories was proposed [13]. The ICF is a coding system of functioning items as the basic classification unit, however, it would be appropriate tool to form the basis for developing an instrument to evaluate the functioning decrements in breast cancer survivors. The contents of the ICF categories on the basis of a patient administered questionnaire have an advantage of unified approach for measuring function. Not only a part of body function but also a comprehensive function can be evaluated by the questionnaires with systemic framework based on the ICF Core Set.

We developed a patient self-administered questionnaire from the items of the brief core set for breast cancer (BCSQ-BC). We then assessed the reliability and content validity of the BCSQ-BC in patients with breast cancer. Dysfunction during the initial phase of diagnosis and definitive treatment planning are different from those that may arise from other phases [14], so we identified and analyzed several common dysfunctions according to the course of cancer treatment using this comprehensive functional assessment, BCSQ-BC.

## METHODS

### Setting and participants

From January to December 2010, we recruited participants among survivors who were referred after breast cancer surgery at our hospitals and had been followed up at a rehabilitation clinic. All participants were women aged 18 years old or over. Patients with other previously diagnosed cancers, and

who were not literate were excluded. The BCSQ-BC was included as part of our cohort study [15]. Demographic and personal characteristics such as age, current marital status, level of education, economic status, and occupation were recorded using self-report questionnaires. Breast cancer and related medical variables included type of surgery and time after surgery. All participants were fully informed regarding study participation and provided written informed consent. The protocol was approved by the Institutional Review Board of Seoul National University Bundang Hospital (ICF IRB no: B-1009/054-003).

### Measures

#### *BCSQ-breast cancer*

The ICF Core Set for breast cancer is the selection of relevant items in ICF categories and not a questionnaire. The BCSQ-BC was created using the Brief ICF Core Set for breast cancer, it consists of 40 questions about problems in the last 30 days (Table 1). It can assess the degree of problem and whether a problem was caused by something other than breast cancer. Section 1 asks about 'body structures and body functions (a problem or impairment with a part of your body, which means you have trouble doing something which you want to do)', section 2 about 'problems with activity and participation (a problem or difficulty with activity and social participation)' and section 3 about 'environmental factors (how much certain factors in your living environment have either helped or hindered your progress since your diagnosis and treatment of breast cancer)'. In sections 1 and 2 patients grade their problems as none (1), mild (2, at a level you can tolerate, occurs rarely), moderate (3, sometimes interferes with your day to day life, happens occasionally), severe (4, partly disrupts your day to day life, occurs frequently), or complete (5, totally disrupts your life, affects you every day). In section 3 they grade on a -4 to +4 scale ranging from complete hindrance to complete help. Then we produced total score and 4 subscales: body function score, body structure score, activity and participation score and environmental score. Subscale scores were the sum of the grades in the items of each section.

#### *Health-related quality of life*

Quality of life was assessed using the European Organization for Research and Treatment of Cancer QLQ-C30 (EORTC-QLQ-C30) questionnaire. The EORTC QLQ-C30 is a well-known instrument for measuring quality of life in cancer survivors; it contains 30 items that measure five functional abilities, global quality of life, and several cancer-related symptoms. A final item evaluates the perceived economic consequences of the disease. In addition, a global health status/quality of life score

