Development and Evaluation of the Breast Cancer Online Rehabilitation (BRECOR) Program for Self-managed Upper-Body Rehabilitation for Women With Breast Cancer

Bolette S. Rafn, PT, MSc[1]*; Carina Nees, PT, MSc*[2]*; Julie Midtgaard, PhD*[3,4]*; Pat G. Camp, PT, PhD*[5,6]*; Jette Vibe-Petersen, MD*[7]*; Kristin L. Campbell, PT, PhD*[8]

[1]Doctoral Candidate, Department of Physical Therapy, Faculty of Medicine, University of British Columbia, Vancouver, British Columbia, Canada; [2]Physical Therapist, Copenhagen Centre for Cancer and Health, Copenhagen, Denmark; [3]Associate Professor, The University Hospitals Centre for Health Research, Copenhagen University Hospital Rigshospitalet, Copenhagen, Denmark; [4]Associate Professor, Department of Public Health, University of Copenhagen, Copenhagen, Denmark; [5]Clinician Scientist, Department of Physical Therapy, Faculty of Medicine, University of British Columbia, Vancouver, British Columbia, Canada; [6]Clinician Scientist, University of British Columbia Centre for Heart Lung Innovation, St Paul's Hospital, Vancouver, British Columbia, Canada; [7]Director, Copenhagen Centre for Cancer and Health, Copenhagen, Denmark; and [8]Associate Professor, Department of Physical Therapy, Faculty of Medicine, University of British Columbia, Vancouver, British Columbia, Canada

Background: Survivors of breast cancer experience upper-body issues. **Objectives:** To develop and evaluate a rehabilitation program (BRECOR) to support self-managed upper-body rehabilitation after treatment for breast cancer. **Design:** Development and feasibility study. **Setting:** Community-based. **Participants:** Development of program elements (clinical assessment tool, education pamphlet, and Website) was informed by 17 physical therapists with experience in oncology rehabilitation and 10 women with breast cancer. Feasibility was evaluated by 35 women who had recently undergone surgery for breast cancer and 29 women who had completed surgery and radiation therapy for breast cancer. **Intervention:** Participants performed an individualized 12-week self-managed upper-body rehabilitation program informed by the clinical assessment tool, with support from the education pamphlet and the Website. **Measurements:** Recruitment/retention rates, adherence, capacity, and participant satisfaction were collected to establish feasibility. **Results:** Feedback from the physical therapists was instrumental in developing the program content. User testing refined the program elements. Participant feedback in the feasibility testing was positive with good recruitment (80%), retention (83%), and adherence (72%) to the self-managed upper-body rehabilitation program. Participants improved their upper-body function and reported benefit from the program. **Limitations:** The effectiveness

Rehabilitation Oncology
Copyright © 2018 Oncology Section, APTA.

Grant Support: *This work was supported by TrygFonden, Østifterne, and the Oda og Hans Svenningsen's grants.*

The authors have no conflicts of interests to declare.

Correspondence: *Kristin L. Campbell, PT, PhD, Department of Physical Therapy, Faculty of Medicine, University of British Columbia, 212 Friedman Bldg, 2177 Wesbrook Mall, Vancouver, BC V6T 1Z3, Canada (**kristin.campbell@ubc.ca**).*

DOI: 10.1097/01.REO.0000000000000151

Copyright © 2018 Oncology Section, APTA. Unauthorized reproduction of this article is prohibited.

of the BRECOR program in improving upper-body function cannot be determined, as this was a single-group feasibility study. **Conclusion:** A feasible, self-managed upper-body rehabilitation program was developed through iterative stages of program development and feasibility testing. The BRECOR program elements provide a toolkit to enforce qualified upper-body assessment, provide rehabilitation prescriptions, and support self-managed upper-body rehabilitation after treatment for breast cancer. **(Rehab Oncol 2018;0:1–10)** *Key words: feasibility study, physical rehabilitation, program development*

INTRODUCTION AND PURPOSE

Breast cancer is the most common malignancy among women in the world.[1] While survival has improved substantially, breast cancer survivors (BCS) are at risk of developing upper-body issues after treatment.[2] Even 5 years postsurgery, approximately 68% of BCS report upper-body pain, 72% have tightness in the area of surgery,[3,4] 67% have limited shoulder range of motion (ROM),[3-5] 60% have impaired muscular strength,[3,4,6] and 20% develop breast cancer–related lymphedema (BCRL).[7-9] While the effectiveness of physical therapy to restore upper-body functioning is well established,[10-12] health care systems in Europe and North America face increasing challenges in providing cost-effective and high-quality rehabilitation.[13] These challenges include the rising costs of overall cancer care and mandate to ensure equitable access to care.

Disparities in access to oncology rehabilitation for BCS is identified to cause underutilization of existing services[14] and a greater risk of development of chronic upper-body issues.[15] The patient-level barriers to access to see a physical therapist include time, any related out-of-pocket costs, and cost or logistics of transportation.[16] At the health system-level, lack of oncology rehabilitation programs and physical therapists with the knowledge, skill, and experience to safely and effectively treat cancer-related impairments hinders timely treatment.[17-19] Both patient-level and health system-level access barriers often disproportionally affect patients of lower socioeconomic status[15] or those living in rural areas. To improve access to high-quality care, the Danish National Clinical Guideline[20] highlighted the need for development of innovative rehabilitation programs that can be delivered across settings.

Based on access challenges, promoting the engagement of BCS in self-management has become a priority of cancer care initiatives,[21,22] including testing self-management models to prevent or manage upper-body issues.[23] Research studies on rehabilitation programs supported by Web-based self-management resources demonstrate a benefit of upper-body function and reduce pain among BCS.[24] In addition to providing written material, supportive video guides or verbal instructions have been suggested as relevant to facilitate long-term rehabilitation behavior[25] and improve clinical outcomes in upper-body function. Furthermore, home-based approaches may assist with patient-level barriers around time, cost, and rural or remote locations.[26] However, novel approaches to guide BCS in self-managed upper-body rehabilitation at home have not been broadly translated into current clinical care. There is a need to develop new approaches to support self-managed rehabilitation that are clinically feasible and acceptable to reduce barriers to care and enhance rehabilitation outcomes. In addition, resources to assist physical therapists in the clinical decision-making around the prescription of upper-body rehabilitation are needed.

This article reports on the development and feasibility evaluation of the Breast Cancer Online Rehabilitation (BRECOR) program to support self-managed upper-body rehabilitation in BCS.

