FEASIBILITY OF A COMMUNITY-BASED PHYSIOTHERAPY PROGRAM FOR CANCER PATIENTS DURING AND AFTER TREATMENTS IN SAGUENAY-LAC-SAINT-JEAN

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ABSTRACT

Background
Physical impairments cause an important functional decline in patient with cancer and survivor. Despite a profound need for physical therapy, many people are unable to access the required services due, in part, to the limited availability of cancer physical therapy programs. The model of community-based rehabilitation presents an opportunity to increase access to outpatient physiotherapy services in Saguenay-Lac-St-Jean.

Aim
The aim of this study was to assess the feasibility of a 10-weeks physical therapy program for cancer patients and survivor in the local community.

Method
A pre-post study was conducted using Bowen's framework to measure the feasibility of a 10-weeks personalized physical therapy program. Feasibility outcomes focused on demand, acceptability, implementation, practicality and limited-efficacity. Limited-efficacity testing was done intra-group from paired comparisons of pre- and post-intervention by calculating mean differences and 95% confidence intervals for normally distributed data or mean and sum of ranks for non-normally distributed data.

Results
Over 19 months, thirty-one people were contacted and eighteen people completed the program [Mean age 54.54 (SD 12.16)]. The most frequent reasons to explain demand for our program were low muscle endurance, weak muscles, range of motion restrictions, reduced functional capacity, poor sleep quality and pain. Participant attended 94.3% of scheduled appointments. Existing equipment of the not-for-profit physiotherapy clinic of University of Quebec in Chicoutimi were used to run the program in the community setting. Participants reported high satisfaction and there were no major adverse events. Main barriers to project included COVID-19 restrictions and participants motivation. Participants made gains in pain, functional capacity, muscle strength and walk distance.

Conclusions
A 10-weeks personalized physical therapy program in Saguenay-Lac-St-Jean community is feasible and safe to improve the physical function and relieve the pain in cancer patients and survivors.

KEY WORDS

CANCER, CARE ACCESS, COMMUNITY, IMPLEMENTATION, PHYSIOTHERAPY, SURVIVORSHIP

Received 22/12/2021
Accepted, after revision 20/01/2022

PURPOSE/OBJECTIVES

In 2020, 19 292 789 patients were diagnosed with cancer worldwide, including 274 364 Canadians.[1] It was estimated that nearly 64% of individuals receiving a new cancer diagnose would survive at least 5 years post diagnosis.[2] This current survival rate is mainly due to the progress in diagnosis tools and medical treatment efficacy (surgery, radiation and/or chemotherapy).[3] Although these treatments have saved countless lives, their use is frequently associated with poor physical and emotional health.[4,5] During treatment, adverse effects depend on several factors, such as the site of the treatment, the type of treatment and the dose delivered.[4-6] Acute symptoms may resolve following the end of treatment. However, many survivors have reported the persistence of these side effects over several years, with a significant life's quality reduction.[7-9] A meta-analysis[10] suggested that survivors often experience many concurrent impairments, which may occur in any organ system and in any aspects of psychological adaptation from months to years after the end of active treatment. In fact, a national survey on the experience of cancer survivors highlighted that more than 67% of 13 000 respondents reported physical, emotional, psychological, and functional impairments after their cancer treatments. Among those, only 51% asked for help for their problems because someone told them it was usual or there was nothing to do.[11] The most common impairments were chronic pain, fatigue, poor muscular and/or cardio endurance, muscular weakness, social isolation, lymphoedema, sleeping disorders, weight gain or loss, anxiety, depression and fear of cancer recurrence which altered functional performance and quality of life.[3, 12-15] Thorsen et al evaluated 1325 survivors and found that 63% reported the need for at least one rehabilitation service, with physical therapy being the most frequently reported need (43%).[16] Medical community have recognized a need for physical therapy, but in Quebec, many people with cancer are unable to access the required services due, in part, to the limited number of established oncology physical therapy programs. Therefore, patients with multiple side effects are not referred to physical therapist as a standard practice and experience in turn, disablement in their daily life and functionality.

The model of community-based rehabilitation presents an opportunity to increase access to outpatient physiotherapy services.[17] Based on this model, the not-for-profit physiotherapy clinic of University of Quebec in Chicoutimi (CUpht) is an appropriate and safe environment to deliver physiotherapy services given the complex cancer patient's rehabilitative goals, their preferences and the care partner supports available to them. While the effectiveness of physical therapy interventions is recognized to improve pain, fatigue, function, and physical impairments at every stage along the course of cancer treatment[18-20] and survivorship,[21-27] less is known about the feasibility of cancer physical therapy program implementation into the community.[28] This scenario leads us to believe that it is important to facilitate the access of these patients to physiotherapy and to offer a service capable of helping to improve their physical condition and quality of life. Particularly for Quebec, this is the first study in a remote region to provide specialized rehabilitation services to this vulnerable clientele. Our research team is interested in filling this gap and determining the benefits of access to treatment and the improvement of motor skills for a sustainable life for this population.

Thus, the main purpose of this study was to assess the feasibility of a 10-weeks physical therapy program offering at the CUpht by using Bowen's framework[29] including a battery of functional and clinical measures in the same experimental design of evaluation/intervention. We hypothesized that the program would be feasible based on the following key domains of Bowen's Framework: demand, implementation, acceptability, practicality, and limited efficacy testing.

METHODS

Study design

A feasibility study employed a pretest-posttest design, based on Bowen's Framework[29] was conducted at the CUpht, between June 2019 and December 2020, to assess the viability of a personalized physiotherapy program for cancer patients and survivors in the community context. Ethics approval was obtained from the Research Ethics Committee of the University of Quebec at Chicoutimi (UQAC) before the start of recruitment (CER #2019-241).

Participants

Participants were referred to the CUpht by allied health professionals or from general population via social medias. To be included in our study, participants require to be aged from 40 to 65 years-old, a diagnosis of solid tumor in the two past years, speak French and a cognitive function higher than 22/30 at the Mini Mental State Examination (MMSE).[30] Participants with severe psychiatric disorders, terminally ill cancers, severe cancer cachexia and for whom physiotherapy was contraindicated according to the allied health professional's opinions were excluded. All participants provided written informed consent prior to participation.

