

Multidisciplinary rehabilitation program after breast cancer: benefits on physical function, anthropometry and quality of life

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Abstract

BACKGROUND: Different clinical trials show beneficial effects of physical training offered during and/or after breast cancer treatment. However, given the variety of side effects that may be encountered, physical training could be combined with psychological, relational and social guidance. This kind of multidisciplinary program has been little studied so far.

AIM: The aim of this study was to determine the benefits of a three-month multidisciplinary rehabilitation program among women after breast cancer treatment.

DESIGN: Controlled no-randomized trial.

SETTING: University for outcomes, University Hospital Center for interventions.

POPULATION: Two hundred and nine outpatients who have been treated for a primary breast carcinoma.

METHODS: Patients were divided into a control group (N.=106) and an experimental group (N.=103) which has benefited from a rehabilitation program of three months including physical training and psycho-educational sessions. The assessments, performed before and after the program, included functional assessments ("Sit and Reach Test", maximal incremental exercise test and "Six-Minute Walk Test"), body composition measurements (Body Mass Index [BMI] and body fat percentage) and a questionnaire (European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-Core 30).

RESULTS: After three months, flexibility, walking distance and all parameters measured during the maximal incremental exercise, except maximal heart rate, were significantly improved in the experimental group. The body fat percentage was significantly decreased and a significant improvement was observed for perceived health status (quality of life), functional role, emotional state, physical, cognitive and social functions and for most symptoms. In the control group, most of

these improvements didn't appear and a significant increase in BMI and body fat percent-age was observed.

CONCLUSIONS: This trial identifies the benefits of a well detailed multidisciplinary rehabilitation program, including physical re-conditioning and psycho-educational sessions, with important improvements in functional capacity, body composition and the majority of functions and symptoms among women after breast cancer treatment.

CLINICAL REHABILITATION IMPACT: Through its results, this study could contribute to the development of hospital quality standards for oncologic rehabilitation. Physiotherapists can efficiently propose this kind of multidisciplinary rehabilitation program.

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Breast neoplasms - Rehabilitation - Body composition - Quality of life.

Although the incidence of mortality due to breast cancer has declined in recent years due to early detection and improved treatment, this cancer remains the most frequently diagnosed in women with 1,671,149 new cases reported worldwide in 2012 (25% of all cancers).^{1, 2}

After completion of treatment for cancer (generally a combination of surgery, radiotherapy, chemotherapy, hormonal therapy and/or targeted therapy), the majority of patients have a high number of side effects, such as fatigue,³⁻¹⁰ weight gain,^{3-5, 8, 9} alopecia,^{5, 8} lymphedema,¹¹ pain,¹² loss of functional capacity^{3, 4, 13} or anxiety,^{5, 8, 14} all having a negative impact on quality of life.

Fatigue³⁻¹⁰ is the most common symptom reported.^{8, 15} It is observed in 70 to 100% of women who have undergone chemotherapy^{8, 15} and generally, patients continue to experience fatigue after completion of their treatment.^{6, 8, 9, 16} Moreover, because of the fatigue experienced, many women often avoid physical efforts and reduce their physical activity levels.¹⁷⁻¹⁹ However, inactivity, causing muscle catabolism is likely to increase the feeling of fatigue.

Different clinical trials^{4, 20, 21} show beneficial effects of physical training offered during and/or after oncologic treatment. However, physical training should ideally be combined with psychological, relational and social guidance to reduce fatigue and to improve quality of life. Few studies investigated the effects of a multidisciplinary approach and these are rarely carried out on a large sample of patients with exhaustive assessments (including validated measures and covering large individual aspects).²¹

Therefore, this study aims to evaluate, by exhaustive measures, the impact of a multidisciplinary rehabilitation program, comprising physical re-conditioning and psycho-educational sessions, on physical capacity, body composition and quality of life of a high number of patients who have been treated for breast cancer. In this way, we hypothesize firstly that the people participating in the program will have significant and better improvements than the control people and secondly, that the

program will allow participants to regain normative values. This approach, if proven beneficial, could contribute to the development of hospital quality standards for oncologic rehabilitation.

Materials and methods

DESIGN

This study was a controlled non-randomized trial. Two hundred and nine voluntary women who had completed their treatments for breast cancer, except for hormonal therapy and/or immunotherapy, were divided into two groups, an experimental group and a control group. The patient could choose to participate in either group. All participants were assessed at baseline and at three months. The experimental group participated in a multidisciplinary rehabilitation program including supervised physical training and psycho-educational sessions for twelve weeks while the control group did not receive any special medical care and were asked not to change their habits (especially in terms of physical activity) during the three months of follow-up.

PARTICIPANTS

Participants were recruited, by phone, from a prospective registry of all patients.

Eligibility criteria were: surgery of a primary breast carcinoma, a minimum period of three weeks and a maximum of one year elapsed since the end of adjuvant chemotherapy and/or radiotherapy (hormonal therapy and immunotherapy could be continued) and the opportunity to participate in group programs. Participants were excluded if they had severe neurological, orthopedic or rheumatic disabilities, a heart failure, a previous or synchronous other malignancy. The trial received ethical approval from the Ethics Committee of the University of Liege (B67020084166) and informed consent was signed by all individual participants included in the study.

