Original Article

A Prospective Model of Care for Breast Cancer Rehabilitation: Function*

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A significant proportion of adult breast cancer survivors experience deficits in function and restriction in participation in life roles that may remain many years after diagnosis. Function is a complex construct that takes into account the interactions between an individual, their health condition, and the social and personal context in which they live. Research to date on limitations in activities of daily living, upper extremity function, and functional capacity in breast cancer survivors illustrates the need for prospective measurement of function using measures that are sensitive to the unique issues of breast cancer survivors and the need for the development of effective rehabilitation interventions to improve function. Limitations in function have a significant impact on quality of life, but less is known about the implications on return to work and survival, as well as the impact of other comorbidities and aging on the function limitations in breast cancer survivors. This review provides a rationale for the integration of measures of function into breast cancer care to more fully appreciate the functional limitations associated with breast cancer diagnosis and treatment and to aid in the development of better rehabilitation care for breast cancer survivors. ***Cancer*** **2012;118(8 suppl):2300–11.** © *2012 American Cancer Society.*

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INTRODUCTION

Traditionally, function has been viewed as interrelated areas of physical performance, such as muscular strength, range of motion, and cardiopulmonary endurance.[1] The more contemporary understanding of function uses a broad perspective that encompasses not only the individual's physical condition but also aspects of their emotional and psychological state and their environmental and social circumstances. The World Health Organization's *International Classification of Functioning, Disability and Health* (ICF) describes a framework that takes this multidimensional or biopsychosocial approach to describing function.[2] Within the ICF framework, function is defined as the interactions between an individual, their health condition, and the social and personal context in which they live.[2,3] It is the complex interaction between these variables that determines function and disability. In the context of breast cancer, morbidity associated with the disease and its treatments can lead to impairments in physiological, psychological, or behavioral attributes (body functions and structures), potentially leading to limitations in the ability to execute desired tasks (activity) and participation in social demands (participation) (Figure 1).

In breast cancer survivors, the impact of diagnosis and treatment on function has been examined from a variety of approaches, and a framework for oncology rehabilitation based on the ICF has been proposed.[4] However, no comprehensive, consensus-driven model has been promulgated to guide rehabilitation strategies. The purposes of this paper are to review the most recent literature on the prevalence of functional changes encountered by breast cancer survivors, review recent evidence on functional measurements applicable to these functional changes, and recommend a prospective surveillance model using these measurement tools in order to prevent the occurrence of enduring functional limitations.

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**A Prospective Surveillance Model for Rehabilitation for Women with Breast Cancer, Supplement to Cancer*

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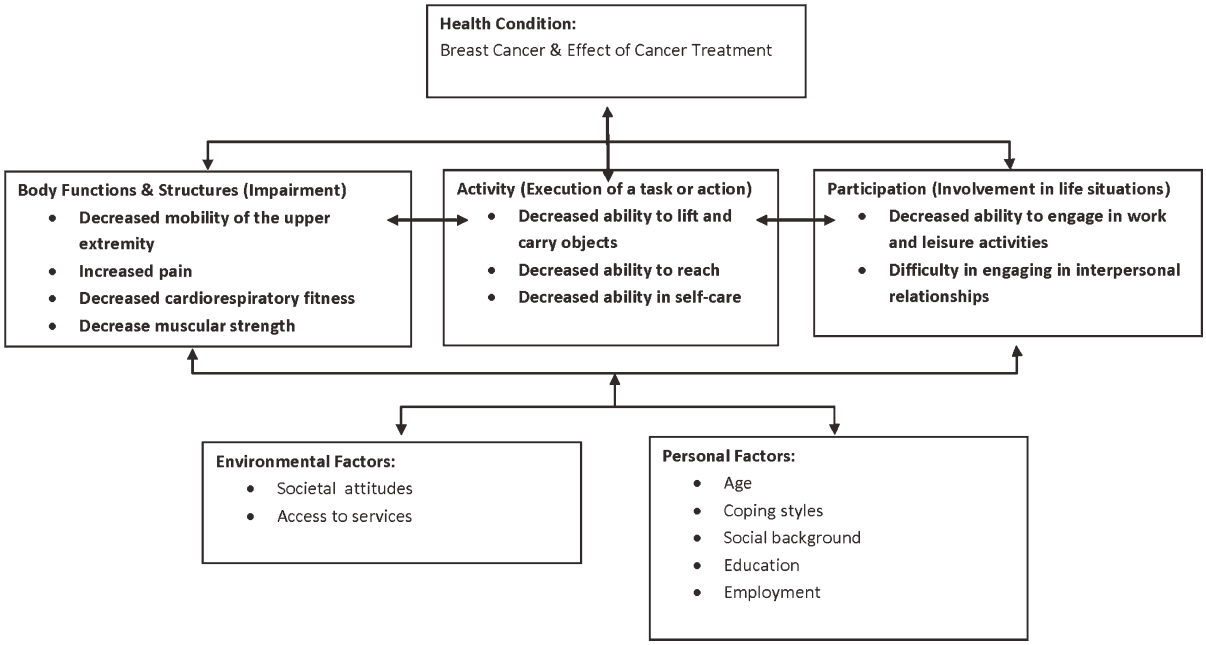