METHODS

Study Design

The study was conducted in 2 stages: (1) program development, which included content development, prototype design, and revisions; and (2) feasibility evaluation of the BRECOR program in 11 municipalities in Denmark (Figure 1).

Fig. 1. Process of developing and feasibility evaluation of a self-managed program for upper-body rehabilitation for women with breast cancer. BCS indicates breast cancer survivor.

Copyright © 2018 Oncology Section, APTA. Unauthorized reproduction of this article is prohibited.

Program Development

Program content and elements were developed by the project team, clinical consultants, and patient representatives. Clinical consultants (the physical therapists who manage community-based oncology rehabilitation in the Capital Region of Denmark, n = 17) participated in 2 workshops and completed questionnaires to evaluate the need for a self-managed upper-body rehabilitation program for BCS and discuss the content, relevance, and usability of the BRECOR program elements. A convenient sample of 10 BCS, who were receiving rehabilitation at one of the rehabilitation centers, served as patient representatives and formed a user panel. The user panel was given the pamphlet and access to the prototype Website for 4 to 8 weeks to perform rehabilitation exercises at home and completed a questionnaire on usability of the resources. Furthermore, a semistructured focus group was conducted with a convenient sample of participants from the user panel (n = 6) to explore the user experience, perceived benefit, strengths, and weaknesses of the program.

Suggestions from the user panel led the team to adjust the Website to include more features such that it functioned as a single location for all relevant information. Videos to demonstrate self-managed manual lymph drainage were added, along with mindfulness audio files, written information about BCRL, and written testimonies of other women's experiences about going through treatment of breast cancer. Input from the clinical consultants led the team to adjust the clinical assessment tool, specifically adding information on correct testing positions for some of the assessments and guidelines for how to teach the rehabilitation exercises, along with the addition of 2 rehabilitation exercises on the Website and the pamphlet. During the second workshop, agreement was obtained among the clinical consultants on how to use the clinical assessment tool that, for example, limitations in shoulder ROM, would trigger a prescription of rehabilitation exercises to improve joint mobility, whereas pain and tightness from scar tissue in the breast region would trigger a prescription for self-massage. The updated version of the program elements was then presented to the clinical consultants at the second workshop who unanimously reported in a questionnaire that the program elements could be tested for feasibility at their rehabilitation center.

Program Description

The final BRECOR program consists of the following: (1) a clinical assessment tool to assist physical therapists in their examination and to inform a prescription of rehabilitation exercises; (2) a Website with videos of rehabilitation exercises to support BCS in performing these at home; and (3) an education pamphlet with the same rehabilitation exercises as the Website, here described in the text with photographs (Table 1). The rehabilitation exercises are upper-body mobility and strength exercises that are recognized as the appropriate rehabilitation for BCS in Scandinavia.[27,28]

The Website[29] is organized with specific rehabilitation exercises depending on the type of surgery, lumpectomy or mastectomy. For each surgery type, the Website includes the following: (1) videos with verbal introductions on the benefits of performing upper-body rehabilitation and what to expect during radiation therapy; (2) information from a multidisciplinary team that answers common concerns (ie, diet, sick leave regulations, physical activity, symptom management, and counseling resources); and (3) 24 videos of rehabilitation exercises that guide the performance of the exercises or activity in the correct pace and provide information about red flags, as well as ways to progress or regress (Table 1). For example, for each surgery type, the Website provides video guides that feature women who have undergone the specific type of surgery who demon-

TABLE 1
Elements in the BRECOR Program

Program Element	User	Description
Clinical assessment tool	Physical therapists	Tool to support the assessment of upper-body impairment including: Active shoulder joint mobility using a goniometer Muscular strength using manual muscle testing Pain and tightness using a numeric pain rating scale Inform the prescription of rehabilitation exercises
Website	Women with breast cancer	Information about benefits of rehabilitation Information from a multidisciplinary team Video guides, n = 24: Self-massage of scar tissue, n = 5 Rehabilitation exercises, n = 11 Self-managed manual lymph drainage, n = 4 Yoga and relaxation, n = 4 Mindfulness sound files for stress-management, n = 3
Education pamphlet	Women with breast cancer	Information about common upper-body issues and recommendations for how to perform rehabilitation exercises Photographs and text illustrating: Self-massage of scar tissue, n = 5 Rehabilitation exercises, n = 11 Self-managed manual lymph drainage, n = 4

Copyright © 2018 Oncology Section, APTA. Unauthorized reproduction of this article is prohibited.

strate tissue flexibility on the operated breast, perform self-managed nerve tissue stretches, or perform rehabilitation exercises for joint mobility or muscle strength.

Feasibility Evaluation

We conducted a single-group, 12-week feasibility study of the BRECOR program in 11 municipalities in Denmark. The study was conducted in 2 parts to evaluate feedback from BCS who had recently undergone surgery for breast cancer (part 1) and BCS who had completed surgery and radiation therapy for breast cancer (part 2). The study was approved by the Danish Ethics Board (H-15017482) and the Danish Data protection Agency (File number: 2015-55-0736) and registered at ClinicalTrials.gov (ID: NCT02752659).

Participants

Women were eligible if they were 18 to 80 years old, have undergone any type of surgery for any stage of breast cancer, and referred to rehabilitation at one of the study centers. For part 1, participants had to be within 8 weeks of surgery. For part 2, participants had to have completed radiation therapy within the last 6 weeks (which is commonly started 9 months postsurgery). Participants also had to have access and ability to use the Internet and ability to read and understand Danish. Women were excluded if they had surgery for breast cancer with immediate breast reconstruction (ie, different rehabilitation needs due to more extensive surgery) or other serious illness that prohibited participation (ie, mental illness or illness requiring surgery within the study period). All patients referred for rehabilitation during the study period were screened for eligibility. Participants for part 1 were recruited consecutively during a 10-week period from January to March 2016, whereas participants for part 2 were recruited consecutively during a 20-week period from June to October 2016. All participants provided written informed consent prior to enrollment.

Assessment Procedures

At baseline, participants underwent an assessment, guided by the clinical assessment tool, by a physical therapist at the rehabilitation center in the municipality of their residence. The assessment included measures of shoulder ROM, upper-body muscle strength, and pain and tightness in the breast region. Each participant was given the education pamphlet, in which the physical therapist marked the rehabilitation exercises specifically recommended for the individual. In addition, participants were verbally introduced to the Website, including the videos for the prescribed rehabilitation exercises and, when possible, the physical therapist demonstrated the navigation of the Website. At the 12-week follow-up, the clinical assessment was repeated for participants in part 1 but not in part 2 due to resource constraints, as these participants had completed treatment and were usually no longer seen for rehabilitation at the centers. While the clinical assessment at baseline is needed to inform the rehabilitation prescription, the follow-up assessment was performed to collect study outcomes is not a key component of the BRECOR program. The physical therapists, who performed the follow-up assessments, were blinded to baseline measures.