MEASURES

Two sessions of assessments were conducted: the first one at 0 month (M0) and the second at 3 months (M3) that is for the experimental group before the intervention and at the end of the program.

At both times, everybody was subjected to a battery of tests including functional assessments, anthropometric and body composition measurements, and a self-administered questionnaire: the European organization for research and treatment of cancer Quality of life Questionnaire Core 30 (EORTC QLQ-C30). Moreover, at M0, participants completed another questionnaire to gather biometric data, data on the history of the disease, on treatment modalities and on her professional status and they completed the Flemish physical activity computerized questionnaire to know her level of physical activity (MET/week).

The sequence of assessments was standardized and conducted by one and the same examiner. Functional assessments were performed during a visit at the university hospital of liege.

Trunk extensor flexibility was measured by the Sit and reach test.²² A ruler marked in centimeters was fixed on top of a box and extending over the front edge of the box towards the test subject with the zero end pointing towards the subject and the 25-cm mark being exactly at the front edge of the box. It had a movable stick that could slide along the ruler. The participant sat on the floor with her knees straight and her feet flat against the front end of the box and pushed the movable stick as far as she could. The best score of two trials was recorded.

To evaluate the aerobic fitness, the participant completed a maximal incremental exercise protocol on a cycle ergometer (Jaeger ergometrics 900, ergoline D-72475 Bitz, Germany). The heart rate was continuously measured using a heart rate monitor (Corina, Marquette Hellige GmbH, Freiburg, Germany) and the maximal heart rate (MHR) was recorded. Ventilatory gas exchanges was also measured throughout the test using a spirometer (Vmax Spectra V29 System, SensorMedics, Yorba Linda, CA, USA) and maximal oxygen consumption (Vo_{2peak}) was determined by the highest value measured on an interval of 60 seconds. Finally, the maximal aerobic power (MAP) reached at the end of effort and the time to exhaustion were recorded. This test was always supervised by the same physician and he was not aware of the patient's group.

The Six-Minute Walk Test (6MWT)²³ was conducted in a quiet corridor without passage, where two cones were placed thirty meters away. Patients were asked to walk the greatest possible distance in six minutes, going back and forth between the cones, without running. After six minutes, the participant stopped walking and the evaluator calculated the distance performed.

Anthropometric and body composition measurements consisted of the measurement of height and body weight to determine the Body Mass Index (BMI) and the measurement of body fat percentage. The body fat percentage was estimated from skinfold thickness measured with calipers at the biceps, triceps, subscapular fold and suprailiac crest using Durnin-Womersley and Siri equations.²⁴

Quality of life and various symptoms and functions were assessed by the EORTC QLQ-C30. This questionnaire assesses six functional areas (health status or quality of life, functional role, emotional state, physical, cognitive and social functions) and nine symptoms due to cancer or its treatments (fatigue, nausea and vomiting, pain, dyspnea, insomnia, loss of appetite, constipation, diarrhea and financial difficulties). For functions, the higher the score, the better is the quality of life and for symptoms, the higher the score, the worst is the quality of life. This questionnaire is validated for people with cancer²⁵ and more specifically breast cancer.²⁶

INTERVENTION FOR THE EXPERIMENTAL GROUP

The experimental group, unlike the control group, participated in a program of rehabilitation including physical training and psycho-educational sessions.

PHYSICAL TRAINING

The training period lasted twelve weeks and consisted of three sessions, of one hour and thirty minutes, per week. Workouts were done in groups under the supervision of two physiotherapists. Participants spent 30 minutes at three different workshops (cardiovascular training, muscular endurance training and a varied activity) and ended with a collective stretching session.

The entire training protocol was based on the recommendations of the American College of Sports Medicine (ACSM) on physical activity and cancer.^{4, 27}

Cardiovascular training was performed on a bicycle ergometer at constant wattage. Participants began to pedal three times eight minutes at 60% of their MAP with one-minute rest in between to gradually ride thirty minutes continuously at 70% of their MAP.

Muscular endurance training was performed on weight machines. The exercises were leg presses, leg extensions, leg curls, biceps curls and triceps extensions. The "10RM" or load that a muscle can lift ten times on full amplitude was evaluated on each machine for each patient. The 1RM was then extrapolated and used as a base for further training. Participants started with two sets of twenty repetitions at 30% of their estimated 1RM and gradually, the difficulty was increased to three sets of thirty repetitions at 35% of their 1RM.

The varied activity was hypopressive abs or exercises on a mat, a step or a Swiss Ball.

PSYCHO-EDUCATIONAL SESSIONS

Two-hour psycho-educational sessions were also provided once a week over the twelve weeks of the program. After a first introductory session where people got to know each other, a specific topic was approached by a specialist at each session: a psychologist supervised sessions on psychological aspects (discussion about the anxiety of relapse, self-esteem, the desire to regain one's physical form and the look and expectation of the family and social entourage) (twice two hours), on stress management (presentation of different stress management tools such as relaxation, meditation, breathing, yoga and visualization) (twice two-hours) and on sexuality (link between breast cancer and sexuality, problems encountered and opportunities for help); a professor in physiotherapy and rehabilitation was responsible for the session on the health benefits of physical activity (justification of the benefits of physical activity, potential risks and recommended modalities); a dietician discussed the good nutrition practices in two sessions (presentation of a healthy diet, recommendations in the context of cancer, effects of drugs on body composition, explanation of BMI and practical advice) and finally, a neurologist presented sleep disorders commonly encountered and their treatments (explanation on normal sleep, on insomnia and hypersomnia, consequences of insomnia and possible treatments). Participants were thus given information, advice and tips on all these topics and had the opportunity to ask questions to the various specialists. Finally, a last session was given by a psychologist and a physical therapist to find out what participants think about the program and encourage them to continue a regular physical activity.