Sample size

A convenient sample which size was selected by comparison to others feasibility studies allowed us to establish that a goal of 30 participants would be enough to demonstrate the protocol feasibility and to obtain preliminary data on limited-efficacy interventions. In addition, as we are designing a future clinical trial to measure the efficacy of our program, an appropriate justification for the sample size should be based on power calculations. However, we need to obtain precisions about mean and variance to use power calculations. In this feasibility study, a minimum sample size of 12 participants is needed for obtaining this precision.[31]

Interventions

To customize the rehabilitation care to the needs of each cancer patient, we built personalized goal-specific interventions for each of them over a period of 10 weeks. The participants completed a 2-h assessment with a physiotherapist and were invited to select with her : 1) their physical therapy goals based on a SMART model (Specific, Measurable, Attainable, Realistic, defined Time period)[32] and 2) the type of physical therapy interventions to include in the program based on participants' preferences. For each selected interventions, the parameters have been determined by the physiotherapist for 1) being specific to the objective, 2) be normalized to the status of an individual participant, 3) having a progressive load increase, 4) being under supervision or at-home and 5) respecting the time required to bring about adaptation. The personalized physiotherapy program sessions could include therapeutic modalities such as manual therapy, muscular strengthening exercises, muscular and cardiovascular endurance training, the balance exercises to prevent falls, the stretching exercises, cardiorespiratory physical therapy, neuroproprioceptive facilitation and educational.[33] The sessions were administered one or twice a week and there was no cost to patients to participate in the program. To be useful for the replicability of the intervention, each component of the program based on *Template for Intervention Description and Replication checklist and guide* are presented in Table 1.[34]

Table 1 - Intervention description based on Hoffmann TC and al (2014).
6MWT [6-Minute Walk Test]; CUpht [Clinique universitaire de physiothérapie de l'UQAC]; RPE [rating of perceived exertion]; HRmax [maximal heart rate]; VO2R [oxygen uptake reserve]; 1-RM [one-repetition maximum]

Description	Cancer rehabilitation
Why	Personalized physiotherapy program may mitigate cancer side effects, reduce disabilities, and improve quality of life
Materials	• Access to CUpht's therapy equipments o Therapeutic modalities (shockwave, ultrasound, interferential, TENS, low level laser, biofeedback) o Therapy equipment (treatment table, parallel bars, stairs, chairs, cones) o Diagnostic tools (biodex system 3 dynamometer, hand grip, manual dynamometer, goniometers/inclinometers, oxymeter, sphygmomanometer, stethoscope, percussion hammer, tape measure, digital timer, modified Borg scale chart, questionnaires) • Access to CUpht's rehab gym o Small exercise products (resistance exercise bands, exercise balls, balance discs, balance pads, bosu balance trainer, rocker boards, dumbbells vinyl coated, cuff weights) o Exercise equipements (recumbent bike, treadmill, pulleys, arm and leg ergometers, balance biodex) • Access to a written personalized home exercise program
Procedures • Provider • How • Where • When • Tailoring • Fidelity	One physiotherapist with oncology experience provided by the research team Face to face sessions and unsupervised home rehabilitation program CUpht or home During or after cancer treatment Personalized physiotherapy program for each patient based on initial assessment and SMART goals Program log-book for each home session and clinical supervision for in-person session
Type	Education • Energy/fatigue management • Pain management • Sleep habits • Human anatomy • Human physiology
	Manual therapy • Traction • Passive mobilizations • Accessory articular movements • Therapeutic massage
	Specialized techniques • Respiratory physiotherapy • Manual lymphatic drainage • Mobilization of scars
	Therapeutic exercise • Resistance • Endurance • Aerobic • Stretching • Positioning • Functional tasks • Proprioception • Balance tasks
Intensity	• Education: 15 min/intervention • Manual therapy: Grade 1 to 4 • Respiratory physiotherapy: depends on objectives • Manual lymphatic drainage: Lean drainage • Mobilization of scars: stretching for 1-min on each side • Resistance exercises: >30% of 1-RM • Endurance exercises: <30% of 1-RM • Aerobic exercises: 14-17/20 on RPE, 64-75% of HRmax, 40-59% of VO2R • Stretching exercises: A lean sensation of stretching • Positioning: N/A • Functional tasks: Depends on tasks, progressively more difficult • Proprioception: Different difficulty levels • Balance tasks: Different difficulty level
Frequency	• Education: 2-3 times for each patient • Manual therapy: >1 time per week • Respiratory physiotherapy: Daily • Manual lymphatic drainage: Daily • Mobilization of scars: Daily • Resistance exercises: 2-3 times a week • Endurance exercises: 3-5 times a week • Aerobic exercises: 3-5 times a week • Stretching exercises: Daily • Positioning: Daily • Functional tasks: Daily • Proprioception tasks: Daily • Balance tasks: Daily
Overall duration	10 weeks

Outcomes

Participant characteristics were recorded including age, sex, height, weight, the body mass index (IMC), cancer type and treatment details. Measures of demand, implementation, acceptability, practicality, and limited efficacy testing are presented in Table 2. Limited-efficacy testing was used to assess change in participants impairments from baseline (week 1) to completion of the program (week 10).

Data Analysis

Participant characteristics, demand, implementation, acceptability, and practicality were reported descriptively. To determine the clinical significance of any changes in patient's impairment following the intervention, we performed separate paired comparisons of pre- and post-intervention for each limited-efficacity outcome measures on assessment period (baseliner to 10-week of physical therapy treatment). Mean differences and 95% confidence intervals were calculated for normally distributed data (FACIT-F [Functional Assessment of Chronic Illness Therapy-Fatigue], SF-36 [Medical Outcome Short-Form 36], FCRI [Fear of cancer Recurrence Inventory], ISI [Insomnia Symptoms Index], HADS [Hospital Anxiety and Depression Scale], 30sSTS [30 seconds Sit to Stand], MMT [Manual Muscular Testing], gait speed, cadence, and step time). Mean and sum of ranks were calculated using a Wilcoxon signed rank test for non-normally distributed data (ECOG [Eastern Cooperative Oncology Group], ESAS-R [Edmonton Symptoms Assessment

Table 2 - Feasibility outcome measures based on Bowen's framework.
FACIT-F [Functional Assessment of Chronic Illness Therapy-Fatigue]; ECOG [Eastern Cooperative Oncology Group]; ESAS-R [Edmonton Symptoms Assessment Systems-Revised]; SF-36 [Medical Outcome Short-Form 36]; BPI [Brief Pain Inventory]; FCRI [Fear of cancer Recurrence Inventory]; ISI [Insomnia Symptoms Index], HADS [Hospital Anxiety and Depression Scale]; TUG [Timed Up and Go]; 30sSTS [30 seconds Sit to Stand]; 6MWT [6-Minute Walk Test].