Intervention

The 12-week self-managed upper-body rehabilitation program was prescribed at the face-to-face baseline assessment by the physical therapist based on the individual need. All physical therapists who delivered the program had experience in oncology rehabilitation and had attended the 2 workshops prior to study start where the program resources were reviewed and agreement was obtained about how to use the resources and prescribe the self-managed program. A typical prescription included 3 rehabilitation exercises that should be performed 4 or more times weekly at home with the support from the Website and education pamphlet with duration of approximately 20 minutes per session. If needed, the physical therapists could adapt the rehabilitation prescription during the study when the participant was seen for treatment as part of usual care. The BRECOR program resources were offered in addition to usual care at the centers. Usual care differed from site to site but generally included a combination of group-based rehabilitation sessions specific for BCS, individual manual treatment, and participation in generic group-based exercise sessions with people with other types of cancers or conditions.

Outcome Measures

Feasibility Outcomes. Recruitment rate, retention rate, adherence, safety, capacity, and participant satisfaction data were collected in agreement with the recommendations for feasibility studies.[30] Recruitment rate was calculated as the proportion of included participants relative to the number of eligible BCS. Patients who did not complete the baseline questionnaires were not enrolled. The retention rate was calculated as the proportion of enrolled participants who completed the follow-up assessment (part 1) or questionnaire (part 2). Feasibility was defined *a priori* as retention of 90% or more.

Adherence was determined by (1) a logbook, (2) tracking the use of the Website, or (3) a questionnaire. Adherence was calculated as the proportion of participants who performed the program 4 or more times weekly, and feasibility was defined *a priori* as 75% or more. The number of times and the duration a participant was logged onto the Website were tracked by Google Analytics. Safety was determined using the logbook. Participants were encouraged to report pain/discomfort during or following the rehabilitation exercises and reasons for discontinuing the program.

Capacity was defined as the time spent by the physical therapist with each participant to complete assessments,

Copyright © 2018 Oncology Section, APTA. Unauthorized reproduction of this article is prohibited.

instruction of the program, and introduction to the Website.

Participant satisfaction was collected by the questionnaire at follow-up. Feasibility was defined *a priori* as 75% or more reporting to be "very/somewhat satisfied" with the program.

Exploratory Outcomes. To understand motivation related to the performance of self-managed upper-body rehabilitation, the participant's initial reaction to the program, intended use of the materials, and perceived importance of performing rehabilitation exercises were collected at baseline. We developed a questionnaire based on the theory of planned behavior (TPB), which has been used in previous research examining health behaviors among BCS,[31-33] and adapted the items to assess motivation for self-managed upper-body rehabilitation. The 19 items used a 7-point Likert scale, with higher scores indicating greater motivation.

Upper-body impairment was evaluated in part 1 by physical therapists and included (1) active shoulder ROM for flexion and external rotation; (2) muscle strength using Manual Muscle Testing; (3) pain and tightness using a 0 to 10 numeric pain rating scale. For shoulder ROM and muscle strength, a 3-level categorical outcome was applied (not limited, moderately limited, or greatly limited). Finally, self-reported upper-body function using the QuickDASH was collected in part 1 and part 2.

Statistical Analysis

Participant characteristics were summarized using descriptive statistics and presented as mean and standard deviations (SD) or frequency counts. The Wilcoxon signed-rank test and the paired *t* test evaluated the changes from baseline to follow-up for categorical and continuous variables, respectively. Bivariate logistic regression tested the prediction of motivation on adherence. The analyses were 2-sided and carried out using the IBM SPSS version 23.0.

RESULTS

Feasibility Outcomes

Of 67 women referred to rehabilitation for part 1, 44 (65.7%) were eligible and 39 (88.6%) consented to participate. The primary reasons for ineligibility were having no access to the Internet and being older than 80 years (Figure 2). Four patients (10.3%) did not complete the baseline questionnaires and were not enrolled. Among the 35 participants enrolled (recruitment rate of 79.5%), 29 participants completed the follow-up assessment (retention rate of 82.9%).

Of 30 women referred to rehabilitation for part 2, 28 (93.3%) were eligible and 26 (92.9%) consented to participate. Two patients (7.7%) did not complete the baseline questionnaires and were not enrolled. Among the enrolled 24 participants (recruitment rate of 85.7%), 20 participants completed the follow-up questionnaire (retention rate of 83.3%).

Most participants were well educated and lived in Copenhagen (Table 2). Ten (20%) participants returned the logbook at follow-up, which precluded its use to establish adherence and to monitor safety. Furthermore, not all participants used the Website and tracking its use had limited utility as a measure for adherence. One-third of