STATISTICAL ANALYSIS

Results were presented as means and standard deviations (SD) for continuous variables and as frequencies for categorical variables. The comparison between groups was done by a student t-test for continuous variables and by a χ^2 test for categorical variables. In each group, comparisons between M0 and M3 measures were done by the paired student t-test. Results were considered to be significant at the 5% level ($P < 0.05$). All statistical calculations were done on the maximum available data at each time. Calculations were done using SAS version 9.3 (SAS Institute, Cary, NC, USA).

Results

SAMPLE CHARACTERISTICS

Biometric, medical, professional and physical activity level data for all participants at baseline are listed in table I. The experimental group and control group were composed respectively of one hundred and three people and one hundred and six people. Both groups were homogenous: the average age for the experimental group was 53 ± 8.9 years compared with 53.7 ± 9.8 years in the control group ($P=0.59$), the experimental group had completed treatment 5.5 ± 2.5 months ago on average and the control group 5.3 ± 2.1 months ago ($P=0.43$), the majority of participants had had a tumor of stage I (43.6% of the experimental group and 44.7% in the control group) ($P=0.78$) and all participants underwent surgery.

The groups were also homogeneous with regard to their physical activity level and to their professional status: 25.5% of the participants in the experimental group had returned to work at the initial stage of the study, compared with 33.3% in the control group ($P=0.13$).

The reasons why the patients chose to join the control group were, in descending order of importance: fear of the cumbersome nature of the proposed program, lack of time to participate, lack of means of travel, too long distance between home and hospital, parking difficulties and the desire not to hear about the disease.

Finally, thirty-nine women, fifteen from the experimental group and twenty-four from the control group, dropped out during the three-months program and did not provide data at M3 (reasons for drop out included personal reasons such as lack of time, transportation difficulties and return to work, $N.=20$; relapse of cancer, $N.=2$; and 17 people did not give any reason or could not be contacted). No complication due to the program have been identified.

The patients flow throughout the study is presented in figure 1.

Table II lists the functional, anthropometric and psychological data at M0. No significant difference between groups was observed for functional and anthropometric data. The two populations were thus strictly identical for these parameters. On the other side, we observed significant differences in the EORTC QLQ-C30 for the health status ($P<0.0001$), functional role ($P=0.0009$), emotional state ($P<0.0001$), physical ($P=0.0001$), cognitive ($P=0.0051$) and social functions ($P=0.0067$) and for fatigue ($P<0.0001$), pain ($P=0.0005$), dyspnea ($P=0.0039$), insomnia ($P=0.0054$), diarrhea ($P=0.0021$) and financial difficulties ($P<0.0001$). For all these items, the evaluation was better in the control group.

TABLE I.—Biometric, medical, professional and physical activity level characteristics of the sample.

Characteristic	Experimental group (N.=103)		Control group (N.=106)		P
	N.	%	N.	%	
Biometric data					
Age (years)					0.59
Mean	53		53.7		
Standard deviation	8.9		9.8		
BMI (kg/m ²)					0.43
Mean	26.2		25.7		
Standard deviation	4.6		5.1		
Medical data					
Time since the end of treatments (months)					0.43
Mean	5.5		5.3		
Standard deviation	2.5		2.1		
Type of tumor					0.36
Ductal carcinoma <i>in situ</i>	12	11.8	11	100.5	
Lobular carcinoma <i>in situ</i>	2	2	0	0	
Invasive ductal carcinoma	76	74.5	76	720.4	
Lobular invasive carcinoma	12	11.8	18	170.1	
Tumor grade					0.022
I	10	10.3	25	240.8	
II	54	55.7	43	420.6	
III	33	34	33	320.7	
Classification of tumor					0.78
Stage 0 (TisN0)	6	5.9	7	60.8	
Stage I (T1N0)	44	43.6	46	440.7	
Stage IIa (T1N1, T2N0)	26	25.7	29	280.2	
Stage IIb (T2N1, T3N0)	17	16.8	11	100.7	
Stage III (T1N2, T2N2, T3N1-2)	8	7.9	10	90.7	
Axillary dissection					0.54
Yes	60	60	58	550.8	
No	40	40	46	440.2	
Chemotherapy					0.052
No	42	40.8	61	570.5	
Neoadjuvant	17	16.5	12	110.3	
Adjuvant	44	42.7	33	310.1	
Radiotherapy					0.040
Yes	99	96.1	106	100	
No	4	3.9	0	0	
Hormonotherapy					0.030
Yes	76	73.8	91	850.8	
No	27	26.2	15	140.2	
Targeted therapy					0.15
Yes	20	19.8	13	120.4	
No	81	80.2	92	870.6	
Professional status					0.13
Active	26	25.5	34	330.3	
Inactive	55	53.9	40	390.2	
Pensioned	21	20.6	28	270.5	
Physical activity level (MET/week)					0.29
Mean		1.57		1.60	
Standard deviation		0.16		0.14	