Outcome	Measure	Source
Demand	• Overall number of recruited patients • Number of recruited patients during treatment versus recruited cancer survivors (after treatment)	Routinely collected data
	• Type and number of detected impairments	Patient assessment
Acceptability	• Number of completed program	Routinely collected data
	• Adherence • Number of SMART goals	Program records
	•Patient satisfaction	Survey
Implementation	• Equipment • Resources	Project documentation
	• Perceived barriers by research team	Routinely collected data
Practicality	• Number of adverse events • Session duration	Routinely collected data
Limited-efficacity	• FACIT-F • ECOG • ESAS-R • SF-36 scales o Physical function (PF) o Social function (SC) o Mental health (MH) o Pain (P) o Change in health (CiH) o Role limitation – Physical (RLP) o Role limitation – Mental (RLM) o Energy/Vitality (EV) o Health perceptions (HP) • BPI • FCRI • ISI • HADS • TUG • 30s STS • 6MWT • Grip strength • Joint Assessment • Manual muscular testing • Gait speed • Gait cadence • Length of steps • Step time • Member-circumference	Patient assessment

Systems-Revised], BPI [Brief Pain Inventory], TUG [Timed Up and Go]; 6MWT [6-Minute Walk Test], grip strength on left and right arms, JA [Joint Assessment], and the length of steps). Cohen's d was used to describe the magnitude of the change with 0.2 representing a small effect; 0.5 a moderate effect and 0.8 a large effect.[35] For all analyses, α level was set to 0.05. All statistics were done using SPSS Software (version 24.0 for Mac, Chicago, IL, USA).

RESULTS

Demand

Over the recruitment period, 31 people were contacted and 27 of them agreed to participate (87% uptake). The recruitment was interrupted from March to October 2020 secondary to COVID-19 pandemic restrictions. However, 80% of participants were recruited before COVID-19 (before March 13th, 2020) (see Figure 1). Nineteen participants were referred from allied health professionals (61.3%) et 12 were recruited by social media (38.7%). Fourteen accepted participants were receiving cancer treatment (during) and 13 were during their survivorship. 87.5% of the participants were female and the mean age was 55 (SD 12.16) (see Table 3). Most participants (62.5%) had a diagnosis of breast cancer and had early stage cancer. Type of cancer treatments received included chemotherapy (n=19), surgery (n=16), radiotherapy (n=12) and 41.7% of participants received a combination of 2 treatment types. At baseline, the most frequent impairments of participants were low muscle endurance (83.3%; 30s STS), weak muscles (100%; MMT), range of motion restrictions (79.2%; Goniometer), reduced functional capacity (95.8%; ECOG), poor sleep quality (75%; ISI), anxiety/depression (100%; HADS) and pain (75%; BPI).

Figure 1 - Program Recruitment Flow chart

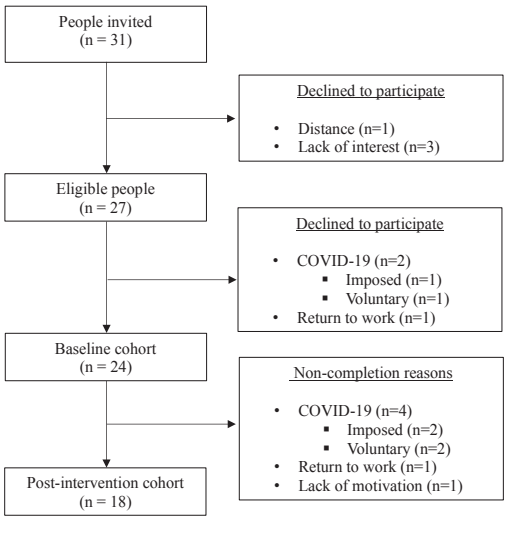

Table 3 - FParticipant Characteristics.
BMI [Body Mass Index]; CNS [Central Nervous System]; MMSE [Mini Mental State Examination]. #Most people have received a combination of cancer treatments.

Characteristics	(n=24)
Sex (M/W)	3/21
Age Mean (SD)	54.54 (12.16)
BMI (kg/m²) Mean (SD)	25.64 (6.48)
Cancer type (n) Breast Lung Multiple myeloma Colorectal Sarcoma Skin Lymphoma Ovary CNS	 14 2 1 1 2 1 1 1 1
Cancer stage (n)	
1 2 3 4 N/D	7 4 5 3 5
Treatment status Current treatment received After treatment	 11 13
Treatments# Surgery Chemotherapy Radiotherapy Specific Therapy Hormonotherapy	 16 19 12 10 4
MMSE Mean (SD)	28.96 (0.91)
Time since diagnostic in month Mean (SD)	19.33 (20.75)

Acceptability

Most participants attended their first appointment (n=24; 89%). The reasons of the three participants who did not attend beyond the first appointment were related to COVID-19 restrictions (n=2) and return to work (n=1). Eighteen participants completed the 10-week program (75%). During the early pandemic period, the program has been interrupted by specific government-imposed public health lockdown. This lockdown was the main reason for non-completion (Figure 1). Fifty-eight physical therapy SMART-goals were built with the remaining participants. These participants attended 94.3% of the 193 scheduled appointment. Overall, the remaining participants accepted supervised exercise, unsupervised home exercise, education sessions, manual therapy and specialized physiotherapy techniques. Adherence rates to home exercise program and to face-to-face exercise program were respectively 64.62% and 100%. 20 participants completed the satisfaction survey (Table 4). 85% (n=17) of participants agreed that their physical health had improved after the program. All participants (100%) reported they were satisfied with the program and would recommend our physiotherapy services to others.

Table 4 - Satisfaction of participants. Data were expressed by mean (SD).

	Total respondents (n)	Median (Range)	Agreed/Strongly agreed % (n)
Overall, I am satisfied with the physical therapy program	(20)	5 (4 to 5)	100%
I am satisfied with the type of intervention included into the physical therapy program (quality)	(19)	5 (5 to 5)	100%
I am satisfied with the physiotherapist communication skills	(19)	5 (4 to 5)	100%
Access to the program (parking, facilities) was easy for me	(16)	5 (2 to 5)	90%
Access to the program (parking, facilities) was safe for me during winter	(19)	5 (4 to 5)	100%

Implementation

Existing equipment of CUpht were used to run the program in the community setting. We had access to CUpht's therapy equipments, to CUpht's rehab gym and participants obtained a written personalized home exercise program (Table 1). The main resource was half-time physiotherapist with oncology-specific experience to implement the program. She was supported by the research physiotherapist to design and coordinate the program. There was no cost to patients to participate in the program. Forty-three facilitators to the program success were identified by participants. The most common facilitators were 1) positive effects of the program on physical health (43.74%), 2) higher motivation level related to supervision (37.5%), 3) the personalized goal-specific intervention model (31.25%) and 4) the physiotherapist accompaniment (31.25%). The main barrier to the program was due to the introduction of COVID-19 restrictions.