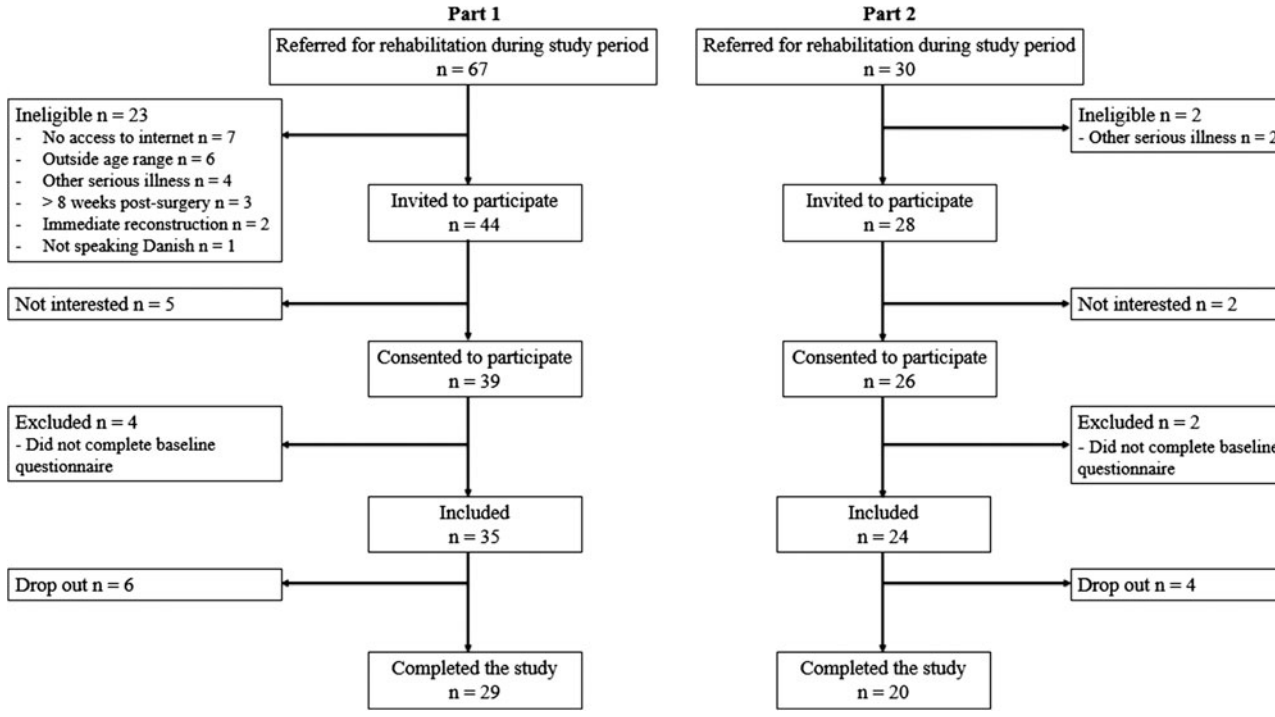

Fig. 2. Flowchart of participants.

Copyright © 2018 Oncology Section, APTA. Unauthorized reproduction of this article is prohibited.

TABLE 2
Participant Characteristics[a]

	Part 1 (n = 35)	Part 2 (n = 24)
Age, mean (SD), y	60.6 (11.6)	55.0 (9.9)
Nationality, n (%)		
Danish	33 (94.3)	23 (95.6)
Other	2 (5.7)	1 (4.2)
Education, n (%)		
High school or less	4 (11.4)	1 (4.2)
Technical degree	7 (20.0)	6 (25.0)
Bachelor's degree	13 (37.1)	10 (41.7)
Graduate degree	11 (31.4)	7 (29.2)
Work, n (%)		
Retired	15 (42.9)	6 (25.0)
Currently working	16 (45.7)	16 (66.7)
Unemployed/student	4 (11.4)	2 (8.3)
Social support, n (%)		
Living alone without children	7 (20.0)	6 (25.0)
Living alone with children	2 (5.7)	2 (8.3)
Married/common law without children	14 (40.0)	9 (37.5)
Married/common law with children	10 (28.6)	7 (29.2)
Other	1 (2.9)	0 (0)
Surgery type, n (%)		
Lumpectomy and SLNB	5 (14.3)	3 (12.5)
Lumpectomy and ALND	13 (37.1)	10 (41.7)
Mastectomy and SLNB	11 (31.4)	1 (4.2)
Mastectomy and ALND	6 (17.1)	9 (37.5)
Number of dissected lymph nodes, mean (SD)	13.66 (10.9)	12.36 (10.4)
Number of positive lymph nodes, mean (SD)	2.51 (4.1)	0.84 (1.1)
Time since surgery, mean (SD), d	26 (12)	215 (122)
Adjuvant therapy, n (%)		
Chemotherapy	18 (62.1)	6 (25.0)
Radiation therapy	19 (65.5)	24 (100)
Antihormonal therapy	26 (89.7)	7 (29.2)
Herceptin	6 (20.1)	. . .

Abbreviations: ALND, axillary lymph node dissection; SLNB, sentinel lymph node biopsy.
[a]Data on Herceptin use were not collected for part 2.

participants did not log in to the Website once, with the primary reasons being "no need" or "forgot about it." The mean number of log-ins was 2.45 and 0.53 per participant in part 1 and part 2, respectively. Participants spent a mean of 7.04 and 5.22 minutes per log-in in part 1 and part 2, respectively. In contrast, 17 (59%) and 8 (40%) participants in part 1 and part 2, respectively, reported to have used the education pamphlet "much/very much" (Table 3). Adherence was therefore calculated using 1 item on the follow-up questionnaire: "During the past 12 weeks, on average how many times have you performed the home-based program?" Adherence to the program was 72% in part 1 and 45% in part 2 (Table 3). Most participants did not report having any barriers to performing the program; however, 5 (25%) participants in part 2 reported that it took too much time to complete.

In terms of capacity for part 1, the time commitment for physical therapists (face-to-face time with participants during the clinical assessment and introduction to the

TABLE 3
BRECOR Program Usability and Satisfaction[a]

	Part 1 (n = 29)	Part 2 (n = 20)
Participant satisfaction and adherence		
Satisfaction with program, n (%)		
Very/somewhat unsatisfied	1 (3.4)	0 (0)
Neutral	11 (37.9)	4 (20.0)
Very/somewhat satisfied	16 (55.2)	12 (60.0)
No response	1 (3.4)	4 (20.0)
Benefit from program, n (%)		
No/little	3 (10.3)	1 (5.0)
Neutral	4 (13.8)	2 (10.0)
Much/very much	26 (89.7)	14 (70.0)
No response	0 (0)	3 (15.0)
Self-reported adherence, n (%)		
≤1 time/wk	4 (13.8)	5 (25.0)
1-3 times/wk	4 (13.8)	6 (30.0)
≥4 times/wk	21 (72.4)	9 (45.0)
Barriers for performing program		
No barriers	18 (62.1)	9 (45.0)
Feeling lonely	3 (10.3)	1 (5.0)
The program took too much time	2 (6.9)	5 (25.0)
Inconvenient	1 (3.4)	2 (10.0)
Needed peer-support	1 (3.4)	2 (10.0)
Website		
Benefit from the Website, n (%)		
No	6 (20.7)	3 (15.0)
A little	5 (17.2)	5 (25.0)
Neutral	5 (17.2)	3 (15.0)
Much/very much	12 (41.4)	5 (25.0)
No response	1 (3.4)	4 (20.0)
Easy to navigate the Website, n (%)		
No	1 (3.4)	1 (5.0)
Neutral	11 (37.9)	5 (25.0)
Yes	15 (51.7)	10 (50.0)
No response	0 (0)	4 (20.0)
The rehabilitation videos were relevant, n (%)		
No	0 (0)	0 (0)
Neutral	8 (27.6)	5 (25.0)
Yes	18 (62.1)	10 (50.0)
No response	3 (10.3)	5 (25.0)
Number of Website log-ins, n (%)		
None	9 (31.0)	7 (36.0)
1-3 times	6 (20.7)	4 (20.0)
3-4 times	5 (17.2)	4 (20.0)
≥5 times	9 (31.0)	4 (20.0)
No response	0 (0)	1 (5.0)
Reasons for no log-in, n (%)		
No need	6 (20.7)	2 (10.0)
Too busy	1 (3.4)	1 (5.0)
IT issues	2 (6.9)	0 (0)
Illness	0 (0)	1 (5.0)
Forgot about it	0 (0)	3 (15.0)
Website helped perform the rehabilitation correctly, n (%)		
No	6 (20.7)	3 (15.0)
A little	3 (10.3)	3 (15.0)
Neutral	3 (10.3)	3 (15.0)
Much/very much	16 (55.2)	7 (35.0)
No response	1 (3.4)	4 (20.0)
Pamphlet		
Use of pamphlet, n (%)		
No	3 (10.3)	4 (20.0)
A little	9 (31.0)	4 (20.0)
Neutral	0 (0)	2 (10.0)
Much/very much	17 (58.6)	8 (40.0)
No response	0 (0)	2 (10.0)