Figure 1. The application of the *International Classification of Functioning, Disability and Health* framework on functioning in breast cancer survivors is shown.

PREVALENCE OF LIMITATONS IN FUNCTION

The prevalence of limitations in function in cancer survivors compared to non–cancer survivors was examined in the National Health and Nutrition Examination Survey (NHANES 1999–2002), a large population-based survey of noninstitutionalized adults in the United States. A functional limitation was defined as an individual reporting "some difficulty," "much difficulty," or "unable to do" to a series of questions based on the participation restrictions and functioning scales of the 36-Item Short-Form Health Survey (SF-36).[5] Although all cancer types were included, breast cancer was the most common cancer type in women (25.4%). In comparison to individuals with no history of cancer, recent cancer survivors (<5 years from diagnosis) (odds ratio [OR], 1.85; 95% confidence interval [CI], 1.23-2.77) and long-term cancer survivors (≥5 years) (OR, 1.49; 95% CI, 1.07-2.08) were more likely to report a performance limitation. For example, difficulty walking a 1.4-mile distance was reported in 8.7% of non–cancer survivors, whereas 21.9% of recent cancer survivors and 22.7% of long-term cancer survivors reported the same level of walking difficulty. Furthermore, 30.5% and 31.3% of recent and long-term cancer survivors, respectively, reported restrictions in participation, compared with 13% of non–cancer survivors.[5] These findings suggest that a significant proportion of adult cancer survivors experience deficits in function and restriction in participation many years after diagnosis, even after controlling for age. The authors note that "cancer survivors may benefit from evaluation for rehabilitation services long after treatment for their original disease" (p. 197).[5]

Function was also assessed in 2 large cohort studies where subsets of cancer survivors were identified. In the Iowa Women's Health Study, a large cohort study of postmenopausal women who averaged 68 years or older, women were asked to respond "yes" or "no" to the question of whether they were healthy enough to complete a task without help, using questions adapted from an assessment tool for functional health in elderly, community-dwelling individuals.[6] In the subset of cancer survivors who responded to the 1997 follow-up questionnaire, the most common cancer diagnosis was breast cancer (approximately 47%). Compared with women without cancer, 5-year breast cancer survivors reported more functional limitations (OR, 1.37; 95% CI, 1.14-1.65).[7] Furthermore, in the large prospective Nurses' Health Study cohort, reduced function, measured using the SF-36, from pre– to post–breast cancer diagnosis, was reported across all stages of breast cancer.[8]

Persistent arm morbidity (ie, pain, reduced range of motion, limited strength) after surgery and adjuvant treatment for breast cancer has been consistently documented, along with a reduction in upper extremity function.[9-11] In addition, limitations in upper extremity function in breast

cancer survivors have been linked to a reduction in perceived ability to complete activities of daily living (ADLs) and lower health-related quality of life (HRQOL).[12-14]

There is less available literature documenting limitations in functional capacity in breast cancer survivors, as measured by performance measures, such aerobic fitness, global lower or upper body muscular strength, or mobility. In a randomized controlled trial of aerobic or resistance exercise during chemotherapy treatment for breast cancer, the usual care (no exercise) group had a 6.4% drop in maximal aerobic capacity in 17 weeks (from pretreatment to posttreatment).[15] However, the true prevalence and extent of limitations in functional capacity related to breast cancer and adjuvant treatment have not been systematically evaluated.