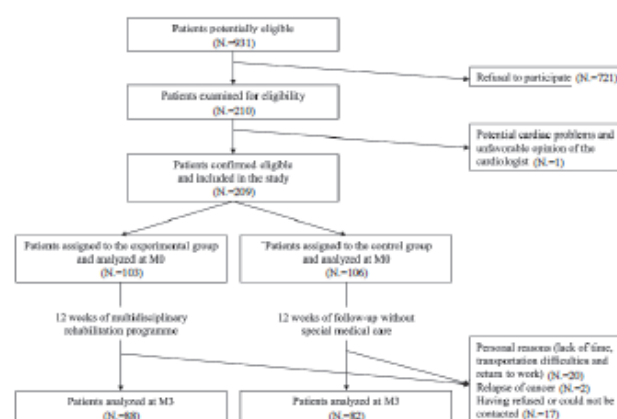


Figure 1.—Flow chart of the patients through the study.

TABLE II.—Functional, anthropometric and psychological data at M0.

Variable	Experimental group	Control group	p
	Mean±SD	Mean±SD	
<i>Functional data</i>			
Sit and Reach Test			
Trunk extensor flexibility, cm	19±9	21±9	0.19
Maximal incremental exercise protocol on a cycle ergometer			
Maximal oxygen consumption, mL/min/kg	18±5	19±6	0.22
Maximal aerobic power, W	94±26	98±32	0.28
Maximal heart rate, bpm	152±21	148±22	0.19
Time to exhaustion, min	8±3	9±3	0.29
Six-Minute Walk Test			
Distance, m	518±72	519±77	0.93
<i>Anthropometric data</i>			
Body mass index, kg/m ²	26±5	26±5	0.43
Body fat percentage, %	35.6±5	34.5±5	0.085
<i>Psychological data</i>			
EORTC QLQ-C30 functions (/100)			
Health status (quality of life)	57±19	68±15	<0.0001
Functional role	71±25	81±20	0.0009
Emotional state	60±25	74±24	<0.0001
Physical functions	77±17	85±14	0.0001
Cognitive functions	64±26	74±24	0.0051
Social functions	68±29	78±25	0.0067
EORTC QLQ-C30 symptoms (/100)			
Fatigue	50±27	35±25	<0.0001
Nausea and vomiting	5±11	3±10	0.23
Pain	40±27	27±26	0.0005
Dyspnea	34±31	22±27	0.0039
Insomnia	53±33	40±33	0.0054
Loss of appetite	11±22	6±17	0.087
Constipation	17±25	17±26	0.84
Diarrhea	11±22	3±11	0.0021
Financial difficulties	29±35	12±25	<0.0001

FUNCTIONAL CAPACITY

The evolution of functional capacity variables between M0 and M3 are listed in Table III. At M3, trunk extensor flexibility was significantly improved in the experimental group only and changes between M0 and M3 were significantly different between groups ($P < 0.0001$), in favor of the experimental group.

About the maximal incremental exercise protocol, we observed, in the experimental group, significant improvement of Vo_{2peak} , MAP and time to exhaustion. In the control group, none of these parameters significantly changed, on the contrary, the MHR decreased significantly. Just like for flexibility, all changes in this test between M0 and M3 were significantly different between the groups and again in favor of the experimental group ($P = 0.0015$ for Vo_{2peak} and $P < 0.0001$ for PMA and for time to exhaustion).

The distance traveled in six minutes was significantly increased in both groups, but more in the experimental group than in the control group and the evolution between M0 and M3 was again significantly different between groups, with a greater evolution in the experimental group ($P = 0.0002$).

BMI AND BODY FAT PERCENTAGE

Table IV presents the changes in body composition between M0 and M3. At M3, we observed that the BMI and the body fat percentage increased significantly in the control group. In the experimental group, the BMI did not change significantly, but the body fat percentage decreased significantly. Moreover, the change in this variable between M0 and M3 was significantly different between groups ($P = 0.0029$) and once more, in favor of the experimental group.

TABLE III.—*Functional capacity between M0 and M3.*

Variable	Experimental group	Control group	p
	$\Delta(M3-M0)$ Mean $\pm$ SD	$\Delta(M3-M0)$ Mean $\pm$ SD	
Sit and Reach Test			
Trunk extensor flexibility, cm	3.22 $\pm$ 3.66 *	-0.97 $\pm$ 5.12	<0.0001
Maximal incremental exercise protocol on a cycle ergometer			
Maximal oxygen consumption, mL/min/kg	2.99 $\pm$ 2.54 *	1.03 $\pm$ 4.99	0.0015
	19 $\pm$ 11 *	-1.75 $\pm$ 10	<0.0001
Maximal aerobic power, W	2.1 $\pm$ 11	-3.1 $\pm$ 10 *	0.0025
Maximal heart rate, bpm	2.01 $\pm$ 1.28 *	0.01 $\pm$ 1.09	<0.0001
Time to exhaustion, min			
Six-Minute Walk Test			
Distance, m	43 $\pm$ 48 *	15 $\pm$ 44 *	0.0002

*Significant change (P<0.05) into the group between M0 and M3.