Practicality

No major adverse event was reported during the study protocol. Five people reported having minor adverse events (muscle soreness) related to the intervention which resolved with rest. These events were all inconsequential. The sessions were 1-h long.

Limited efficacy testing

At the end of protocol, participants demonstrated significant changes in physical impairments such as an improving on 30s STS by a mean difference of 3.72 (95% CI 1.91 to 5.53), MMT by a mean difference of 3.12 (95% CI -0.004 to 6.24), ECOG (N=18, Z=-2.31, p=0.021), TUG (N=18, Z=-2.42, p=0.016), 6MWT (N=18, Z=-3.2, p = 0.001). Clinical improvements were also reported for the BPI questionnaire – pain relief (N=18, Z=-2.06, p=0.04) and pain intensity (N=18, Z=-2.11, p=0.035), and the SF-36 CiH subscale (N=18, Z=-2.86, p=0.004). Finally, grip strength on left arm was improved (N=18, Z=-2.32, p=0.02). There was no difference in other few variables related to limited efficacity testing such as some categories of SF-36 (see Tables 5 and Table 6).

DISCUSSION

In this study, we explored the feasibility of implementing a personalized 10-weeks physical therapy program in cancer patient offering in community setting. The main finding was that program was feasible, safe, and well tolerated in mixed cohort of cancer patients. The participants who completed the program have shown a very good demand and higher rate of adherence and reported a high satisfaction level. Participants made gains in pain, functional capacity, muscle strength and walk distance, even who were receiving current cancer treatments. These results have direct implications for clinical decision making for this population in the Saguenay Lac-Saint-Jean region in Quebec. We add to evidence by providing clinical real data on how physiotherapy can be delivered in the local community to meet the physical needs of patients across the full cancer continuum of care.
Participants in our sample were mainly females, mostly diagnosed with breast cancer and receiving more than one cancer treatment type. These sample characteristics were comparable to population of 34 clinicals trials in cancer rehabilitation field.[36-69] In total, the RCTs represented 3,417

Table 5 - Limited efficacity testing outcomes of normally distributed data
FFACIT-F [Functional Assessment of Chronic Illness Therapy-Fatigue]; SF-36 [Medical Outcome Short-Form 36]; FCRI [Fear of cancer Recurrence Inventory]; ISI [Insomnia Symptoms Index], HADS [Hospital Anxiety and Depression Scale]; 30sSTS [30 seconds Sit to Stand]; MMT [Manual muscular testing].
(*) Significant difference between pre and post-test.

Measures	Paired-sample t-test of normally distributed data					*t*	ddl	*p*-Value (bilateral)	N	Cohen's *d*
	Mean Difference	Standard Deviation	Standard error mean (SEM)	95% CI Lower	95% CI Upper					
FACIT-F	2.72	694	1.64	-0.73	6.18	1.66	17	0.12	18	0.14
FCRI	-1.67	5.40	1.27	-4.35	1.02	-1.31	17	0.21	18	0.09
ISI	-1.56	6.17	1.45	-4.62	1.51	-1.07	17	0.30	18	0.06
HADS	-0.28	3.12	0.74	-1.83	1.27	-0.38	17	0.71	18	0.01
30s STS	3.72	3.64	0.86	1.91	5.53	4.34	17	**0.00***	18	0.53
MMT	3.12	6.07	1.47	-0.004	6.24	2.12	16	**0.05***	17	0.22
GAITRite										
• Gait speed	0.01	0.28	0.068	-0.13	0.15	0.14	16	0.89	17	0.00
• Cadence	0.29	16.11	3.91	-7.99	8.58	0.08	16	0.94	17	0.00035
• Step time	-0.01	0.079	0.019	-0.05	0.031	-0.49	16	0.63	17	0.01

Table 6 - Limited efficacity testing outcomes of non-normally distributed data
ECOG [Eastern Cooperative Oncology Group]; ESAS-R [Edmonton Symptoms Assessment Systems-Revised]; BPI [Brief Pain Inventory]; TUG [Timed Up and Go]; 6MWT [6-Minute Walk Test]; JA [Joint assessment].
(*) Significant difference between pre and post-test.

Measures	Positive ranks			Negative ranks			Ex aequo	Total	Statistical Tests		
	N (Pre > Post)	Mean rank	Sum of ranks	N (Pre < Post)	Mean rank	Sum of ranks	N (Pre = Post)	N	Z	Effect size (r)	P-value
ECOG	8	5.13	41.0	1	4.0	4.0	9	18	-2.31	0.54	**0.02***
ESAS-R Total	12	8.42	101.0	5	10.4	52.0	1	18	-1.16	0.27	0.245
SF-36											
• Physical function (PF)	9	7.72	69.5	5	7.1	35.4	4	18	-1.08	0.25	0.24
• Social function (SF)	7	6.93	48.5	4	4.38	17.5	7	18	-1.39	0.33	0.16
• Mental health (MH)	6	7.83	47.0	7	6.29	44.0	5	18	-0.11	0.03	0.92
• Pain (P)	9	7.67	69.0	5	7.2	36.0	4	18	-1.04	0.25	0.3
• Change in health (CiH)	10	5.5	55.0	0	0.00	0.00	8	18	-2.86	0.67	**0.004***
• Role limitation - Physical (RLP)	7	6.43	45.00	3	3.33	10.0	8	18	-1.81	0.43	0.07
• Role limitation – Mental (RLM)	4	4.25	17.0	2	2.0	4.0	12	18	-1.39	0.33	0.16
• Energy/Vitality (EV)	9	8.94	80.5	6	6.58	39.5	3	18	-1.18	0.28	0.24
• Health perceptions (HP)	9	7.39	66.5	7	9.93	69.5	2	18	-0.08	0.02	0.94
BPI											
• Worst pain	9	8.28	74.5	4	4.1	16.5	5	18	-2.06	0.48	**0.04***
• Pain intensity	11	8.82	97.0	4	5.8	23.0	3	18	-2.11	0.50	**0.035***
• Pain interference	9	8.11	73.0	4	4.5	18.0	5	18	-1.92	0.45	0.054
TUG	15	9.4	141.0	3	10.0	30.0	0	18	-2.42	0.57	**0.016***
6MWT	2	4.5	9.0	15	9.6	144.0	0	17	-3.20	0.77	**0.001***
Grip strength G	3	6.5	19.5	12	8.4	100.5	2	17	-2.32	0.56	**0.02***
Grip strength D	3	10.5	31.5	12	7.4	88.5	2	17	-1.64	0.40	0.1
JA	2	7.75	15.5	10	6.3	62.5	5	17	-1.87	0.45	0.062
GAITRite											
• Length of steps	8	7.69	61.5	8	9.3	74.5	1	17	-0.34	0.08	0.736