(*continues*)

Copyright © 2018 Oncology Section, APTA. Unauthorized reproduction of this article is prohibited.

TABLE 3
BRECOR Program Usability and Satisfaction[a] (*Continued*)

	Part 1 (n = 29)	Part 2 (n = 20)
Capacity		
Baseline, mean (SD), min		
Clinical assessment	48.8 (14.3)	
Introduction to the Website	16.4 (7.5)	. . .
Documentation	26.2 (16.2)	
Total time spent per participant	92.4 (27.1)	
Follow-up, mean (SD), min		
Clinical assessment	35.2 (9.5)	
Introduction to the Website	7.6 (6.1)	. . .
Documentation	11.7 (5.0)	
Total time spent per participant	54.2 (12.7)	

[a]Data on capacity were not collected for part 2.

Website, followed by documentation) was 92.4 ± 27.1 minutes at baseline and 54.2 ± 12.7 minutes at follow-up. Twenty-six (90%) participants in part 1 and 14 (70%) in part 2 reported to have benefitted "much/very much" from performing the program. Satisfaction with the program was reported by 16 (55%) and 12 (60%) participants in part 1 and part 2, respectively.

Exploratory Outcomes

For part 1, 3 motivational constructs predicted adherence to the program: (1) instrumental attitude ($\beta = 2.48$, $R^2 = 0.34$, $P = .02$); (2) planning ($\beta = 0.46$, $R^2 = 0.21$, $P = .05$); and (3) subjective norm ($\beta = 0.94$, $R^2 = 0.22$, $P = .04$) (Table 4). For part 2, no constructs predicted adherence. When the motivational data from part 1 and part 2 were merged, same 3 constructs predicted adherence.

In part 1, fewer participants presented with limited muscle strength and shoulder ROM at follow-up (Table 5). Furthermore, upper-body tightness improved. Self-reported upper-body function improved for participants in part 1 and part 2, although the improvements were not significant.

DISCUSSION

The BRECOR program is a novel resource to assist physical therapists and BCS in self-managed upper-body rehabilitation and has the potential to be widely disseminated. Based on the recruitment and retention rates, this

TABLE 4
Prediction of Theory of Planned Behavior Constructs on Adherence[a]

	Internal Consistency (α)	TBP, Mean (SD)	Adherence, n (%)	β	R^2	P
Instrumental attitude, 3 items						
Part 1	0.92	6.45 (0.54)	21 (72.41)	2.48	0.34	.02[b]
Part 2	0.73	6.38 (0.42)	9 (45.00)	0.81	0.04	.46
Merged	0.86	6.42 (0.49)	30 (61.22)	1.73	0.19	.01[b]
Affective attitude, 3 items						
Part 1	0.88	4.82 (1.09)	21 (72.41)	0.45	0.06	.27
Part 2	0.84	4.45 (1.15)	9 (45.00)	0.47	0.06	.34
Merged	0.86	4.65 (1.12)	30 (61.22)	0.46	0.07	.12
Intention, 2 items						
Part 1	0.09	. . .	. . .	. . .	. . .	. . .
Part 2	0.88	6.20 (1.12)	9 (45.00)	2.62	0.33	.07
Merged	0.45	. . .	. . .	. . .	. . .	. . .
Planning, 4 items						
Part 1	0.93	5.69 (1.91)	21 (72.41)	0.46	0.21	.05[b]
Part 2	0.97	5.16 (2.00)	9 (45.00)	0.59	0.23	.11
Merged	0.95	5.46 (1.95)	30 (61.22)	0.51	0.22	<.01[b]
Self-efficacy, 2 items						
Part 1	0.98	5.90 (1.46)	21 (72.41)	0.24	0.04	.37
Part 2	0.98	5.46 (1.48)	9 (45.00)	0.43	0.10	.25
Merged	0.98	5.70 (1.47)	30 (61.22)	0.36	0.09	.09
Perceived behavioral control, 2 items						
Part 1	0.71	6.09 (1.21)	21 (72.41)	0.02	0.00	.96
Part 2	0.66	5.26 (1.48)	9 (45.00)	0.32	0.06	.35
Merged	0.66	5.71 (1.39)	30 (61.22)	0.29	0.05	.19
Subjective norm, 3 items						
Part 1	0.91	6.34 (0.97)	21 (72.41)	0.94	0.22	.04[b]
Part 2	0.94	5.90 (1.36)	9 (45.00)	0.60	0.15	.17
Merged	0.93	6.14 (1.17)	30 (61.22)	0.81	0.21	.01[b]

Abbreviation: TBP, theory of planned behavior questionnaire.
[a]Adherence was calculated as a 2-level categorical outcome, defined yes/no for performing 4 or more weekly sessions reported at follow-up. The TBP scores 1 to 7, with higher scores indicating more motivation. The intention data for part 1 did not have sufficient internal consistency to be included in the analysis. Part 1, n = 29; part 2, n = 20; merged part 1 and part 2, n = 49.
[b]$P \leq .05$.

Copyright © 2018 Oncology Section, APTA. Unauthorized reproduction of this article is prohibited.