IMPLICATION OF FUNCTIONAL LIMITATIONS:

While the existence of impaired function in breast cancer survivors is clear, it is unclear how impaired function may manifest in activity limitations and affect participation in life roles.[16] There is a lack of evidence that stratifies impairments sufficiently, specifically factoring in possible mediators and moderators. The effect of cumulative impairments on disability also requires further exploration. For example, in breast cancer survivors with stage IV cancer, the absolute number of physical impairments explained 50% of variance in survivors and clinician-reported functional assessment scores.[17]

Numerous studies have reported that function is less affected by type of treatment or disease stage than by other factors. For example, in a large study of disease-free breast cancer survivors (N = 1933), HRQOL was less affected by the type of treatment than it was by demographic characteristics, time since surgery, comorbidity, fatigue, and depression.[18] Furthermore, overweight or obese women who gained weight after diagnosis reported lower quality of life and higher fatigue compared with those who maintained stable weight;[19] women who were older, African American or Hispanic Spanish-speaking, widowed/never married, or working were less likely to report severe symptoms.[20] The number of comorbid conditions and receipt of chemotherapy were also positively associated with reporting symptoms.[20]

The impact of cancer diagnosis and treatment on the trajectory of functional decline with aging, in the absence of cancer, is not clear.[16] In the aging literature, function is a major determinant of functional independence and development of frailty and disability.[21] Therefore, it could be assumed that, based on the limitations in function noted in breast cancer survivors, this group would be at a high risk for the development of age-related frailty and disability. The age at time of diagnosis is an important consideration that has not been fully explored, with the trajectory of aging and functional decline likely being different for a woman diagnosed at age 45 versus age 70.

Of note, some breast cancer survivors report comparable quality of life to the general population despite experiencing limitations in function. This may be a function of selection bias or response shift.[22,23] Illness representations also appear to play an important role in perceived health in survivors. Women who viewed their illness as associated with serious symptoms and consequences, who believed their illness to be chronic, and who considered their illness to be uncontrollable reported worse physical and mental health than those who believed the opposite.[24] Furthermore, objective and subjective assessment of impairments in function may differ.[9]

The impact of function on return to work has been underexplored. During treatment, uncertainty about ability to work, physical appearance, and possible job loss affected decisions about returning to work.[25] After treatment, while women want to return to "normal life," multiple factors, such as health variables (eg, disease stage, fatigue) and work-related variables (eg, physical demands at work) potentially interfered.[26] There is a paucity of convincing information on how function and the work environment influences the survivor's experience of return to work and ability to perform occupational duties.[25]

Recently, function has been linked to survival in breast cancer survivors. In a large, prospective population-based cohort of early-stage breast cancer survivors, the Life After Cancer Epidemiology (LACE) cohort, participants were asked if they could perform a list of ADLs.[27] At least 1 functional impairment was present in 39% of breast cancer survivors at the median follow-up time of 9 years postdiagnosis, irrespective of clinical, lifestyle, and sociodemographic factors.[27] Older, less educated, and more obese survivors were more likely to have greater functional limitation burden. Women with functional limitations were less physically active compared with women without limitations.[27] Functional limitations were associated with a significantly increased risk of death from all causes (hazard ratio [HR], 1.40; 95% CI, 1.03-1.92), but not from breast cancer (HR, 0.90; 95% CI, 0.64-1.26). This is not surprising, since for women in the general population, physical inactivity is a strong predictor of cardiovascular and all-cause mortality.[28,29]

In contrast, greater prediagnosis physical activity and physical activity maintained posttreatment are associated with better quality of life and function posttreatment. In the Health, Eating, Activity, and Lifestyle (HEAL) cohort study of 545 breast cancer survivors, physical activity in the year prior to diagnosis and at 29 months postdiagnosis was

Table 1. Measures of Functional Capacity

Category	Outcome Measures	Description	Time to Complete	Equipment
Aerobic fitness	Maximal aerobic fitness (mL/kg/min)	Maximal graded exercise test or estimated from submaximal exercise test	30 min	Treadmill or cycle ergometer with or without an metabolic cart
	6-min walk test (m)	Maximal distanced walked in 6 min on flat, level surface	10 min	Measuring tape and stopwatch
	12-min walk test (m)	Maximal distanced walked in 12 min on flat, level surface	16 min	Measuring tape and stopwatch
Muscular strength	1-RM (kg)	Maximal strength test or estimated from submaximal strength test	15 min	Graded weight system and appropriate weight lifting seat or bench
	Hand grip (kg)	Maximal strength measured via hand grip dynamometer	<5 min	Hand dynamometer
Mobility	Gait speed (m/s)	Measure of functional mobility	<5 min	Measuring tape, stopwatch
	Chair stand (no. of seconds to complete 5 stands)	Measure of functional mobility	<5 min	Chair, stopwatch

Abbreviations: 1-RM, 1-repetition maximum; FLIC, Functional Living Index-Cancer; ICC, Intra-class correlation coefficient; M-CSDS, Marlowe-Crowne Social Desirability Scale; MRM, Modified radical mastectomy; MSK, Musculoskeletal; POMS-SF, Short form of the Profile of Mood States; SRM, standardized response mean.

associated with better function at 39 months postdiagnosis.[30] In another study, survivors with physical activity above the median prior to diagnosis who maintained this level of activity during the first year after starting endocrine treatment reported better quality of life, physical activity, and less fatigue 2 years later compared with those with low levels of physical activity, which further decreased after cancer diagnosis.[19] While the relationships between function and quality of life have yet to be adequately elucidated, promoting physical activity among the breast cancer survivors should have significant benefits.