participants living with cancer (2,472 women/ 945 men) between 20 and 90 years of age. The cancer types represented in the sample group were breast (60.7%), prostate (17.9%), colon (2%) and others (19.8%). All participants were receiving one of the following cancer treatments: chemotherapy only (1,142 participants), radiation therapy only (198 participants), hormone therapy only (178 participants) or multiple modalities (1,899 participants).

Our results for participant recruitment and retention were similar to the other study related to community-based rehabilitation model in cancer patients.[70, 71] However, in contrast with these studies, our drop-out patients were mostly related to the introduction of COVID19 restrictions. In addition, self-referrals due to social media formed 38.7 % of the sample attend beyond the first appointment. This result shown that social media are a great facilitator for recruitment. The most frequent impairments to explain demand for our program were low muscle endurance, weak muscles, range of motion restrictions, reduced functional capacity, poor sleep quality and pain. Psychological components may have an important influence on physical impairments. Therefore, it is not surprising that anxiety or depression were reported in all participants at baseline. These results are supported by previous studies in cancer populations.[16, 72-74]

Cancer side effects and patient needs are very heterogeneous in terms of global health outcomes. To increase access to all of them, a free and flexible community physical therapy care model appears to be a relevant choice. Our personalized physical therapy program was defined as the selection and customized application of a goal-specific intervention towards the physiological status of the patient. Clearly, even within carefully selected homogenous clinical trial cohorts, considerable heterogeneity likely still exists in cardiopulmonary function, lifestyle behavior, age, prior treatment, concomitant comorbidities, and genetic predisposition. Thus, application of a generic or standardized intervention failing to consider such parameters will most often result in wrong optimal selected modality. To our knowledge, there are few publish reports of goal-specific physiotherapy programs for cancer patients. Similar to our study, patients with physical impairments undergoing or following cancer treatment benefit from goal-specific physiotherapy programs to improve physical function and reduce pain.[75-77] Choosing treatment goals based on the patient's need is a more patient-centered approach than one-size-fits-all approach. Bennell et al concluded that personalized support care is a "ideal gold standard for clinical practice".[28]

We found interesting result concerning limited efficacity outcomes. Indeed, even though there was a non-significant increase for fatigue level, the cohort improved their SF-36 change in health scale, 30s STS, MMT, ECOG, BPI worst pain, BPI pain intensity, TUG, 6MWT and the left arm grip strength. These might be clinically relevant for daily functioning.[73] The fatigue level results are promising as we found a non-significant increase even if 45.83% of the patients were receiving concomitant cancer treatments. There are many determinants for quality of life and, despite the availability of advanced tools, it is difficult to truly measure the isolated impact of their determinants on quality of life as perceived by the participant. Consequently, we do not know the true contribution of the physical components and which adaptation mechanisms should be targeted by through adaptation mechanisms. It is, therefore, not surprising that our results showing the least impact are those objectified by quality-of-life indicators. However, the addition of specific psychological interventions into our program might have led to more improvement in fatigue level and changes for other quality of life indicators.[78]

We recognize that main limitations in our work are a small sample size and the absence of a control group are factors that limit the scope of our findings. The natural effect of time on our results cannot be excluded because of the absence of control group. This precluded our ability to perform statistical analysis between our program and clinical measures. Nonetheless, this data was invaluable to develop our future RCT. While participants got many benefits through the study, the higher representation of participants being females with a diagnosis of breast cancer suggests that results may not be generalized to other cancer groups. Finally, we cannot ignore the barriers caused by the COVID-19 pandemic. Due to the nature of our interventions, we have stopped our program for 7 months.

In this study, we found that personalized 10-weeks physical therapy program in community setting was feasible and safe and efficient to improve the function and pain in patients with cancer. The satisfaction rate among participants shown the acceptability of personalized physiotherapy services. Moreover, limited-efficacy results suggest the trend to overcome some cancer side effects even with active treatments status. Overall, we provide some preliminary data necessary for the development of a larger randomized study aimed to measure the efficacy of this model of rehabilitation across the cancer care continuum and survivorship.

Acknowledgements

Authors would thank the CUpht to offer the infrastructure needed for this study and all participants. We also thank the allied health professionnals of *Centre Intégré Universitaire de Santé et de Services Sociaux du Saguenay-Lac-St-Jean* (CIUSSS SLSJ) for referring the participants.

Funding

S.S.D. was funded by the *Fondation de l'Université du Québec à Chicoutimi* (FUQAC). M.D was funded by the *Ordre Professionnel de la Physiothérapie du Québec* (OPPQ) and the *Centre intersectoriel en Santé Durable* (CISD).

Honorarium

Not applicable.

Author contribution

SSD has contributed to the study conception and design. SSD, MD, JSAL, MAK, SS, JLMG and RADS have contributed to data acquisition, analysis, or interpretation. SSD and MD have drafted the manuscript. All authors have revised the manuscript. SSD, MD and RADS have performed the statistical analysis. Material preparation was performed by JSAL, MAK, SS and JLMG. SSD and RADS have completed the supervision of the manuscript. All authors read and approved the final manuscript.

Conflict of interest

The authors have no conflict of interest.