**Table 1.** Overall results for the 96 patients completing the Brief ICF questionnaire

		Problems	
		%	No.
Problems with part of your body* (n= 11)			
b152	Emotional functions	12.5	12/96
b280	Sensation of pain	18.8	18/96
b130	Energy and drive (motivation)	15.6	15/96
b180	Experience of self and time functions	10.4	10/96
b710	Mobility of joint functions	17.7	17/96
b640	Sexual functions	16.7	16/96
b134	Sleep functions	20.8	20/96
b435	Immunological system functions	10.4	10/96
b730	Muscle power functions	22.9	22/96
b126	Temperament and personality functions	15.6	15/96
b455	Exercise tolerance functions	18.8	18/96
Problems with body structure* (n=5)			
s630	Structure of reproductive system (breast)	12.5	12/96
s420	Structure of immune system (lymph node)	14.6	14/96
s720	Structure of shoulder region	16.7	16/96
s810	Structure of areas of skin	17.7	17/96
s730	Structure of upper extremity	10.4	10/96
Problems with activity and social participation* (n= 11)			
d240	Handling stress and other psychological demands	10.4	10/96
d770	Intimate relationships	10.4	10/96
d760	Family relationships	15.6	15/96
d445	Hand and arm use	19.8	19/96
d230	Carrying out daily routine	16.7	16/96
d640	Doing housework	18.8	18/96
d850	Remunerative employment	20.8	20/96
d430	Lifting and carrying objects	27.1	26/96
d920	Recreation and leisure	22.9	22/96
d570	Looking after one's health	12.5	12/96
d510	Washing oneself	6.3	6/96
Problems with your environment† (n= 13)			
e450	Individual attitudes of health professionals	15.6	15/96
e310	Immediate family	20.8	20/96
e320	Friends	19.8	19/96
e355	Health professionals	18.8	18/96
e115	Products and technology for personal use in daily living	30.2	29/96
e410	Individual attitudes of immediate family members	17.7	17/96
e165	Assets	34.4	33/96
e580	Health services, systems and policies	24.0	23/96
e420	Individual attitudes of friends	25.0	24/96
e570	Social security services, systems and policies	25.0	24/96
e315	Extended family	30.2	29/96
e590	Labor and employment services, systems and policies	33.3	32/96
e465	Social norms, practices and ideologies	9.4	9/96

ICF=International Classification of Functioning, Disability and Health.

\*Moderate, severe, and complete grades; †Hindrances and neither hindrance or help.

can be computed. This consists of two items that assess the global health status and the global quality of life. According to the guidelines provided by the EORTC, all scores of the QLQ-C30 were transformed linearly, so that all scales range from 0 to 100. On the function scales, higher scores represent a higher level of functioning. On the symptom scales/items, a higher score

represents a higher level of symptoms or problem. Participants answered the questionnaires with a trained researcher [16].

#### *Upper limb dysfunction (ULD)*

Shoulder disability was measured by a validated Korean version of the widely used "disability of the arm, shoulder, and

hand" (K-DASH) questionnaire [17], which is used to measure the functional status and symptoms associated with different degrees and levels of upper extremity disability. The DASH questionnaire consists of 30 items, each of which has five possible responses [18,19]. Twenty-one items ask about the degree of difficulty in performing activities of daily living (DASH-ADL), six items ask about symptoms (DASH-symptom), and the remaining three items ask about psychosocial impact (DASH-social). The DASH-global score, which includes these three domains, was considered to indicate the overall disability caused by ULD.

### Analyses

The test-retest reliability was analyzed by administering the BCSQ-BC once again to the same patients 2 weeks later. Kappa statistics were computed for agreement between test-retest patient-complete ICF data. Kappa values above 0.6 represent 'good' agreement, with values above 0.80 being 'very good.' Factor analysis, the approach commonly used to reflect construct validity, was performed using the principle components method with the varimax rotation technique. Meanwhile, Kerser-Meyer-Olkin and Bartlett's test of Sphericity were carried out to evaluate the sampling adequacy for factor analysis. To determine the content validity of the BCSQ-BC, 2 analyses were carried out. Pearson's coefficient measured the amount of association between BCSQ-BC and EORTC QLQ subscale/domain scores. It was expected that all scales of the BCSQ-BC would have a negative correlation with the EORTC functional abilities. BCSQ-BC scales that mainly included the use of upper extremities should correlate substantially with the DASH scores.

The levels of significance and odds ratios (OR) for experiencing each of these functional problems were reported for individuals with early post-acute and long-term context and with conservative surgery and extensive surgery, with significant problems on ICF items, with a moderate (3), severe (4), or complete (5) score being regarded as significant for sections

1 and 2 and a hindrance/neither hindrance or help (-4 to 0) score being regarded as significant for section 3.

To identify differences in functioning between early post-acute and long-term context, while controlling for other confounders, logistic regression models were performed in an exploratory data analysis. Each of the dichotomous ICF categories was used as dependent variables in separate models. The age, current marital status, level of education, economic status, and occupation and type of adjuvant treatment were used as co-variables. SPSS software version 17.0 (SPSS Inc., Chicago, USA) was used for statistical analyses. Two-tailed *p*-values < 0.05 were deemed statistically significant.