Functional impairments with increased focus on patient-reported outcome (PRO) data associated with breast reconstruction surgery are only now being elucidated. Advances in surgical technique have led to a variety of abdominal donor flaps that can be used for postmastectomy breast reconstruction; however, donor site morbidity can include abdominal wall discomfort and weakness. Futter et al[31] used functional dynamometry, the SF-36, and a subjective interview to measure abdominal wall morbidity after free transverse abdominal myocutaneous (TRAM) flap and deep inferior epigastric artery perforator (DIEP) flaps. The free TRAM patients had significantly decreased objective abdominal wall strength, but there was no difference in the SF-36 physical functioning scale. Notably, the SF-36 results did not correlate with the findings from a subjective interview, where significantly more women in the free TRAM group reported functional limitation and postoperative lower back pain when compared with the DIEP group. These results suggest that breast cancer survivors' subjective experience of abdominal wall weakness after TRAM flap reconstruction may be different than weakness measured by dynamometry. Furthermore, it suggests that a generic PRO measure, such as the SF-36, may not be adequately sensitive to subtle physical limitations that women experience after TRAM reconstruction (eg, getting out of bed, making a bed).

The prevalence of functional limitations in ADLs, upper extremity function, and functional capacity in breast cancer survivors and proposed impact of functional limitations on activity, participation in life roles, return to work, and survival illustrates the need for prospective measurement of function to better quantify limitations and assess the impact of rehabilitation interventions.

MEASUREMENT OF FUNCTION

A key aspect in the development of rehabilitation approaches to improve function in breast cancer survivors is identifying measurement tools that can capture functional limitations to inform treatment decisions and rehabilitation programming. The measures need to be sensitive to the unique issues of breast cancer survivors (eg, shoulder mobility after mastectomy) and responsive to change in the patients' status. Additionally, measures should ideally be designed both for research purposes, and to guide individual patient assessment and management in clinical care. Proposed measures are divided into measures of functional capacity (Table 1), upper extremity function (Table 2), and general function (Table 2).

Measures of Functional Capacity

Cardiorespiratory system

The current gold standard for measuring aerobic fitness is a graded exercise test with measurement of expired

Table 2. Measure of Upper Extremity Function and General Function

Outcome Measure	Construct of Measure	Description	Time to Complete	Clinical Interpretation	Cut-points/MID/MDC	Comments	Reliability, Validity, and Sensitivity in Breast Cancer Population
KAPS	Upper extremity problems (symptoms) and function	13-items; 5-point scale (1-5)	3-5 min	Higher score=more symptoms and poorer function	Cut-points: total score, ≥21.5; problems score,≥14.5; ADL score, ≥7.5	Developed to identify shoulder and arm problems during breast cancer treatment	Concurrent and discriminant validity with arm abduction and concurrent validity with SF-36 physical component scale Test/retest reliability: Cronbach's alpha >0.92
PSFS	Clinical measure of function	3 items; 11-point scale (0-10)	5 min (clinician with patient)	Higher score=better function	MDC: 3 points for individual item; 2 points for average of 3 items in MSK population	For use in clinical setting: measures change in function specific to the individual survivor	Tested in the United States Validated against FACT-B and UEFI postsurgery (n=65 patients; good convergent construct validity of average score) Sensitivity to change (n=26 patients postsurgery): SRM=3.25 (95% CI, 2.54-4.93) Sensitivity to change significantly better than FACT-B and UEFI.
DASH	Pain-related upper extremity disability	30 items; 5-point scale (1-5)	<10 min	Higher score=poorer function	15 points in MSK population	Has not been validated in the breast cancer population	NA
UEFI	Upper extremity function	20 items; 5-point scale (0-4)	3 min, 30 sec	Higher score=better function	MDC: 10 points in MSK population	Valid and sensitive to change in the breast cancer population	Tested in the United States Validated against FACT-B (n=65 patients postsurgery; good convergent construct validity) Sensitivity to change (n=26 patients post surgery): SRM=1.52 (95% CI, 1.23-1,99)
BREAST-Q	Satisfaction and surgery-related QoL	36-items (mastectomy module) or 55 items (reconstruction module); 5-point scale	10-14 min	Higher score=higher satisfaction, better QoL	MID: 5 points for reconstruction module	Developed for survivors undergoing MRM with/without reconstruction	Tested in the United States and Canada (n=1950; test/retest reliability, 491) High internal consistency (Cronbach's alpha 0.81-0.98), good test/retest reliability (ICC 0.85-0.98) Validated against EORTC-BR23, BIBCQ, and SF-36 (good convergent and discriminant validity)