REFERENCES

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA: A Cancer Journal for Clinicians. 2020;71(3):209-49.
2. Comité consultatif des statistiques canadiennes sur le cancer ecalScdc, Statistique Canada et l'Agence de la santé publique du Canada. Statistiques canadiennes sur le cancer 2021. Société canadienne du cancer. 2021.
3. Aziz NM. Cancer survivorship research: state of knowledge, challenges and opportunities. Acta Oncol. 2007;46(4):417-32.
4. Habash M, Bohorquez LC, Kyriakou E, Kron T, Martin OA, Blyth BJ. Clinical and Functional Assays of Radiosensitivity and Radiation-Induced Second Cancer. Cancers (Basel). 2017;9(11).
5. Chagani P, Parpio Y, Gul R, Jabbar AA. Quality of Life and Its Determinants in Adult Cancer Patients Undergoing Chemotherapy Treatment in Pakistan. Asia Pac J Oncol Nurs. 2017;4(2):140-6.
6. Fagherazzi G, El Fatouhi D, Bellicha A, El Gareh A, Affret A, Dow C, et al. An International Study on the Determinants of Poor Sleep Amongst 15,000 Users of Connected Devices. J Med Internet Res. 2017;19(10):e363.
7. Landier W, Skinner R, Wallace WH, Hjorth L, Mulder RL, Wong FL, et al. Surveillance for Late Effects in Childhood Cancer Survivors. J Clin Oncol. 2018;36(21):2216-22.
8. Schmidt ME, Wiskemann J, Steindorf K. Quality of life, problems, and needs of disease-free breast cancer survivors 5 years after diagnosis. Qual Life Res. 2018;27(8):2077-86.
9. Jitender S, Mahajan R, Rathore V, Choudhary R. Quality of life of cancer patients. J Exp Ther Oncol. 2018;12(3):217-21.

10. Yeganeh L, Harrison C, Vincent AJ, Teede H, Boyle JA. Effects of lifestyle modification on cancer recurrence, overall survival and quality of life in gynaecological cancer survivors: A systematic review and meta-analysis. Maturitas. 2018;111:82-9.
11. cancer Pccl. Vivre avec un cancer : Rapport sur l'expérience du patient. Toronto, Ontario: Partenariat canadien contre le cancer; Janvier 2018. p. 52 pages.
12. Alappattu MJ, Coronado RA, Lee D, Bour B, George SZ. Clinical characteristics of patients with cancer referred for outpatient physical therapy. Phys Ther. 2015;95(4):526-38.
13. Bradley CJ, Neumark D, Oberst K, Luo Z, Brennan S, Schenk M. Combining registry, primary, and secondary data sources to identify the impact of cancer on labor market outcomes. Med Decis Making. 2005;25(5):534-47.
14. Movsas SB, Chang VT, Tunkel RS, Shah VV, Ryan LS, Millis SR. Rehabilitation needs of an inpatient medical oncology unit. Arch Phys Med Rehabil. 2003;84(11):1642-6.
15. Simard Sb, Thewes B, Humphris G, Dixon Ml, Hayden C, Mireskandari S, et al. Fear of cancer recurrence in adult cancer survivors: a systematic review of quantitative studies. Journal of Cancer Survivorship : Research and Practice. 2013;7(3):300-22.
16. Thorsen L, Gjerset GM, Loge JH, Kiserud CE, Skovlund E, Fløtten T, et al. Cancer patients' needs for rehabilitation services. Acta Oncol. 2011;50(2):212-22.
17. Seijas VA, Lugo LH, Cano B, Escobar LM, Quintero C, Nugraha B, et al. Understanding community-based rehabilitation and the role of physical and rehabilitation medicine. Eur J Phys Rehabil Med. 2018;54(1):90-9.
18. Manneville F, Rotonda C, Conroy T, Bonnetain F, Guillemin F, Omorou AY. The impact of physical activity on fatigue and quality of life during and after adjuvant treatment for breast cancer. Cancer. 2018;124(4):797-806.
19. van Vulpen JK, Peeters PH, Velthuis MJ, van der Wall E, May AM. Effects of physical exercise during adjuvant breast cancer treatment on physical and psychosocial dimensions of cancer-related fatigue: A meta-analysis. Maturitas. 2016;85:104-11.
20. Schmidt T, Weisser B, Durkop J, Jonat W, Van Mackelenbergh M, Rocken C, et al. Comparing Endurance and Resistance Training with Standard Care during Chemotherapy for Patients with Primary Breast Cancer. Anticancer research. 2015;35(10):5623-9.
21. Fuller JT, Hartland MC, Maloney LT, Davison K. Therapeutic effects of aerobic and resistance exercises for cancer survivors: a systematic review of meta-analyses of clinical trials [with consumer summary]. British Journal of Sports Medicine 2018 Oct;52(20):1311. 2018.
22. Bonsignore A, Marzolini S, Oh P. Cardiac rehabilitation for women with breast cancer and treatment-related heart failure compared with coronary artery disease: A retrospective study. J Rehabil Med. 2017;49(3):277-81.
23. Brown JC, Huedo-Medina TB, Pescatello LS, Ryan SM, Pescatello SM, Moker E, et al. The efficacy of exercise in reducing depressive symptoms among cancer survivors: a meta-analysis. PLoS ONE 2012 Jan;7(1):e30955. 2012.
24. De Backer IC, Van Breda E, Vreugdenhil A, Nijziel MR, Kester AD, Schep G. High-intensity strength training improves quality of life in cancer survivors. Acta oncologica (Stockholm, Sweden). 2007;46(8):1143-51.
25. Brown JC, Schmitz KH. The prescription or proscription of exercise in colorectal cancer care. Medicine and science in sports and exercise. 2014;46(12):2202-9.
26. Minetama M, Kawakami M, Teraguchi M, Kagotani R, Mera Y, Sumiya T, et al. Supervised physical therapy vs. home exercise for patients with lumbar spinal stenosis: a randomized controlled trial. Spine J. 2019;19(8):1310-8.
27. Driessen EJ, Peeters ME, Bongers BC, Maas HA, Bootsma GP, van Meeteren NL, et al. Effects of prehabilitation and rehabilitation including a home-based component on physical fitness, adherence, treatment tolerance, and recovery in patients with non-small cell lung cancer: A systematic review. Crit Rev Oncol Hematol. 2017;114:63-76.
28. Bennell KL, Egerton T, Pua YH, Abbott JH, Sims K, Buchbinder R. Building the rationale and structure for a complex physical therapy intervention within the context of a clinical trial: a multimodal individualized treatment for patients with hip osteoarthritis. Phys Ther. 2011;91(10):1525-41.
29. Bowen DJ, Kreuter M, Spring B, Cofta-Woerpel L, Linnan L, Weiner D, et al. How we design feasibility studies. Am J Prev Med. 2009;36(5):452-7.
30. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res. 1975;12(3):189-98.
31. Julious SA. Sample size of 12 per group rule of thumb for a pilot study. Pharmaceutical Statistics. 2005;4(4):287-91.
32. Bovend'Eerdt TJ, Botell RE, Wade DT. Writing SMART rehabilitation goals and achieving goal attainment scaling: a practical guide. Clin Rehabil. 2009;23(4):352-61.
33. 33. Stout NL, Santa Mina D, Lyons KD, Robb K, Silver JK. A systematic review of rehabilitation and exercise recommendations in oncology guidelines. CA Cancer J Clin. 2021;71(2):149-75.
34. Hoffmann TC, Glasziou PP, Boutron I, Milne R, Perera R, Moher D, et al. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. Bmj. 2014;348:g1687.
35. Fritz CO, Morris PE, Richler JJ. Effect size estimates: current use, calculations, and interpretation. J Exp Psychol Gen. 2012;141(1):2-18.
36. Adamsen L, Quist M, Andersen C, Moller T, Herrstedt J, Kronborg D, et al. Effect of a multimodal high intensity exercise intervention in cancer patients undergoing chemotherapy: randomised controlled trial. BMJ. 2009;339:b3410.
37. Alberga AS, Segal RJ, Reid RD, Scott CG, Sigal RJ, Khandwala F, et al. Age and androgen-deprivation therapy on exercise outcomes in men with prostate cancer. Support Care Cancer. 2012;20(5):971-81.
38. Battaglini C, Bottaro M, Dennehy C, Rae L, Shields E, Kirk D, et al. The effects of an individualized exercise intervention on body composition in breast cancer patients undergoing treatment. Revista Paulista de Medicina [Sao Paulo Medical Journal] 2007;125(1):22-28. 2007.
39. Andersen C, Rorth M, Ejlertsen B, Stage M, Moller T, Midtgaard J, et al. The effects of a six-week supervised multimodal exercise intervention during chemotherapy on cancer-related fatigue. Eur J Oncol Nurs. 2013;17(3):331-9.
40. Braz da Silva Leal NF, de Oliveira HF, Angotti Carrara HH. Supervised physical therapy in women treated with radiotherapy for breast cancer. Revista Latino-Americana de Enfermagem (RLAE). 2016;24:1-8.
41. Bryant AL, Deal AM, Battaglini CL, Phillips B, Pergolotti M, Coffman E, et al. The Effects of Exercise on Patient-Reported Outcomes and Performance-Based Physical Function in Adults With Acute Leukemia Undergoing Induction Therapy: Exercise and Quality of Life in Acute Leukemia (EQUAL). Integr Cancer Ther. 2018;17(2):263-70.
42. Buffart LM, Galvao DA, Chinapaw MJ, Brug J, Taaffe