TABLE 5
Upper-Body Impairment[a]

	Baseline (n = 35)	Follow-up (n = 29)	*P*
Shoulder range of motion on surgery side			
Flexion, n (%)			
Not limited	19 (54.3)	27 (93.1)	
Moderately limited	13 (37.1)	1 (3.4)	>.01[b]
Greatly limited	1 (2.9)	0 (0)	
Missing	1 (2.9)	1 (3.4)	
External rotation, n (%)			
Not limited	17 (48.6)	21 (72.4)	
Moderately limited	11 (31.4)	6 (20.7)	.03[b]
Greatly limited	3 (8.6)	1 (3.4)	
Missing	4 (11.4)	1 (3.4)	
Upper-body muscle strength on surgery side			
Latissimus dorsi, n (%)			
Not limited	25 (71.4)	25 (86.2)	
Moderately limited	9 (25.7)	1 (3.4)	.01[b]
Greatly limited	0 (0)	0 (0)	
Missing	1 (2.9)	3 (10.3)	
Serratus anterior, n (%)			
Not limited	16 (45.7)	16 (55.2)	
Moderately limited	13 (37.1)	10 (34.5)	.59
Greatly limited	1 (2.9)	1 (3.4)	
Missing	5 (14.3)	2 (6.9)	
Pectoralis major clavicular part, n (%)			
Not limited	13 (37.1)	17 (58.6)	
Moderately limited	18 (51.4)	8 (27.6)	.01[b]
Greatly limited	0 (0)	0 (0)	
Missing	4 (11.4)	4 (13.8)	
Pectoralis major sternum part, n (%)			
Not limited	21 (60.0)	22 (75.9)	
Moderately limited	13 (37.1)	6 (20.7)	.11
Greatly limited	0 (0)	0 (0)	
Missing	1 (2.9)	1 (3.4)	
Pain and tightness			
Pain, NRS (scores 0-10), median (IQs)	1.0 (1.0, 3.0)	1.0 (1.0, 2.0)	.18
Tightness, NRS (scores 0-10), median (IQs)	4.0 (3.0, 7.0)	2.5 (2.0, 4.8)	<.01[b]
Upper-body function			
QuickDASH, mean (SD)			
Part 1	19.8 (13.3) n = 24	13.5 (15.8) n = 17[c]	.08
Part 2	15.2 (14.8)	11.0 (8.2)	.85

Abbreviations: IQs, interquartiles; NRS, numeric pain rating scale.
[a]The NRS scores 0 to 10, with higher scores indicating more pain/tightness.
[b]$P \leq .05$.
[c]Three of 20 participants did not complete the QuickDASH questionnaire at follow-up. The QuickDASH scores 0 to 100, with higher scores indicating more limitations.

program is feasible and of interest to most women in this study.

Overall, recruitment and retention rates were high, demonstrating an interest by women in receiving this type of program. Most participants adhered to the program, were satisfied with, and expressed benefit from participating. We defined adherence as 75% or more of participants performing 4 or more sessions weekly. While few studies apply *a prior* thresholds for adherence, this threshold has been used previously in feasibility studies of self-managed exercise interventions.[34] The adherence in part 1 was 72%, which fell just below the *a priori* feasibility criteria, whereas participants in part 2 had much lower adherence (45%). This study cannot determine the reasons for the low adherence in part 2. While we anticipated that radiation therapy would be a point in the cancer treatment trajectory when upper-body issues may be prevalent, the length of time since the primary surgery may have reduced the perceived need by BCS to engage in upper-body rehabilitation. Qualitative research is needed to fully understand this. Previous feasibility studies of self-managed programs among BCS have reported adherence between 39% and 91%.[35-37] The difference in adherence originates in a diversity of decision making when determining the frequency of performing a self-managed program and consequently in definitions for adherence employed. For example, Stan and colleagues[35] reported 39% adherence to a DVD-delivered yoga program when defining adherence as performing 3 or more weekly sessions for 7 or more of the 12-week study.[35] In contrast, Javaheri and colleagues[37] employed an individualized weekly step-count goal determined in partnership with the participant and reported 91% adherence to a walking program during radiation therapy. In our study, the prescribed frequency was 4 or more weekly sessions for all participants (and not tailored to each individual), which likely affected the reported adherence rates. As such, shared decision-making and goal-setting between the patient and the health professional may be ideal to foster good adherence and could be employed in future research.

The time required by physical therapists to deliver the program was an average of approximately 1 hour per participant at baseline and 40 minutes at follow-up plus time for documentation. The time allocated to the baseline assessment (excluding introduction to the Website) is a part of usual care when referred to rehabilitation following breast cancer surgery in Denmark and therefore not an additional expense for the health care system. The follow-up assessment was, however, delivered in addition to usual care to collect study outcomes. While this time commitment may be higher than a standard number of 15 or 30 minutes appointments, one thorough, longer, face-to-face appointment at baseline to guide months of self-managed rehabilitation may be an efficient use of a therapist's time and reduce the burden of BCS to travel for several appointments. To date, no other study has reported the capacity of delivering a self-managed rehabilitation program that prohibits comparison of our findings with that of others. As such, cost-effectiveness comparisons of self-managed and traditional in-person rehabilitation programs are warranted.

Fewer participants than anticipated used the Website. This may be explained by multiple factors. First, the program was offered in addition to usual care, which is quite extensive in Denmark, and may have been sufficient for some participants. Furthermore, more participants used the education pamphlet, as this may be more convenient than logging into a Website when performing the rehabilitation exercises routinely. However, among the

Copyright © 2018 Oncology Section, APTA. Unauthorized reproduction of this article is prohibited.

participants who used the Website, the majority reported that the videos helped them perform the rehabilitation exercises more correctly. As such, multiple modes of delivery may be ideal to support BCS with various preferences for Web-based resources.[22,25]

Of note, the proportion of BCS in part 1 with upper-body issues decreased following the 12-week program. The improvements were expected, as it is well established that rehabilitation exercises are effective in restoring upper-body function after surgery for breast cancer.[10] However, in the absence of a control group, these improvements cannot be attributed to the program. We did not include a control group, as the purpose was to evaluate the feasibility of using the program elements in current practice, which, in Denmark, includes upper-body rehabilitation delivered by physical therapists for all BCS. These results show the program is feasible and has the potential to be efficacious, thus suggesting the need for future testing.

Instrumental attitude (ie, I think the home-based rehabilitation exercises are useful, beneficial, important) most strongly predicted adherence to the self-management program in the current study. While the performance of rehabilitation exercises can be viewed as a rational behavior motivated by the experience of pain or functional limitations, adherence to a rehabilitation program may therefore be predicted by belief in the usefulness and benefits of such behavior.[38] Overall, these results provide preliminary support for the TPB as a framework for developing and evaluating self-managed rehabilitation programs for BCS. However, given the paucity of research examining theoretical predictors of upper-body rehabilitation, making comparative evaluations is difficult and further research is needed to better understand how to design a program guided by a behavior change framework.