*Significant change ($P<0.05$) into the group between M0 and M3.

TABLE IV.—*Body Mass Index and body fat percentage between M0 and M3.*

Variable	Experimental group	Control group	p
	$\Delta(M3-M0)$ Mean $\pm$ SD	$\Delta(M3-M0)$ Mean $\pm$ SD	
Body Mass Index, kg/m ²	-0.10 $\pm$ 1.01	0.12 $\pm$ 0.49 *	0.075
Body fat percentage, %	-0.45 $\pm$ 2.00 *	0.45 $\pm$ 1.88 *	0.0029

*Significant change ($P<0.05$) into the group between M0 and M3.

TABLE V.—*Quality of life, symptoms and functions from the EORTC QLQ-C30 between M0 and M3.*

Variable	Experimental group	Control group	p
	$\Delta(M3-M0)$ Mean $\pm$ SD	$\Delta(M3-M0)$ Mean $\pm$ SD	
EORTC QLQ-C30 functions (/100)			
Health status (quality of life)	15 $\pm$ 19 *	-0.9 $\pm$ 16	<0.0001
Functional role	11 $\pm$ 26 *	2 $\pm$ 23	0.024
Emotional state	18 $\pm$ 25 *	3 $\pm$ 24	<0.0001
Physical functions	7 $\pm$ 13 *	2 $\pm$ 14	0.020
Cognitive functions	8 $\pm$ 21 *	5 $\pm$ 22 *	0.37
Social functions	11 $\pm$ 28 *	8 $\pm$ 25 *	0.49
EORTC QLQ-C30 symptoms (/100)			
Fatigue	-21 $\pm$ 25 *	-6 $\pm$ 23 *	<0.0001
Nausea and vomiting	-1 $\pm$ 13	0 $\pm$ 11	0.54
Pain	-13 $\pm$ 24 *	2 $\pm$ 24	<0.0001
Dyspnea	-9 $\pm$ 32 *	-3 $\pm$ 22	0.13
Insomnia	-18 $\pm$ 32 *	-7 $\pm$ 28 *	0.018
Loss of appetite	-6 $\pm$ 23 *	-0.4 $\pm$ 19	0.086
Constipation	-6 $\pm$ 22 *	-3 $\pm$ 19	0.37
Diarrhea	-5 $\pm$ 22 *	2 $\pm$ 16	0.015
Financial difficulties	-8 $\pm$ 29 *	-4 $\pm$ 23	0.41

*Significant change ($P<0.05$) into the group between M0 and M3.

QUALITY OF LIFE, SYMPTOMS AND FUNCTIONS FROM THE EORTC QLQ-C30

Table V lists the items of the EORTC QLQ-c30 and their changes between M0 and M3. As a reminder, for functions, the higher the score, the better is the quality of life and for symptoms, the higher the score, the worst is the quality of life. After three months, in the control group, significant improvement was observed with respect to only cognitive and social functions and to fatigue and insomnia. In the experimental group, all functions were significantly improved: health status, functional role, emotional state and physical, cognitive and social functions. About symptoms, we observed a significant decrease in fatigue, pain, dyspnea, insomnia, loss of appetite, constipation, diarrhea and financial difficulties. Concerning the evolution between M0 and M3, a significant difference was observed between groups for health status ($P<0.0001$), functional role ($P=0.024$), emotional state ($P<0.0001$), physical functions ($P=0.020$), fatigue ($P<0.0001$), pain ($P<0.0001$), insomnia ($P=0.018$) and diarrhea ($P=0.015$).

Discussion

Various clinical trials^{4, 20, 21} show the benefits of a physical training offered during and/or after breast cancer treatment, but few studies evaluate the benefits of a multidisciplinary approach comprising a physical reconditioning and psycho-educational sessions. Moreover, they are rarely carried out on a large sample of patients with exhaustive assessments on physical capacity, body composition and quality of life.

Therefore, the aim of this study was to demonstrate the feasibility and benefits of this kind of multidisciplinary rehabilitation in women having been treated for breast cancer. Results indicate that participants receiving the 3-month intervention significantly improved trunk extensor flexibility measured by the Sit and Reach test, VO_{2peak} , MAP and time to exhaustion during the maximal incremental exercise protocol and walking distance at the 6MWT. Their BMI was unchanged, their body fat percentage was significantly decreased and most of their EORTC QLQ-C30 parameters improved significantly: health status (quality of life), functional role, emotional state, physical, cognitive and social functions and symptoms of fatigue, pain, dyspnea, insomnia, loss of appetite, constipation, diarrhea and financial difficulties. In the control group, most of these improvements did not appear and moreover, a significant increase in BMI and body fat percentage was observed.

In the experimental group, the values of MAP, VO_{2peak} and time to exhaustion, following the rehabilitation, appear significantly increased and the results approach reference values.^{28, 29} Courneya *et al.*,³⁰ with a similar experimental protocol and substantially identical values to those mentioned in our work, especially with, for example, an improvement of VO_{2peak} of 2.7 ± 2.6 mL/min/kg within their experimental group (compared to an improvement of 2.99 ± 2.54 mL/min/kg in our study), confirms the benefits observed and therefore, the benefits of appropriate care on functional capacity after breast cancer.