DR, Spry N, et al. Mediators of the resistance and aerobic exercise intervention effect on physical and general health in men undergoing androgen deprivation therapy for prostate cancer. Cancer. 2014;120(2):294-301.
43. Chang PH, Lai YH, Shun SC, Lin LY, Chen ML, Yang Y, et al. Effects of a walking intervention on fatigue-related experiences of hospitalized acute myelogenous leukemia patients undergoing chemotherapy: a randomized controlled trial. Journal of Pain & Symptom Management. 2008;35(5):524-34.
44. Christensen JF, Jones LW, Tolver A, Jorgensen LW, Andersen JL, Adamsen L, et al. Safety and efficacy of resistance training in germ cell cancer patients undergoing chemotherapy: a randomized controlled trial. England2014 Jul 8. 8-16 p.
45. Cormie P, Galvao DA, Spry N, Joseph D, Chee R, Taaffe DR, et al. Can supervised exercise prevent treatment toxicity in patients with prostate cancer initiating androgen-deprivation therapy: a randomised controlled trial. BJU Int. 2015;115(2):256-66.
46. Cornette T, Vincent F, Mandigout S, Antonini MT, Leobon S, Labrunie A, et al. Effects of home-based exercise training on VO2 in breast cancer patients under adjuvant or neoadjuvant chemotherapy (SAPA): a randomized controlled trial. European Journal of Physical and Rehabilitation Medicine 2016 Apr;52(2):223-232. 2016.
47. Courneya KS, McKenzie DC, Mackey JR, Gelmon K, Reid RD, Friedenreich CM, et al. Moderators of the effects of exercise training in breast cancer patients receiving chemotherapy: a randomized controlled trial. Cancer. 2008;112(8):1845-53.
48. Dodd MJ, Cho MH, Miaskowski C, Painter PL, Paul SM, Cooper BA, et al. A randomized controlled trial of home-based exercise for cancer-related fatigue in women during and after chemotherapy with or without radiation therapy. Cancer Nurs. 2010;33(4):245-57.
49. Dolan LB, Gelmon K, Courneya KS, Mackey JR, Segal RJ, Lane K, et al. Hemoglobin and aerobic fitness changes with supervised exercise training in breast cancer patients receiving chemotherapy. United States: 2010 Aacr.; 2010 Nov. 2826-32 p.
50. Griffith K, Wenzel J, Shang J, Thompson C, Stewart K, Mock V. Impact of a walking intervention on cardiorespiratory fitness, self-reported physical function, and pain in patients undergoing treatment for solid tumors. Cancer. 2009;115(20):4874-84.
51. Hojan K, Kwiatkowska-Borowczyk E, Leporowska E, Gorecki M, Ozga-Majchrzak O, Milecki T, et al. Physical exercise for functional capacity, blood immune function, fatigue, and quality of life in high-risk prostate cancer patients during radiotherapy: a prospective, randomized clinical study. European journal of physical and rehabilitation medicine. 2016;52(4):489-501.
52. Hojan K, Kwiatkowska-Borowczyk E, Leporowska E, Milecki P. Inflammation, cardiometabolic markers, and functional changes in men with prostate cancer: A randomized controlled trial of a 12-month exercise program. Polish Archives of Internal Medicine. 2017;127(1):25-35.
53. Hornsby WE, Douglas PS, West MJ, Kenjale AA, Lane AR, Schwitzer ER, et al. Safety and efficacy of aerobic training in operable breast cancer patients receiving neoadjuvant chemotherapy: A phase II randomized trial. Acta Oncologica. 2014;53(1):65-74.
54. Hwang JH, Chang HJ, Shim YH, Park WH, Park W, Huh SJ, et al. Effects of supervised exercise therapy in patients receiving radiotherapy for breast cancer. Korea South2008 Jun 30. 443-50 p.
55. Mijwel S, Backman M, Bolam KA, Jervaeus A, Sundberg CJ, Margolin S, et al. Adding high-intensity interval training to conventional training modalities: optimizing health-related outcomes during chemotherapy for breast cancer: the OptiTrain randomized controlled trial. Breast Cancer Research and Treatment. 2018;168(1):79-93.
56. Milecki P, Hojan K, Ozga-Majchrzak O, Molinska-Glura M. Exercise tolerance in breast cancer patients during radiotherapy after aerobic training. Wspolczesna Onkologia [Contemporary Oncology] 2013;17(2):205-209. 2013.
57. Mock V, Frangakis C, Davidson NE, Ropka ME, Pickett M, Poniatowski B, et al. Exercise manages fatigue during breast cancer treatment: a randomized controlled trial. Psychooncology. 2005;14(6):464-77.
58. Monga U, Garber SL, Thornby J, Vallbona C, Kerrigan AJ, Monga TN, et al. Exercise prevents fatigue and improves quality of life in prostate cancer patients undergoing radiotherapy. Archives of Physical Medicine and Rehabilitation 2007 Nov;88(11):1416-1422. 2007.
59. Mutrie N, Campbell AM, Whyte F, McConnachie A, Emslie C, Lee L, et al. Benefits of supervised group exercise programme for women being treated for early stage breast cancer: pragmatic randomised controlled trial [with consumer summary]. BMJ 2007 Mar 10;334(7592):517-523. 2007.
60. Nilsen TS, Raastad T, Skovlund E, Courneya KS, Langberg CW, Lilleby W, et al. Effects of strength training on body composition, physical functioning, and quality of life in prostate cancer patients during androgen deprivation therapy. Acta Oncol. 2015;54(10):1805-13.
61. Samuel SR, Arun Maiya G, Babu AS, Vidyasagar MS. Effect of exercise training on functional capacity & quality of life in head & neck cancer patients receiving chemoradiotherapy. Indian Journal of Medical Research. 2013;137(3):515-20.
62. Schwartz AL, Winters-Stone K, Gallucci B. Exercise effects on bone mineral density in women with breast cancer receiving adjuvant chemotherapy. United States2007 May. 627-33 p.
63. Travier N, Velthuis MJ, Steins Bisschop CN, van den Buijs B, Monninkhof EM, Backx F, et al. Effects of an 18-week exercise programme started early during breast cancer treatment: a randomised controlled trial. England2015 Jun 8. 121 p.
64. Van Vulpen JK, Velthuis MJ, Steins Bisschop CN, Travier N, Van Den Buijs BJ, Backx FJ, et al. Effects of an Exercise Program in Colon Cancer Patients undergoing Chemotherapy. Med Sci Sports Exerc. 2016;48(5):767-75.
65. van Waart H, Stuiver MM, van Harten WH, Geleijn E, Kieffer JM, Buffart LM, et al. Effect of Low-Intensity Physical Activity and Moderate- to High-Intensity Physical Exercise During Adjuvant Chemotherapy on Physical Fitness, Fatigue, and Chemotherapy Completion Rates: Results of the PACES Randomized Clinical Trial. United States: 2015 by American Society of Clinical Oncology.; 2015 Jun 10. 1918-27 p.
66. Wall BA, DA GA, Fatehee N, Taaffe DR, Spry N, Joseph D, et al. Exercise Improves V O2max and Body Composition in Androgen Deprivation Therapy-treated Prostate Cancer Patients. Med Sci Sports Exerc. 2017;49(8):1503-10.
67. Wang YJ, Boehmke M, Wu YW, Dickerson SS, Fisher N. Effects of a 6-week walking program on Taiwanese women newly diagnosed with early-stage breast cancer. Cancer Nursing 2011 Mar-Apr;34(2):E1-E13. 2011.
68. Xie X, Liu Z, Qu S, Guo F, Zheng Z, Liu Y, et al. 169 patients with postoperative breast cancer on exercising the function of limbs and investigating quality of life: A clinical study. Chinese-German Journal of Clinical On-