(Continued)

Table 2. Measure of Upper Extremity Function and General Function (Continued)

Outcome Measure	Construct of Measure	Description	Time to Complete	Clinical Interpretation	Cut-points/MID/MDC	Comments	Reliability, Validity, and Sensitivity in Breast Cancer Population
FACT-B	Multidimensional QoL in survivors with breast cancer	36 items; 5-point scale (0-4)	10 min	Higher score=better QoL	MID: 7-8 points (2-3 points on the breast subscale)	Focuses on nonsurgical treatment-related issues	Validated against the FLIC, POMS-SF, and short form of the M-CSDS Internal consistency was high (Cronbach's alpha 0.9) Test/retest reliability, convergent and divergent validity, and sensitivity to change were demonstrated.
FACT-B+4	Upper extremity impairment	4 items with arm subscale; 5-point scale (0-4)	10+ min for full scale	Higher score=better QoL, less impairment	NR	Measures impairment not function	Validated (n=308 patients), good internal consistency (Cronbach's alpha 0.62-0.88); test/retest reliability, 0.97
EORTC-QLQ B23	Multidimensional QoL in survivors with breast cancer	23 items; 4-point scale (1-4)	10 min	Higher score=better QoL	MID: 5-10 points	Used along with EORTC QLQ general cancer module	Pilot-tested (n=618 patients), adequate reliability (Cronbach's alpha 0.7-0.91) Clinical and cross-cultural validity determined via extensive psychometric analysis
SF-36	General health-related QoL, physical and mental health	36 items	5-10 min	Higher score=better function	MID: ≈5 points	Normative data available	Internal consistency range: Cronbach's alpha 0.49-0.81 Reliability coefficient range: 0.78-0.93 Discriminant validity found to be high

Abbreviations: BIBCQ, Body Image After Breast Cancer Questionnaire; CI, confidence interval; DASH, Disabilities of the Arm, Shoulder and Hand; EORTC-QLQ B23, The European Organization for Research and Treatment of Cancer Quality of Life Questionnaire—Breast Cancer Module; FACT-B, Functional Assessment of Cancer Therapy, Breast; KAPS, Kwan's arm problem scale; MDC, minimal detectable change; MID, minimally important difference; NA, not available; NR, not reported; PSFS, Patient-Specific Functional Scale; QoL, quality of life; SF-36, Short-Form-36; UEFI, Upper Extremity Functional Index.

gases by indirect calorimetry for determination of maximal oxygen consumption (VO_2 max).[32] In breast cancer survivors, this technique has been used more commonly in research settings than in clinical practice.[33] Aerobic fitness has been documented at baseline in some exercise intervention trials for breast cancer survivors, with reported values ranging from 17.5 mL/kg/min to 25.2 mL/kg/min,[15,34-36] which is below population norms for women <65 years.[37] Submaximal graded exercise tests without collection of expired gases, which then rely on predictive equations to determine maximal aerobic fitness, have also been used to quantify aerobic fitness in breast cancer survivors.[32,38] However, it is not clear if the assumptions underlying these equations are reliable in breast cancer survivors, particularly during adjuvant treatment.[39]

The 6-minute or 12-minute walk test has also been used as a proxy measure of aerobic fitness in breast cancer survivors.[40-47] The 6- or 12-minute walk test records the distance an individual can quickly walk on a flat hard surface in 6 or 12 minutes and is used to assess a submaximal level of functional capacity and may be more feasible in a clinical setting than maximal graded exercise testing.[48] A good correlation between maximal aerobic capacity and 6-minute walk test ($r = 0.73$) has been noted in individuals with end-stage lung disease;[48] however, this has not been tested in breast cancer survivors.