Other studies have also evaluated the effect of training on cardiopulmonary function. Indeed, in the discussion of the rules of conduct about physical training among cancer survivors,⁴ the ACSM presents three randomized controlled clinical trials (RCTs) with a workout during adjuvant treatments³¹⁻³³ and

six in which the training takes place after the treatments.³⁴⁻³⁹ All observed a significant improvement in cardiopulmonary function. All these data corroborate thus the observations made in our study.

With respect to anthropometric and body composition measurements at M3, we observed that the values of the experimental group stayed identical or even slightly decreased for the BMI and significantly decreased for the body fat percentage in contrast to the control group whose values significantly increased. Similar results were observed in three studies^{30, 40, 41} cited by the systematic review of McNelly *et al.*²⁰ The randomized controlled trial of Schmitz *et al.*⁴¹ especially observed a significant decrease in the percentage of body fat in his experimental group and even higher than that observed in our study ($-1.15 \pm 0.45\%$ vs. $-0.45 \pm 2.00\%$). This may be due to the fact that their training involved only weight training during six months, as opposed to ours, which also included endurance training but only during three months. The ACSM⁴ also exposes other studies examining the effect of exercises, during treatments or after them, on body composition and body weight. The observed effects vary and therefore show, as in our research, few significant change, but also no further weight gain with care. A multidisciplinary approach, including physical training and sound advice about diet, could therefore help stabilizing body weight after treatments for breast cancer and prevent weight gain observed in the absence of intervention.

About the EORTC QLQ-C30 after the three-month follow-up, we observed few significant modifications in the control group (who had better data initially) unlike the experimental group in which a significant improvement in all functions and in most symptoms was present. Compared to the standards obtained for a healthy female population of the same average age,⁴² we thus observed that the values of the experimental group, after the program, tend to get closer. Indeed, at the end of the three months of follow-up, the score of health status (quality of life) for example is 73 ± 17 in our experimental group (following the increase of 15 ± 18) and the standard value is 77 ± 21 . Thus, these results show the benefit of this kind of rehabilitation, including a physical training and psycho-educational sessions, on the quality of life of patients, on their psychological, emotional and physical well-being and on their symptomatology.

Health status (or quality of life) improvement, as a result of a rehabilitation program, was also evaluated in other studies, especially in the study of Courneya *et al.*³⁰ In this study, as in ours, the overall quality of life was significantly improved in the treated group after the intervention.

The ACSM also presents six other RCTs showing the beneficial effects of physical activity only performed after the treatments on quality of life^{34-36, 43-45} against two having no effect.^{37, 46} However, these two studies evaluated the effect of a very different intervention. Indeed, Demark-Wahnefried *et al.*,⁴⁶ for example, assessed the effect of a ten-month program in which only documents promoting physical activity were sent to the participants.

The feeling of the improvement of the different functions and symptoms observed in the experimental group in our study may be correlated with the physical improvement objectified through functional assessments. Moreover, the psycho-educational sessions probably gave many tips to participants allowing them to better manage stress and daily activities, balance their diet, better control their pain, improve their sleep and thus reduce their fatigue. Finally, the meeting of other people and the group cohesion certainly allowed patients to regain confidence and maybe helped to a reintegration into the

social, professional and family environments. The multidisciplinary approach seems to be necessary to improve all variables touched by breast cancer and its treatments.

LIMITATIONS OF THE STUDY

Finally, it is important to consider the strengths and limits of our study.

On the one hand, a first strength of our study is the large sample size. Indeed, two hundred and nine voluntary women meeting inclusion criteria were included. A second strength is the exhaustive assessments with validated measures and covering the areas of physical capacities, body composition and functions, symptoms and quality of life. Few studies focuses on all these aspects. We also note the multidisciplinary care with supervised exercises and rigor in conducting assessments.

On the other hand, the most important weakness is that our study was not randomized and that there were differences between groups baseline, not about biometric, functional and anthropometric data, but about aspects of quality of life (the experimental group is more symptomatic than the control group). We must take this into account in the interpretation of our results. Finally, a minor weakness is that we do not know which aspect of the multidisciplinary program, the physical training or the psycho-educational sessions, provided most benefits.

Conclusions

Although our results should be interpreted with caution, in summary, they demonstrate the benefits of a well detailed multidisciplinary rehabilitation program, including physical re-conditioning and psycho-educational sessions, with important improvements in functional capacity and the majority of functions and symptoms among women who have been treated for breast cancer. Moreover, the breast cancer survivors who received the intervention in this study, not only improved their fitness and their quality of life, but also stabilized their BMI and decreased significantly their body fat percentage. Future research is needed on the effects of exercise and psychoeducational sessions on patients with and survivors of cancer other than breast cancer. It will be important to assess whether this multidisciplinary program can be readily translated to other cancer populations (*i.e.* bowel, lung etc.). In addition, studies show beneficial effects of a program carried out during adjuvant therapies and after, it would be necessary to determine the optimal time of care. Finally, extended follow ups are needed to determine whether the improvements made by the rehabilitation persist over time.