cology. 2010;9(10):590-3.
69. Yang C, Tsai J, Huang Y, Lin C. Effects of a home-based walking program on perceived symptom and mood status in postoperative breast cancer women receiving adjuvant chemotherapy. Journal of Advanced Nursing. 2011;67(1):158-68.
70. G.A. Tan AMD, D. Nagarajan, J.E. Freeman, C.L. Peiris. . Program For Oncology Wellness And Exercise Rehabilitation (Power): A Feasibility Study Of Oncology Rehabilitation In The Community. . J Cancer Rehabil 2020. 2020;3:30-9.
71. Dennett AM, Zappa B, Wong R, Ting SB, Williams K, Peiris CL. Bridging the gap: a pre-post feasibility study of embedding exercise therapy into a co-located cancer unit. Support Care Cancer. 2021;29(11):6701-11.
72. Cheville AL, Morrow M, Smith SR, Basford JR. Integrating Function-Directed Treatments into Palliative Care. Pm r. 2017;9(9s2):S335-s46.
73. Silver JK, Baima J, Mayer RS. Impairment-driven cancer rehabilitation: an essential component of quality care and survivorship. CA Cancer J Clin. 2013;63(5):295-317.
74. Berger AM, Mooney K, Alvarez-Perez A, Breitbart WS, Carpenter KM, Cella D, et al. Cancer-Related Fatigue, Version 2.2015. J Natl Compr Canc Netw. 2015;13(8):1012-39.
75. Hutchison NA, Deval N, Rabusch S, Rich H, Kelley T, Flinn N, et al. Physical Therapy-Based Exercise Protocol for Cancer Patients: Evaluating Outcomes for Cardiopulmonary Performance and Cancer-Related Fatigue. Pm r. 2019;11(11):1178-83.
76. Swenson KK, Nissen MJ, Knippenberg K, Sistermans A, Spilde P, Bell EM, et al. Cancer rehabilitation: outcome evaluation of a strengthening and conditioning program. Cancer Nurs. 2014;37(3):162-9.
77. Campbell KL, Neil SE, Winters-Stone KM. Review of exercise studies in breast cancer survivors: attention to principles of exercise training. Br J Sports Med. 2012;46(13):909-16.
78. Rosenberg K, Zolot J. Exercise and Psychological Interventions are Best for Cancer-Related Fatigue. Am J Nurs. 2017;117(7):63.