## RESULTS

### Patient characteristics

Of 105 patients we contacted, 96 satisfied of the inclusion and exclusion criteria. Nine women were excluded from the analysis because of refusal to participate in this study. Age at diagnosis ranged from 30 to 73 years (mean  $\pm$  standard deviation, 50.1  $\pm$  9.8 years). Most patients were married (93%), 77% had at least high school education, and 42.1% worked full- or part-time. The mean elapsed time from breast cancer surgery to participation was 15.4  $\pm$  12.9 months (1-60 months). According to the time after surgery, 53 patients (54.1%) were evaluated at less than 1 year after surgery. Forty-three patients (43.9%) were evaluated at more than 1 year after surgery. In addition, the patients were categorized according to surgical procedure, 44 patients (45.8%) underwent conservative surgery and 52 patients (54.2%) underwent extensive surgery.

### Reliability

Of these 25 (33%) attended clinic for interview and also completed the ICF questionnaire (before clinic), while 22 (29%) also completed a repeat ICF questionnaire (after the first questionnaire). Though numbers are small there was consistently good test-retest agreement in patient-completed

**Table 2.** Association of Brief ICF items with EORTC functional subscales and DASH

	EORTC functional scale					DASH
	Physical function	Role function	Emotional function	Cognitive function	Social function	
Body function score	-0.624*	-0.515*	-0.654*	-0.605*	-0.576*	0.669*
Body structure score	-0.396*	-0.370*	-0.464*	-0.405*	-0.411*	0.540*
Activity and participation score	-0.708*	-0.613*	-0.634*	-0.596*	-0.550*	0.761*
Environment score	0.265*	0.298*	0.344*	0.324*	0.224*	-0.374*
Total score	-0.371*	-0.185	-0.272*	-0.218*	-0.286*	0.326*

Values are Pearson correlation coefficients.

ICF=International Classification of Functioning, Disability and Health; EORTC=European Organization for Research and Treatment of Cancer; DASH=disabilities of arm, shoulder and hand.

\**p*<0.001.

questionnaires before and after clinic, with median kappa values of 0.76 (0.69-0.85).

### Content and construct validity

The content validity was assessed by analyzing the relationship between ICF subscales and total score and EORTC domains and DASH (Table 2). Problems with activity and participation were strongly associated with physical functional domains of EORTC and DASH. Body function, activity and participation subscales are significantly related with EORTC and DASH. Problems with activity and participation were strongly associated with physical functional domains of EORTC ( $r = -0.708$ ,  $p < 0.001$ ) and DASH ( $r = 0.761$ ,  $p < 0.001$ ). ICF environmental problems were most prevalent among all categories of ICF, but they were weakly correlated with EORTC physical functional domains ( $r = 0.265$ ,  $p < 0.001$ ). Emotional functioning was significantly correlated with some environmental factors (range for spearman  $r$  being from 0.309 to 0.418) such as individual attitudes of health professionals, friends, health professionals, products and technology for personal use in daily living, health services, individual attitudes of friends, extended family, labor and employment services, systems and policies and social norms, practices and ideologies (data not shown).

Factor analysis was conducted to test construct validity. The Kerker-Meyer-Olkin was 0.793 which was greater than 0.7, indicating an adequate correlation for factor analysis. Meanwhile, Bartlett's test of Sphericity was significant with the chi-square test ( $351 = 1,424.979$  ( $p < 0.001$ )). Principle component analysis identified 4 factors with eigenvalues greater than 1, explaining 63.22% of the variance. The rotated component matrix is presented in Table, and 4 factors were extracted using the cutoff point of 0.4 as the criterion. Items loading on 2 factors were determined by the heavier loading point (Table 3).

### Prevalence of dysfunction

The BCSQ-BC was generally completed. There were no notable ceiling or floor effects arising from the results of the Brief ICF questionnaire. The percentage with no problems (sections 1 and 2) or complete help (section 3) ranged from 6.3% and 62.5% between items, median 40.2% (Table 1) while the percentage with 'significant' problems (i.e., moderate, severe or complete for sections 1 and 2 or 'lack of help' including hindrance or neutral for section 3) ranged from 6.3% to 34.4%. The results emphasize problems particularly in 'muscle power functions' (22.9%) for body functions and 'lifting and carrying objects' (27.1%) for activities and participation. Significant problems on ICF environmental factors were hindrance from assets (34.4%) and labor and employment services (33.3%). A