Global measure of upper body or lower body muscular strength

A 1-repetition maximum (1-RM) for a squat or leg press is the gold standard measure of global muscular strength in the lower body, while the corresponding test for the upper body is commonly the chest or shoulder press. The use of 1-RM testing is more common in research studies than in clinical practice.[32] This technique has recently been shown to be safe in breast cancer survivors.[49] An estimated 1-RM using maximal resistance at 6-8 repetitions can be used to estimate 1-RM using predictive equations[32,50] and has been used in intervention studies of breast cancer survivors.[15] Hand grip strength, a proxy measure of upper extremity strength, has also been used to measure strength in breast cancer survivors;[9,44,51] however, it has not been validated as a proxy measure in the breast cancer population.

Mobility

Measures of functional mobility such as the timed-up-and-go test or gait speed have recently been linked to health outcomes and all-cause survival in older adults[52] and cancer survivors.[53] Functional mobility tests have also been used in breast cancer survivors to examine both the impact of function on risk of falls[54] and the impact of neurotoxic chemotherapy agents, such as taxanes used in breast cancer treatment, on function.[55] Use of a mobility testing battery, such as the Short Physical Performance Battery,[56] may help to capture mobility issues. However, the available norms for these tests have been developed for older frail adults and may not be appropriate for breast cancer survivors, especially younger survivors.

Measures of Upper Extremity Function: Range of motion, performance measures and patient reported outcomes

Shoulder range of motion, measured by goniometry, is an objective measure of upper extremity function that has been used extensively in the breast cancer rehabilitation literature[57] and is highlighted in the article by McNeely et al[58] on upper extremity rehabilitation in this supplement of *Cancer*. A limitation in shoulder flexion and abduction is the most common pattern reported postsurgery for breast cancer;[57] however, the impact of these limitations on function has not been systematically evaluated.

A number of PRO measures have been developed to capture the effects of injury or disease on upper extremity function. Those commonly used with breast cancer survivors include Kwan's arm problem scale (KAPS), the Disabilities of the Arm, Shoulder, and Hand (DASH), the Upper Extremity Functional Index (UEFI), the Functional Assessment of Cancer Therapy (FACT)-Breast (B+4), and the Patient-Specific Functional Scale (PSFS).[59-61] To date, only the KAPS,[62] UEFI,[61] and FACT-B+4[60] have had their psychometric properties investigated in breast cancer survivors.

The KAPS was developed to identify shoulder and arm problems during breast cancer treatment, including problems with arm/shoulder function, pain, stiffness, and swelling and impairments in basic ADLs due to arm/shoulder problems.[63] The scale has been shown to be highly reliable and to have good convergent and discriminant validity in breast cancer survivors.[62]

The DASH is designed to measure pain-related upper extremity function and examines symptoms such as pain, weakness, and numbness, and the degree of disability related to work and recreational activity.[59] This scale has been shown to possess acceptable levels of validity and reliability in other populations, but while it has been used with breast cancer survivors,[14] its psychometric properties have not been estimated for this population.

The UEFI is designed to measure general upper extremity function. The UEFI has displayed acceptably high

levels of reliability, validity, and sensitivity to change in patients with orthopedic upper extremity conditions,[64-67] and Binkley et al[61] found it to have acceptable levels of validity and sensitivity to change in women after breast cancer surgery.

The FACT-B+4[60] is a 4-item subscale of the FACT-B designed to capture the impact of arm morbidity to a greater extent than the FACT-B. The FACT-B+4 is reported to be sensitive to change based on average scale score improvement over time since surgery, but formal investigation of sensitivity to change or comparison with other valid upper extremity scales has not been performed.[60]

The PSFS was designed as a clinical measure of function when the goal is to measure change related to the effect of a treatment/intervention for an individual. An individual identifies up to 3 ADLs with which they are having difficulty and rates the current level of difficulty of each activity. The PSFS is more sensitive to change than relevant condition-specific or generic scales in a number of orthopedic conditions[68-70] and in breast cancer survivors.[61] Convergent construct validity of the PSFS in breast cancer survivors after surgery has been evaluated with the FACT-B.[61]

Overall, initial work suggests that the UEFI and PSFS are valid and sensitive to individual change to assess outcome in breast cancer survivors after surgery.[61] The PSFS appears to be more sensitive than the UEFI and the FACT-B,[61] and is, therefore, a useful clinical measure when the goal is to measure change in function at the level of the individual. Further research is needed to document the measurement properties of other upper extremity scales, such as the DASH, that are often administered to women with breast cancer.