The main limitation of the study was that only 66% of women referred right after surgery were eligible. An eligibility criterion was access to the Internet, as the Website was a key component. Based on our findings that the Website was not used extensively suggests that the program could be successfully delivered by physical therapists using only the pamphlet for those without Internet access. This may also be effective in older adults by eliminating the barrier of requiring technology. The sample was also homogeneous with regard to location in an urban center. As a key goal of a self-managed approach is reach outside of the urban centers where access to services is already concentrated, future work is needed to examine this approach in a rural setting. While the recruitment and retention rates were high, completion of the questionnaires demonstrated to be a barrier. Seven percent to 10% of eligible patients did not complete the baseline questionnaires and could not be included, and 17% of participants in part 2 did not complete the follow-up questionnaire and were recorded as dropouts. While this study was carried out in a real-world setting, the importance of such research-associated activities may not have been fully communicated to or appreciated by the participants. Therefore, we propose that reach and retention may be higher if these were part of a clinical program that did not require additional time to complete questionnaires.

The BRECOR program has the potential to be successful in improving access to services in a variety of settings, as it does not require specific equipment to be carried out and requires only one face-to-face assessment to inform the rehabilitation prescription resulting in no or little out-of-pocket cost for patients. While the program was designed to be offered in addition to usual care in Denmark, it could also be delivered as a stand-alone program in other settings where usual care is less extensive or for patients who cannot access in-person services. Thus, the development and testing of this type of program represent an important step toward reaching large numbers of BCS and improving access to high-quality upper-body rehabilitation. As such, future evaluation of the reach, effect, adoption, implementation, and maintenance is important when disseminating the BRECOR program into clinical programs across Danish health care settings.[39]

CONCLUSION

Preliminary testing of the BRECOR program suggests that it is feasible and acceptable and can assist in restoring upper-body function after treatment of breast cancer. We demonstrated good reach and retention, and participants reported benefits of performing the program. However, effectiveness of the program in reducing the prevalence of upper-body issues will need to be evaluated further.

ACKNOWLEDGMENTS

The authors thank the study participants, along with the physical therapists in the 11 municipalities for their invaluable involvement in this study.

REFERENCES

1. Ferlay J, Héry C, Autier P, Sankaranarayanan R. Global burden of breast cancer. In: Li C, ed. *Breast Cancer Epidemiology*. New York, NY: Springer; 2010:1-19.
2. National Cancer Institute. Dictionary of cancer terms. https://www.cancer.gov/publications/dictionaries/cancer-terms?cdrid=450125. Accessed January 31, 2017.
3. Lee TS, Kilbreath SL, Refshauge KM, Herbert RD, Beith JM. Prognosis of the upper limb following surgery and radiation for breast cancer. *Breast Cancer Res Treat*. 2008;110(1):19-37. doi:10.1007/s10549-007-9710-9.
4. Kibar S, Dalyan Aras M, Ünsal Delialioğlu S. The risk factors and prevalence of upper extremity impairments and an analysis of effects of lymphoedema and other impairments on the quality of life of breast cancer patients. *Eur J Cancer Care (Engl)*. 2017;26(4). doi:10.1111/ecc.12433.
5. Rietman JS, Dijkstra PU, Hoekstra HJ, et al. Late morbidity after treatment of breast cancer in relation to daily activities and quality of life: a systematic review. *Eur J Surg Oncol*. 2003;29(3):229-238.
6. Verbelen H, Gebruers N, Eeckhout F-M, Verlinden K, Tjalma W. Shoulder and arm morbidity in sentinel node-negative breast cancer patients: a systematic review. *Breast Cancer Res Treat*. 2014;144(1):21-31. doi:10.1007/s10549-014-2846-5.

Copyright © 2018 Oncology Section, APTA. Unauthorized reproduction of this article is prohibited.