**Table 3.** Factor analysis of the breast ICF Core Set questionnaire: factor loading matrix by items

Item	Factors			
	I FUN	II STR	III ACT	IV ENV
ICF_b126 (FUN)	0.696	0.637	0.680	0.238
ICF_b130 (FUN)	0.818	0.507	0.529	0.006
ICF_b134 (FUN)	0.632	0.348	0.531	0.133
ICF_b152 (FUN)	0.673	0.493	0.598	0.225
ICF_b180 (FUN)	0.653	0.513	0.689	0.133
ICF_b280 (FUN)	0.763	0.200	0.372	-0.039
ICF_b435 (FUN)	0.522	0.457	0.372	0.145
ICF_b455 (FUN)	0.732	0.466	0.412	-0.319
ICF_b640 (FUN)	0.366	0.533	0.492	-0.139
ICF_b710 (FUN)	0.762	0.258	0.384	-0.009
ICF_b730 (FUN)	0.793	0.147	0.269	-0.107
ICF_s420 (STR)	0.053	0.741	0.499	-0.074
ICF_s630 (STR)	0.562	0.568	0.507	-0.291
ICF_s720 (STR)	0.548	0.793	0.463	0.075
ICF_s730 (STR)	0.297	0.906	0.458	0.099
ICF_s810 (STR)	0.282	0.815	0.339	0.029
ICF_d230 (ACT)	0.484	0.415	0.899	0.046
ICF_d240 (ACT)	0.621	0.618	0.680	0.151
ICF_d430 (ACT)	0.590	0.517	0.782	0.004
ICF_d445 (ACT)	0.624	0.407	0.746	-0.047
ICF_d510 (ACT)	0.247	0.439	0.610	-0.307
ICF_d570 (ACT)	0.418	0.337	0.873	0.088
ICF_d640 (ACT)	0.392	0.424	0.943	0.015
ICF_d760 (ACT)	0.484	0.502	0.778	-0.070
ICF_d770 (ACT)	0.333	0.370	0.633	-0.164
ICF_d850 (ACT)	0.208	0.464	0.885	0.029
ICF_d920 (ACT)	0.639	0.322	0.715	0.027
ICF_e115 (ENV)	0.135	-0.095	0.037	0.747
ICF_e165 (ENV)	0.116	-0.057	0.191	0.372
ICF_e310 (ENV)	-0.244	0.035	-0.083	0.122
ICF_e315 (ENV)	0.089	0.245	0.020	0.499
ICF_e320 (ENV)	-0.024	0.019	0.057	-0.061
ICF_e355 (ENV)	-0.242	0.057	-0.221	0.436
ICF_e410 (ENV)	-0.294	0.082	-0.073	0.201
ICF_e420 (ENV)	-0.049	0.043	0.057	-0.014
ICF_e450 (ENV)	-0.028	-0.272	-0.209	0.681
ICF_e465 (ENV)	0.068	0.262	-0.023	0.380
ICF_e570 (ENV)	0.008	-0.014	-0.015	0.972
ICF_e580 (ENV)	0.060	-0.098	-0.053	0.887
ICF_e590 (ENV)	-0.198	-0.029	0.215	0.527

Varix/principal, factor loading  $\geq 0.40$ .

ICF=International Classification of Functioning, Disability and Health; FUN=body function; STR=body structure; ACT=activity and participation; ENV=environmental factor.

minority had 'significant' problems, most notably for washing (6.3%).

The prevalence of dysfunctions varied with type of surgery. Immobility of joint (15% vs. 7%,  $p = 0.046$ ) and lymphatic dysfunction (17% vs. 3%,  $p = 0.035$ ) were indexed more frequently in extensive surgery cases than in conservative sur-

**Table 4.** Comparison of significant problem between the patients evaluated less than 1 year and more than 1 year after surgery and univariate regression analysis