Measures of General Function

PRO measures designed to measure HRQOL after breast cancer treatment rely on subjective measurement of patient experiences, symptomatology, and functional limitations. Although challenging to construct, well-developed PRO tools with strong psychometric properties are essential to obtaining a complete understanding of function in breast cancer survivors.

Generic patient reported outcome measures

A generic PRO measure is a broad-based questionnaire, such as the SF-36, that measures psychological, social, spiritual, and physical functioning aspects of HRQOL in diverse patient populations.[71] Although useful to provide benchmark data and comparison of outcomes across different patient cohorts, generic measures are generally not adequately sensitive to condition-specific patient issues.

Breast cancer–specific PRO measures

To overcome this limitation of generic measures, condition-specific PRO measures for breast cancer survivors have been developed. A recent systematic review identified 10 PRO measures that have been developed and validated for use in breast cancer survivors.[72] Five of these measures (European Organization for Research and Treatment of Cancer Quality of Life Questionnaire—Breast Cancer Module [EORTC QLQ BR23], FACT-B, Hopwood Body Image Scale [HBIS], Body Image After Breast Cancer Questionnaire [BIBCQ], and the BREAST-Q) showed evidence of appropriate development and psychometric properties. Among these, the EORTC QLQ BR23,[73] FACT-B,[74] and BREAST-Q[75] were notably designed to address issues related to function. Of these, only the BREAST-Q and FACT-B were developed with the aid of newer psychometric methods to enhance the questionnaire's ability to measure individual patient outcomes in clinical care.

The EORTC QLQ-BR23 is intended for use along with the EORTC QLQ general cancer module. In validation studies, this scale distinguished clearly between survivors differing in performance status and treatment modality (including surgery).[72,73]

The FACT-B is designed to measure multidimensional quality of life in breast cancer survivors.[74] The FACT-B consists of the FACT-General (FACT-G) and the Breast Cancer Subscale. The FACT-B has been shown to have high internal consistency and reliability, and sensitivity to change has been supported in 2 validation samples in breast cancer survivors.[74,76] The Trial Outcome Index (TOI)-Breast can be computed from the FACT-B scale by summing the physical well-being, functional well-being, and "additional concerns" subscales and may be a more useful metric for determining functional status, because it may be more responsive to change than the overall score, which also considers social and emotional well-being. Although social and emotional well-being are important aspects of quality of life, they may not be as responsive to an intervention.[77] The TOI-Anemia has been found to be more responsive to change after interventions addressing physical and functional aspects of quality of life in lymphoma survivors than the full FACT scale.[76]

The BREAST-Q is a new PRO measure that measures both satisfaction and HRQOL of breast cancer survivors undergoing either mastectomy alone or with reconstruction.[75] The questionnaire may be administered

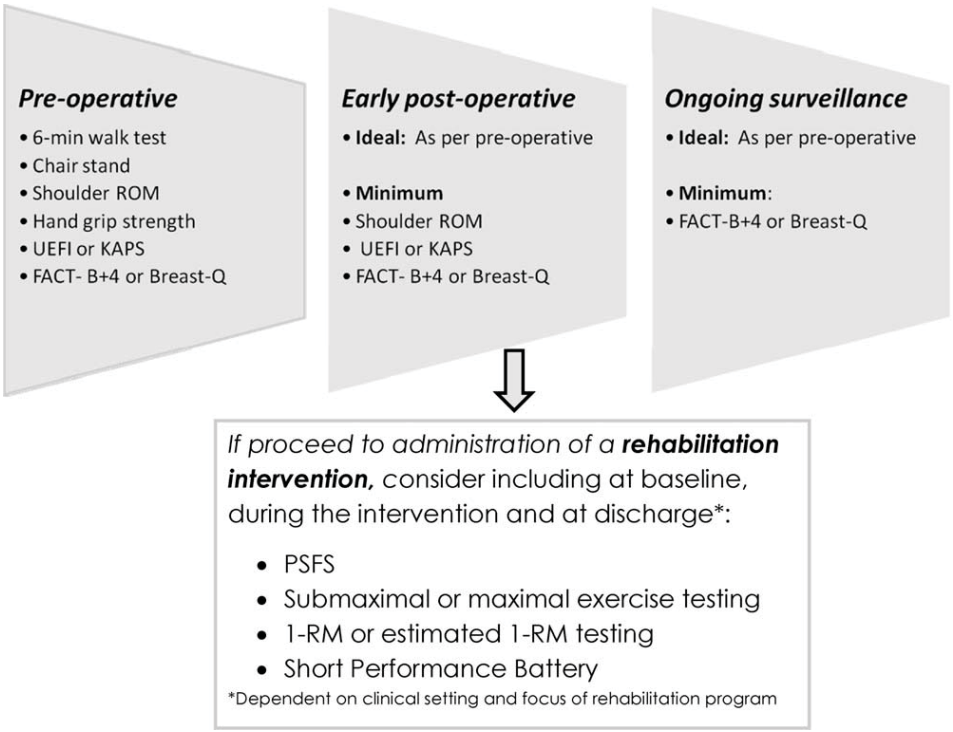

Figure 2. A model of physical rehabilitation for women with breast cancer is shown including measures of function within prospective surveillance.