References

1. Ghoncheh M, Mirzaei M, Salehiniya H. Incidence and mortality of breast cancer and their relationship with the human development index (HDI) in the World in 2012. *Asian Pac J Cancer Prev* 2015;16:8439-43.
2. Renard F, Van Eycken L, Arbyn M. High burden of breast cancer in Belgium: recent trends in incidence (1999-2006) and historical trends in mortality (1954-2006). *Arch Public Heal* 2011;69:2.
3. Wilmoth MC, Coleman EA, Smith SC, Davis C. Fatigue, weight gain, and altered sexuality in patients with breast cancer: exploration of a symptom cluster. *Oncol Nurs Forum* 2004;31:1069-75.
4. Schmitz KH, Courneya KS, Matthews C, Demark-Wahnefried W, Galvão DA, Pinto BM, *et al.* American college of sports medicine roundtable on exercise guidelines for cancer survivors. *Med sci Sports Exerc* 2010;42:1409-26.
5. Shapiro CL, Recht A. Side Effects of Adjuvant Treatment of Breast Cancer. *N Engl J Med* 2001;344:1997-2008.

6. de Jong N, Candel MJJM, Schouten HC, Abu-Saad HH, Courtens AM. course of mental fatigue and motivation in breast cancer patients receiving adjuvant chemotherapy. *Ann Oncol* 2005;16:372-82.
7. Tchen N, Juffs HG, Downie FP, Yi QL, Hu H, Chemerynsky I, *et al.* Cognitive function, fatigue, and menopausal symptoms in women receiving adjuvant chemotherapy for breast cancer. *J Clin Oncol* 2003;21:4175-83.
8. De Jong N, Courtens AM, Abu-Saad HH, Schouten HC. Fatigue in patients with breast cancer receiving adjuvant chemotherapy: a review of the literature. *Cancer Nurs* 2002;25:283-97.
9. Broderick JM, Hussey J, Kennedy MJ, O'Donnell DM. Testing the "teachable moment" premise: does physical activity increase in the early survivorship phase? *Support Care Cancer* 2014;22:989-97.
10. Garabeli Cavalli Kluthcovsky A, Urbanetz A, de Carvalho D, Pereira Maluf E, Schlickmann Sylvestre G, Bonatto Hatschbach S. Fatigue after treatment in breast cancer survivors: prevalence, determinants and impact on health-related quality of life. *support care cancer* 2012;20:1901-9.
11. Shah C, Vicini FA. Breast cancer-related arm lymphedema: Incidence rates, diagnostic techniques, optimal management and risk reduction strategies. *Int J Radiat Oncol Biol Phys* 2011;81:907-14.
12. Rietman JS, Dijkstra PU, Debreczeni R, Geertzen JHB, Robinson DPH, De Vries J. Impairments, disabilities and health related quality of life after treatment for breast cancer: a follow-up study 2.7 years after surgery. *Disabil Rehabil* 2004;26:78-84.
13. Merchant CR, Chapman T, Kilbreath SL, Refshaug KM, Krupa K. decreased muscle strength following management of breast cancer. *Disabil Rehabil* 2008;30:1098-105.
14. So WKW, Marsh G, Ling WM, Leung FY, Lo JCK, Yeung M, *et al.* Anxiety, depression and quality of life among Chinese breast cancer patients during adjuvant therapy. *Eur J Oncol Nurs* 2010;14:17-22.
15. Bower JE, Ganz PA, Desmond KA, Rowland JH, Meyerowitz BE, Belin TR. Fatigue in Breast Cancer Survivors: occurrence, correlates, and impact on quality of life. *J Clin Oncol* 2000;18:743-53.
16. Minton O, Stone P. How common is fatigue in disease-free breast cancer survivors? a systematic review of the literature. *breast cancer Res Treat* 2008;112:5-13.
17. Irwin ML, Crumley D, McTiernan A, Bernstein L, Baumgartner R, Gilliland FD, *et al.* Physical activity levels before and after a diagnosis of breast carcinoma: The health, eating, activity, and lifestyle (HEAL) study. *Cancer* 2003;97:1746-57.
18. Valenti M. Physical Exercise and Quality of Life in Breast Cancer Survivors. *Int J Med Sci* 2008;5:24.
19. Humpel N, Iverson DC. Depression and quality of life in cancer survivors: is there a relationship with physical activity? *int J behav Nutr phys act* 2007;4:65.
20. McNeely ML, Campbell KL, Rowe BH, Klassen TP, Mackey JR, courneya Ks. Effects of exercise on breast cancer patients and survivors: a systematic review and meta-analysis. *cMaj* 2006;175:34-41.
21. Egan MY, McEwen S, Sikora L, Chasen M, Fitch M, Eldred s. rehabilitation following cancer treatment. *disabil rehabil* 2013;35:2245-58.
22. Wells KF, Dillon EK. The sit and reach: a test of back and leg flexibility. *Res Q* 1952;23:115-8.
23. Crapo RO, Casaburi R, Coates AL, Enright P, MacIntyre NR, McKay RT, *et al.* ATS Statement : Guidelines for the Six-Minute Walk Test. *am J respir crit care Med* 2002;166:111-7.
24. Durnin JVGA, Womersley J. Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 years. *Br J Nut* 1973;32:77-97.
25. Aaronson N, Ahmedzai S, Bergman B, Bullinger M, Cull A, Duez NJ, *et al.* The European organization for research and treatment of cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology. *J Natl Cancer Inst* 1993;85:365-76.
26. McLachlan SA, Devins GM, Goodwin PJ. Validation of the European organization for research and treatment of cancer quality of life questionnaire (LQ-C30) as a measure of psychosocial function in breast cancer patients. *Eur J Cancer* 1998;34:510-7.
27. Wolin KY, Schwartz AL, Matthews CE, Courneya KS, Schmitz KH. Implementing the Exercise Guidelines for cancer survivors. *J support oncol* 2012;10:171-7.
28. Fletcher GF, Balady GJ, Amsterdam EA, Chaitman B, Eckel R, Fleg J, *et al.* Exercise standards for testing and training: a statement for healthcare professionals from the american heart association. *circulation* 2001;104:1694-40.
29. Bovens AM, van Baak MA, Vrencken JG, Wijnen JA, Saris WH, Verstappen ft. Maximal aerobic power in cycle ergometry in middleaged men and women, active in sports, in relation to age and physical activity. *Int J Sports Med* 1993;14:66-71.
30. Courneya KS, Mackey JR, Bell GJ, Jones LW, Field CJ, Fairey AS. randomized controlled trial of exercise training in postmenopausal breast cancer survivors: cardiopulmonary and quality of life outcomes. *J Clin Oncol* 2003;21:1660-8.
31. Campbell A, Mutrie N, White F, McGuire F, Kearney N. A pilot study of a supervised group exercise programme as a rehabilitation treatment for women with breast cancer receiving adjuvant treatment. *Eur J Oncol Nurs* 2005;9:56-63.
32. Mock V, Dow KH, Meares CJ, Grimm PM, Dienemann JA, HaisfieldWolfe ME, *et al.* Effects of exercise on fatigue, physical functioning, and emotional distress during radiation therapy for breast cancer. *oncol Nurs Forum* 1997;24:991-1000.
33. Schwartz AL, Winters-Stone K. Effects of a 12-month randomized controlled trial of aerobic or resistance exercise during and following cancer treatment in women. *Phys Sportsmed* 2009;37:62-7.
34. Basen-Engquist K, Taylor CLC, Rosenblum C, Smith MA, Shinn EH, Greisinger A, *et al.* randomized pilot test of a lifestyle physical activity intervention for breast cancer survivors. *Patient Educ couns* 2006;64:225-34.
35. Daley AJ, Crank H, Saxton JM, Mutrie N, Coleman R, Roalfe A. randomized trial of exercise therapy in women treated for breast cancer. *J clin oncol* 2007;25:1713-21.
36. Herrero F, San Juan AF, Fleck SJ, Balmer J, Pérez M, Cañete S, *et al.* combined aerobic and resistance training in breast cancer survivors: A randomized, controlled pilot trial. *Int J Sports Med* 2006;27:573-80.
37. Thorsen L, Skovlund E, Strømme SB, Hornslien K, Dahl AA, Fosså SD. Effectiveness of physical activity on cardiorespiratory fitness and health-related quality of life in young and middle-aged cancer patients shortly after chemotherapy. *J Clin Oncol* 2005;23:2378-88.
38. Pinto BM, Clark MM, Maruyama NC, Feder SI. Psychological and fitness changes associated with exercise participation among women with breast cancer. *Psychooncology* 2003;12:118-26.
39. Nikander R, Sievänen H, Ojala K, Oivanen T, Kellokumpu-Lehtinen P-L, Saarto T. Effect of a vigorous aerobic regimen on physical performance in breast cancer patients - a randomized controlled pilot trial. *Acta Oncol* 2007;46:181-6.