		Significant problems			Univariate regression analysis		
		< 1 yr after surgery (%)	≥ 1 yr after surgery (%)	p-value	Exp (B)	95% CI	p-value
Problems with part of your body							
b152	Emotional functions	8	4	0.384	0.667	0.185-2.403	0.535
b280	Sensation of pain	9	8	0.403	1.318	0.456-3.814	0.610
b130	Energy and drive (motivation)	7	5	0.588	0.938	0.272-3.228	0.919
b180	Experience of self and time functions	8	2	0.131	0.316	0.063-1.587	0.162
b710	Mobility of joint functions	6	10	0.058	2.821	0.918-8.664	0.070
b640	Sexual functions	9	6	0.433	0.762	0.241-2.408	0.643
b134	Sleep functions	8	14	0.048	2.460	1.884-6.846	0.045
b435	Immunological system functions	6	4	0.597	0.929	0.243-3.556	0.915
b730	Muscle power functions	16	8	0.043	0.714	0.263-1.943	0.510
b126	Temperament and personality functions	10	3	0.125	0.373	0.095-1.466	0.158
b455	Exercise tolerance functions	12	4	0.047	0.324	0.167-0.647	0.039
Body function score		7.4±6.8*	7.1±6.1*	0.148	-0.410 <sup>†</sup>	-3.294-2.474 <sup>†</sup>	0.778 <sup>†</sup>
Problems with activity and social participation							
d240	Handling stress and other psychological demands	8	2	0.117	0.301	0.060-1.515	0.146
d770	Intimate relationships	7	3	0.330	0.563	0.135-2.347	0.430
d760	Family relationships	7	1	0.082	0.180	0.021-1.529	0.116
d445	Hand and arm use	11	6	0.399	0.739	0.247-2.215	0.589
d230	Carrying out daily routine	8	8	0.570	1.065	0.336-3.375	0.915
d640	Doing housework	10	6	0.470	0.813	0.247-2.475	0.715
d850	Remunerative employment	12	6	0.281	0.621	0.208-1.856	0.393
d430	Lifting and carrying objects	16	8	0.238	0.621	0.233-1.653	0.340
d920	Recreation and leisure	14	7	0.269	0.633	0.227-1.767	0.383
d570	Looking after one's health	10	2	0.041	0.265	0.054-0.416	0.041
d510	Washing oneself	4	0	0.107	0.267	0.054-1.316	0.105
Activity and participation score		8.2±9.3*	6.6±6.1*	0.331	-1.594 <sup>†</sup>	-5.126-1.937	0.372

Exp (B)=exponentiation of the B coefficient; CI=confidence interval.

\*Comparison of subscale (body function score and activity and participation score) between groups with Wilcoxon rank sum test; <sup>†</sup>β correlation coefficient from univariate linear regression analysis after adjusting age, current marital status, level of education, economic status, and occupation and type of adjuvant treatment.

gery. Muscle power (16% vs. 8%,  $p=0.043$ ), exercise tolerance functions (12% vs. 4%,  $p=0.047$ ) and looking after one's health (10% vs. 2%,  $p=0.041$ ) were mainly impaired in patients evaluated within 1 year after surgery, while sleep dysfunction (8% vs. 14%,  $p=0.048$ ) was a major problem in patients evaluated over 1 year after surgery (Table 4). After adjusting the covariables such as age, current marital status, level of education, economic status, and occupation and type of adjuvant treatment, the prevalence of sleep disorder in the patients evaluated over 1 year after surgery showed a 2-fold higher risk (OR, 2.46;  $p=0.045$ ).

## DISCUSSION

This study, to our knowledge, is the first clinical application of the breast ICF Core Set as a patient self-administered questionnaire to characterize dysfunctions in patients with breast cancer. To do this application, we developed a simple questionnaire which can be applied as a comprehensive and standard-

ized outcome measure and not just confined to a clinical-rating scale. We found it to be a measure with good reliability and validity by means of which the main dysfunctions were confirmed throughout the course of cancer treatment. Muscle power, exercise tolerance functions and looking after one's health were mainly impaired in patients evaluated within 1 year after surgery, while sleep dysfunction was a major problem in patients evaluated over 1 year after surgery.

Although there are many health-related quality of life [9,10] and functional outcome assessment instruments in cancer, the BCSQ-BC is different in that it assessed not only changes in body structures and body functions, but also the patient's ability to participate in everyday life situations and the influence of environmental factors systemically [12] based on the WHO International Classification of Functioning, Disability and Health [11].

The problems and rehabilitation categories in the previous studies [20,21] did not provide a comprehensive or standardized understanding of functioning in the cancer survivors.