both before and after surgery. The BREAST-Q measures physical well-being (chest and upper body, abdomen, and trunk), psychosocial well-being, and sexual well-being, as well as satisfaction with breasts, overall outcome, and care. In a recent validation study (n = 817 women), BREAST-Q scale reliability was supported by high Cronbach's alpha coefficients (>0.80), intraclass correlation coefficients (>0.80), and appropriate item-total correlations (range of means, 0.58-0.87). Scale validity was supported by inter-scale correlations, findings from known group tests and correlations with sociodemographic variables.

Key Timing of Measures

Serial measures of function should be administered at key intervals along the cancer treatment and survivorship continuum. The chosen time points should consider the natural course and expected rate of recovery from breast cancer, and the levels of detectable change in the measure used.[78] Measures should also be considered as a way to facilitate discussion among health care providers, employers, breast cancer survivors, third-party payers, and policy makers. Moreover, accurate documentation of symptoms and physical limitations may provide justification for funding and resource allocation at both a patient and program level.[78] The type of measure that is most suitable to quantify function may differ by specific deficit identified (ie, upper extremity range of motionor participation in ADLs), the population (ie, younger or older breast cancer survivors), and the setting (ie, research or community).

EFFICACY OF REHABILITATION INTERVENTIONS TO IMPROVE FUNCTION

The efficacy of physical activity and focused rehabilitation interventions on HRQOL, performance measures, and upper extremity function in breast cancer survivors has been clearly demonstrated.[57,79-82] A prospective physical therapy intervention demonstrated the benefits of preoperative education and exercise instruction on postoperative upper extremity range of motion, strength, and function.[83] A key feature of the intervention was prospective surveillance, with assessment at 1, 3, 6, and 12+ months postoperatively, which allowed additional physical therapy treatment to be provided when an impairment was identified. The result was that the majority of women achieved a full recovery at 12 months. However, questions around effectiveness or generalizability of rehabilitation interventions outside of research studies and the most effective exercise prescription parameters need further study.[84] Given the documented effectiveness of treatment,

there is strong rationale for surveillance and rehabilitation programming aimed at improving function in breast cancer survivors.

PROSPECTIVE SURVEILLANCE MODEL

Breast Cancer Diagnosis and Treatment Planning

The goal of the preoperative visit is to establish baseline measures of function that are most appropriate to the clinical setting. A standard battery of tests to capture 1) functional capacity; 2) upper extremity range of motion, strength, and function; and 3) HRQOL is proposed (Figure 2). A breast cancer–specific tool that includes health-related quality of life and function, such as the FACT-B+4 or the BREAST-Q, may be the most effective measure for surveillance of function and impact of function on HRQOL from the preoperative to the early postoperative phase. Furthermore, a comparison of preoperative values with age-match population normal values could serve as the foundation for a postoperative rehabilitation program to improve functional capacity if preoperative values fall below expected norms.

Postoperative Period

Reassessment of preoperative measures at appropriate time points postoperatively could pick up deficits in function that could be amenable to rehabilitation. If a rehabilitation intervention is warranted, condition-specific measures, such as the UEFI and the PSFS, are best suited to measuring incremental progress in breast cancer survivors because of their superiority in measuring change in an individual. The standard battery of tests should be administered at admission and at discharge from the rehabilitation program.

Adjuvant Treatment and Survivorship Care

In the ongoing surveillance phase, the standard battery of tests could be administered at standard intervals or a PRO tool, such as the FACT-B or BREAST-Q, would be appropriate for intermittent ongoing evaluation of function and HRQOL.

CONCLUSIONS

Function is complex and a difficult construct to capture. Nonetheless, functional limitations clearly impact the HRQOL of breast cancer survivors. The integration into breast cancer care of performance measures and PRO that address function is essential to more fully appreciate the multiple functional limitations associated with breast cancer and to improve rehabilitation care for breast cancer survivors.

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CONFLICT OF INTEREST

The authors made no disclosures.

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