7. McLaughlin SA, Wright MJ, Morris KT, et al. Prevalence of lymphedema in women with breast cancer 5 years after sentinel lymph node biopsy or axillary dissection: objective measurements. *J Clin Oncol*. 2008;26(32):5213-5219. doi:10.1200/JCO.2008.16.3725.
8. Sagen A, Kaaresen R, Sandvik L, Thune I, Risberg MA. Upper limb physical function and adverse effects after breast cancer surgery: a prospective 2.5-year follow-up study and preoperative measures. *Arch Phys Med Rehabil*. 2014;95(5):875-881. doi:10.1016/j.apmr.2013.12.015.
9. DiSipio T, Rye S, Newman B, Hayes S. Incidence of unilateral arm lymphoedema after breast cancer: a systematic review and meta-analysis. *Lancet Oncol*. 2013;14(6):500-515. doi:10.1016/S1470-2045(13)70076-7.
10. McNeely ML, Campbell K, Ospina M, et al. Exercise interventions for upper-limb dysfunction due to breast cancer treatment. *Cochrane Database Syst Rev*. 2010;(6):CD005211. doi:10.1002/14651858.CD005211.pub2.
11. De Groef A, Van Kampen M, Dieltjens E, et al. Effectiveness of postoperative physical therapy for upper-limb impairments after breast cancer treatment: a systematic review. *Arch Phys Med Rehabil*. 2015;96(6):1140-1153. doi:10.1016/j.apmr.2015.01.006.
12. Stuiver MM, ten Tusscher MR, Agasi-Idenburg CS, Lucas C, Aaronson NK, Bossuyt PMM. Conservative interventions for preventing clinically detectable upper-limb lymphoedema in patients who are at risk of developing lymphoedema after breast cancer therapy. *Cochrane Database Syst Rev*. 2015;(2):CD009765. doi:10.1002/14651858.CD009765.pub2.
13. Alfano CM, Pergolotti M. Next-generation cancer rehabilitation: a giant step forward for patient care. *Rehabil Nurs*. 2018;43(4):186-194. doi:10.1097/rnj.0000000000000174.
14. Stubblefield MD. The underutilization of rehabilitation to treat physical impairments in breast cancer survivors. *PM R*. 2017;9(9S2):S317-S323. doi:10.1016/j.pmrj.2017.05.010.
15. Flores AM, Nelson J, Sowles L, Bienenstock K, Blot WJ. Physical impairments and physical therapy services for minority and low-income breast cancer survivors. *SpringerPlus*. 2016;5(1):1227. doi:10.1186/s40064-016-2455-3.
16. Miedema B, Easley J. Barriers to rehabilitative care for young breast cancer survivors: a qualitative understanding. *Support Care Cancer*. 2012;20(6):1193-1201. doi:10.1007/s00520-011-1196-7.
17. Canestraro A, Nakhle A, Stack M, et al. Oncology rehabilitation provision and practice patterns across Canada. *Physiother Can*. 2013;65(1):94-102. doi:10.3138/ptc.2011-53.
18. Smith-Turchyn J, Richardson J, Tozer R, McNeely M, Thabane L. Physical activity and breast cancer: a qualitative study on the barriers to and facilitators of exercise promotion from the perspective of health care professionals. *Physiother Can*. 2016;68(4):383-390. doi:10.3138/ptc.2015-84.
19. Reigle BS, Zhang B. Women's rehabilitation experiences following breast cancer surgery. *Rehabil Nurs*. 2018;43(4):195-200. doi:10.1097/rnj.0000000000000168.
20. Sundhedsstyrelsen. National klinisk retningslinie for følgevirkninger efter operation for tidlig brystkræft. https://sundhedsstyrelsen.dk/da/udgivelser/2015/~/media/498BCA8D56204AA7ACDCF82FE3096C71.ashx. Published 2015. Accessed September 6, 2018.
21. McCorkle R, Ercolano E, Lazenby M, et al. Self-management: enabling and empowering patients living with cancer as a chronic illness. *CA Cancer J Clin*. 2011;61(1):50-62. doi:10.3322/caac.20093.
22. Gast KC, Allen SV, Ruddy KJ, Haddad TC. Novel approaches to support breast cancer survivorship care models. *Breast Edinb Scotl*. 2017;36:1-13. doi:10.1016/j.breast.2017.08.004
23. Harder H, Holroyd P, Burkinshaw L, et al. A user-centred approach to developing bWell, a mobile app for arm and shoulder exercises after breast cancer treatment. *J Cancer Surviv Res Pract*. 2017;11(6):732-742. doi:10.1007/s11764-017-0630-3.
24. Galiano-Castillo N, Cantarero-Villanueva I, Fernández-Lao C, et al. Telehealth system: a randomized controlled trial evaluating the impact of an Internet-based exercise intervention on quality of life, pain, muscle strength, and fatigue in breast cancer survivors. *Cancer*. 2016;122(20):3166-3174. doi:10.1002/cncr.30172.
25. Davis TC, Williams MV, Marin E, Parker RM, Glass J. Health literacy and cancer communication. *CA Cancer J Clin*. 2002;52(3):134-149. doi:10.3322/canjclin.52.3.134.
26. Rogers LQ, Markwell SJ, Verhulst S, McAuley E, Courneya KS. Rural breast cancer survivors: exercise preferences and their determinants. *Psychooncology*. 2009;18(4):412-421. doi:10.1002/pon.1497.
27. Tørsleff KR. Late effects from breast cancer [Senfølger Ved Brystkræft] (in Danish). In: Johansen C, ed. *Kræft—Senfølger Og Rehabilitering*. Copenhagen, Denmark: Hans Reitzels Forlag; 2013:296-305.
28. Danish Breast Cancer Cooperative Group. Care description for physical therapy during the trajectory of breast surgery [Forløbsbeskrivelse for fysioterapi under brystkirurgiske patientforløb] (in Danish). http://www.dbcg.dk/PDF%20Filer/Kap%2021%20Forloebsbeskrivelse%20for%20fysioterapi%20under%20brystkirurgiske%20patientforloeb%2005.pdf. Published 2011. Accessed September 6, 2018.
29. The BRECOR Web site. https://www.sundhed.dk/borger/behandling-og-rettigheder/rehabilitering/brystrehabilitering. Accessed September 5, 2018.
30. Bowen DJ, Kreuter M, Spring B, et al. How we design feasibility studies. *Am J Prev Med*. 2009;36(5):452-457. doi:10.1016/j.amepre.2009.02.002.
31. Peddle-McIntyre CJ, Bell G, Fenton D, McCargar L, Courneya KS. Changes in motivational outcomes after a supervised resistance exercise training intervention in lung cancer survivors. *Cancer Nurs*. 2013;36(1):E27-E35. doi:10.1097/NCC.0b013e31824a78e4.
32. Vallance JKH, Courneya KS, Plotnikoff RC, Mackey JR. Analyzing theoretical mechanisms of physical activity behavior change in breast cancer survivors: results from the activity promotion (ACTION) trial. *Ann Behav Med*. 2008;35(2):150-158. doi:10.1007/s12160-008-9019-x.
33. Aparicio-Ting FE, Farris M, Courneya KS, Schiller A, Friedenreich CM. Predictors of physical activity at 12 month follow-up after a supervised exercise intervention in postmenopausal women. *Int J Behav Nutr Phys Act*. 2015;12(1):55. doi:10.1186/s12966-015-0219-z.
34. Coats V, Maltais F, Simard S, et al. Feasibility and effectiveness of a home-based exercise training program before lung resection surgery. *Can Respir J*. 2013;20(2):e10-e16.
35. Stan DL, Croghan KA, Croghan IT, et al. Randomized pilot trial of yoga versus strengthening exercises in breast cancer survivors with cancer-related fatigue. *Support Care Cancer*. 2016;24(9):4005-4015. doi:10.1007/s00520-016-3233-z.
36. Gokal K, Wallis D, Ahmed S, Boiangiu I, Kancherla K, Munir F. Effects of a self-managed home-based walking intervention on psychosocial health outcomes for breast cancer patients receiving chemotherapy: a randomised controlled trial. *Support Care Cancer*. 2016;24(3):1139-1166. doi:10.1007/s00520-015-2884-5.
37. Javaheri PA, Nekolaichuk C, Haennel R, Parliament MB, McNeely ML. Feasibility of a pedometer-based walking program for survivors of breast and head and neck cancer undergoing radiation therapy. *Physiother Can*. 2015;67(2):205-213. doi:10.3138/ptc.2014-24O.
38. Blanchard CM, Courneya KS, Rodgers WM, Murnaghan DM. Determinants of exercise intention and behavior in survivors of breast and prostate cancer: an application of the theory of planned behavior. *Cancer Nurs*. 2002;25(2):88-95.
39. Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: the RE-AIM framework. *Am J Public Health*. 1999;89(9):1322-1327.

Copyright © 2018 Oncology Section, APTA. Unauthorized reproduction of this article is prohibited.