Lehmann et al. [20] identified the needs of a cancer population and categorized the functional limitations into psychological distress, general weakness, dependence in activities of daily living, pain, difficulties with balance in ambulation, housing, neurologic deficits, family support, and work-related problems and finances (in decreasing order of frequency). Whelan et al. [21] summarized the symptoms of cancer patients including fatigue, worry and anxiety, sleep disruption, and pain. Recently, Cheville et al. [22] subcategorized the impairments of patients with metastatic breast cancer into lymphedema, neurogenic weakness, sensory deficit, peripheral neuropathy, central nervous system deficit, cranial nerve deficit, ataxia, generalized weakness, exertional intolerance and myofascial dysfunction. While there are a wide variety of tools available to assess functioning, they refer to different aspects of functioning: some measures for the changes in body functions [22], and the others for activity limitations and participation restrictions in life situations (e.g., patient questionnaires, clinician-based rating scales like the Performance) [20,21]. Areas of functioning and health are scarcely captured comprehensively by already existing tools. The ICF is a useful tool framework to encourage a comprehensive bio-psycho-social assessment of functioning. What makes the BCSQ-BC different is its basis within the WHO International Classification of Functioning, Disability and Health [13].

The BCSQ-BC is designed to assess functional outcome. In this study, there were significant correlations between its items and EORTC domains. The data gained from the cross-sectional survey are supporting the content validity of the BCSQ-breast cancer. More items in the activity and participation were significantly correlated with physical, role, emotional and social functions than items in the part of body. Functioning at the level of the whole person in a social context may be more directly related with functional domain of EORTC than at the level of body or body part. Psychological function, poor body image impaired by surgery or chemotherapy categorized as health condition were interacted with not only emotional and social function but also physical function measured by DASH. The BCSQ-BC also embraces many social functions such as labor and employment services and family or health professional relationships. These were correlated with the social functioning of the EORTC. Some environmental factors were strongly associated with emotional functioning. Interestingly, friends and individual attitudes of friends were related with physical function. Relationship with friends may be influenced either by one's physical function, or this external factor may affect some physical functioning levels. The patient's functioning is conceived as a dynamic interaction between the underlying health condition and specific personal and environmental

contextual factors [11,23]. It has been demonstrated that physical function had some influence on social and psychological function which were highly related to emotional function [24]. In our study, we found the interactions between health conditions and contextual factors in the ICF framework adopting a multifactor understanding of function and disability and merging several factors into a bio-psycho-social perspective.

Lymphedema and range of motion are significantly associated with type of surgery. Previous study revealed that those having a modified radical mastectomy had less external rotation in comparison with those having a lumpectomy [25]. The prevalence of pectoralis tightness and lymphedema were significantly greater in the mastectomy group compared with the breast-conserving therapy group [15]. We also demonstrated that patients having a mastectomy had more immobility of joint and lymphatic dysfunction such as lymphedema than those having conservative surgery.

There are multiple phases that impact an individual's life throughout the course of cancer and its treatments. Possible dysfunctions during the initial phase of diagnosis and treatment are different from those that may arise from other phases, i.e., during the advanced phases of recurrence or end-of-life [14]. We identified and analyzed several common dysfunctions according to the course of cancer treatment using BCSQ-BC. Weakness and exercise intolerance is the main problems in the treatment phase, while insomnia is prevalent in the after-treatment phase. Littman et al. [26] conducted a longitudinal cohort study and found that physical activity levels decreased by 50% in the 12 months after diagnosis and overall physical activity levels had increased at 19-20 months post-diagnosis. Effective and efficient rehabilitation services specified to the various phases could be developed based on our data.

We have several limitations preventing the formulation of more definitive conclusions. First, converting the Brief ICF for breast cancer into a questionnaire posed problems. The ICF is written in scientific and medical terms and necessary to reword some domains and the scoring system into a language more easily understood. In addition, the international ICF Core Set should be translated from the original English version into Korean language. Generally, a self-administered questionnaire should not only be well-translated linguistically but also be adapted culturally to maintain the quality and validity of the content. We used the ICF manual developed by Shin et al. [27] written in Korean and we had an effort to correct some complex terms into a simple and plain one in the development phase. However, to develop an ICF-oriented assessment with an international comparability, the application of item response theory and the methodology of adaptive testing are needed. We are extending our study using Rasch model, item response

model used most widely. Second, the data gained from the cross-sectional survey and most were under early phase of cancer and treatment. A long-term follow-up study is required with a large number with more advanced phase.

The BCSQ-BC developed from the ICF Core Set for breast cancer is a reliable and valid instrument to measure the functioning of breast cancer patients and could be useful for identifying the problems comprehensively in functioning of patients with breast cancer. The interactions between health conditions and contextual factors were found in the ICF framework adopting a multifactor understanding of function and disability. Environmental factors referring to interpersonal support should be included in the functional assessment for breast cancer survivors.

## CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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