40. Segal R, Evans W, Johnson D, Smith J, Colletta S, Gayton J, *et al.* structured exercise improves physical functioning in women with stages i and ii breast cancer: results of a randomized controlled trial. *J Clin Oncol* 2001;19:657-65.
41. Schmitz KH, Ahmed RL, Hannan PJ, Yee D. Safety and Efficacy of Weight Training in Recent Breast Cancer Survivors to Alter Body Composition , Insulin , and Insulin-Like Growth Factor Axis Proteins. *Cancer Epidemiol Biomarkers Prev* 2005;14:1672-80.
42. Michelson H, Bolund C, Nilsson B, Brandberg Y. Health-related quality of life measured by the EORTC QLQ-C30 - reference values from a large sample of swedish population. *acta oncol (Madr)* 2000;39:477-84.
43. Cho OH, Yoo YS, Kim NC. Efficacy of comprehensive group rehabilitation for women with early breast cancer in south Korea. *Nurs Heal Sci* 2006;8:140-6.
44. Ohira T, Schmitz KH, Ahmed RL, Yee D. Effects of weight training on quality of life in recent breast cancer survivors: the weight training for breast cancer survivors (WTBS) study. *Cancer* 2006;106:2076-83.
45. Vallance JKH, Courneya KS, Plotnikoff RC, Yasui Y, Mackey JR. randomized controlled trial of the effects of print materials and step pedometers on physical activity and quality of life in breast cancer survivors. *J Clin Oncol* 2007;25:2352-9.
46. Demark-Wahnefried W, Clipp EC, Lipkus IM, Lobach D, Snyder DC, Sloane R, *et al.* Main outcomes of the FRESH START trial: a sequentially tailored, diet and exercise mailed print intervention among breast and prostate cancer survivors. *J Clin Oncol* 2007;25:2709-18.