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ORIGINAL ARTICLE

Water versus land-based multimodal exercise program effects on body composition in breast cancer survivors: a controlled clinical trial

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Abstract
Goals of work Our aim was to compare the effects of land versus water multimodal exercise programs on body composition and breast cancer-specific quality of life in breast cancer survivors.
Patients and methods Ninety-eight breast cancer survivors were assigned to three groups: control, land exercise, and water exercise. Both exercise groups participated in an 8-week multimodal program. Adiposity was measured by anthropometry (body mass index, waist circumference) and bioelectrical impedance (body fat and muscle lean body mass). Incidence of clinically significant secondary lymphedema was also assessed. Finally, specific quality of life was assessed using the European Organization for Research and Treatment of Cancer Quality of Life BR-23.
Main Results Using ANCOVA, significant group × time interactions for body fat percentage (F=3.376; P=0.011) and lean body mass (F=3.566; P=0.008) were found. Breast cancer survivors in the land exercise group exhibited a greater decrease in percentage of body fat than those in the water exercise (P<0.001) and control (P=0.002) groups. The ANCOVA revealed a significant group × time interaction for waist circumference (F=4.553; P=0.002): breast cancer survivors in the control group showed a greater waist circumference when compared to water (P=0.003) and land (P<0.001) exercise groups. A significant group × time interaction was also found for breast symptoms (F=9.048; P<0.001): participants in the water exercise group experienced a greater decrease of breast symptoms than those in the land exercise (P<0.01) and control (P<0.05) groups.
Conclusion Land exercise produced a greater decrease in body fat and an increase in lean body mass, whereas water exercise was better for improving breast symptoms.

Keywords Breast cancer · Exercise · Body composition · Quality of life

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Introduction

Evidence suggests that women who gain weight after breast cancer diagnosis may be at increased risk of poor outcomes [22]. In fact, obese women with breast cancer have a 30 % higher risk of breast cancer-related mortality [34]. This data stimulated the implementation of interventions aimed to improve body composition in breast cancer survivors based on mixed interventions of dietary control and exercises [20, 30]. Different meta-analyses have reported that physical activity is

associated with significant reduction in body mass index and body weight in patients who have completed treatment for cancer [13, 36]. However, there is not clear evidence on which type of exercise modality is more feasible and efficient for improving body composition in breast cancer survivors.

Subgroups of breast cancer survivors have demonstrated various cancer-related symptoms such as reduced shoulder–neck mobility [31], shoulder–neck pain [12], and fatigue [9]. These cancer-related symptoms are intricately associated [12] causing functional limitations such as decreased levels of physical activity and weight gain [46]. Preliminary evidence supports the objective of maintaining high pre-diagnosis physical activity levels and a healthy body for better quality of life after breast cancer [45]. Therefore, studies investigating the most appropriate exercise programs which improve body composition and quality of life in breast cancer survivors are necessary.

Various studies have investigated the effects of different exercises modalities on body composition in breast cancer survivors during their rehabilitation phase. Exercise interventions including 150–225/min of moderate-to-vigorous aerobic exercise per week [18] or weight training [32] have been shown to improve body composition. In contrast, no significant changes in body composition have been observed after unsupervised light to moderate aerobic exercise interventions [26], resistance exercise [12], or mixed strength and endurance exercise interventions [23]. Due to these controversial findings, experts have concluded that evidence on the effects of exercise on body composition of breast cancer survivors is inconsistent [15].

Exercise in water has become increasingly popular. In fact, therapeutic aquatic exercise appears to be a safe and effective treatment modality for pain [19] and reduced mobility [15]. Water immersion decreases axial loading and, through the effects of buoyancy, allows performance of movement that may be difficult or impossible on land [4]. By using the unique properties of water (buoyancy, resistance, flow, and turbulence), a progressive exercise program from assisted to resisted movements can be created for breast cancer survivors. While the appearance or aggravation of lymphedema may reduce adherence to water exercise programs, previous studies have shown an immediate improvement [42] in cancer-related lymphedema after water exercise.

It seems that the use of water exercise in the treatment of breast cancer survivors has received only anecdotal attention. To the best of the authors' knowledge, there are no studies comparing the effects of specific water-based and land-based exercise programs in breast cancer survivors. The purpose of the current study was to examine whether the combination of both resistance and aerobic exercise is more effective when performed either on land or in water. Therefore, we investigated the effects of these multimodal exercise programs on body composition and breast cancer-specific quality of life.

Methods and procedures

Participants

Breast cancer survivors recruited from the Breast Oncology Unit Hospital Virgen de las Nieves (Granada, Spain) from December 2009 to June 2011 gave their written informed consent prior to participation in the study. Participants were eligible if they (a) had a diagnosis of breast cancer (stage I–IIIA); (b) were between 25–65 years of age; (c) had finished co-adjuvant treatment except hormone therapy; (d) did not have active cancer; and (e) had four to five of the following physical findings, judged by the referring oncologist: neck or shoulder pain symptoms, reduced range of motion in neck–shoulder, reduced physical capacity, increased fatigue, sleep disturbances, or any problem in coping with reduced physical–psychosocial functioning. Participants were excluded if they (a) were receiving chemotherapy or radiotherapy treatment at the time of the study; (b) had chronic or orthopedic disease which did not permit them to follow the physical program; or (c) had uncontrolled hypertension (diastolic pressure > 95 mm Hg).

Study design

The sample size was calculated on an 80 % power to detect a mean difference of 0.7 kg [17] with a standard deviation similar in both treatment groups on the lean body mass outcome, using a type 1 error (α) of 5 % and a type 2 error (β) of 20 %. This power calculation resulted in 33 patients in each group. To accommodate expected dropouts before study completion, a total of 132 participants were invited to participate in this study.

The present study was a controlled clinical trial where participants were assigned to land exercise intervention, water exercise intervention, or usual-care group. For practical and ethical reasons, randomization of the patients was not feasible. We had an ethical obligation with patients who had participated as a control group in a previous study [8] to provide actual treatment. Nevertheless, due to limited resources, we created a waiting list. Therefore, patients from this waiting list agreed to be part of the usual-care group (control group) and were offered the intervention program at the end of the follow-up period. Data collected during the control period were included in the current analysis. Since the aim of the study was focused in the effects of exercise, all participants were informed about health effect of adequate and sensible diets, but we did not recommend a caloric restriction during the study. All outcomes measures were assessed at baseline, 1 week after the intervention and at 6 months after discharge by an assessor blinded to the treatment received by the patient.

The research protocol was reviewed and approved by the Ethics Committee of the Hospital Virgen de las Nieves (Granada, Spain) following the ethical guidelines of the Declaration of Helsinki.

Land exercise program

The exercise program was based on previous guidelines for cancer survivors [37] and general population [28]. The program objectives were to improve health status with minimal risk of injury, and provide sufficient knowledge about dose, execution, and intensity of the physical activity undertaken during the time period of the program. This supervised program consisted of 60-min sessions, three times a week, over 8 weeks. The program was supervised by a fitness specialist and by two physical therapists with clinical experience in the management of patients with various cancer conditions.

During 40–50 % of each 60-min exercise session, the training intensity was kept within 60 % of the maximum heart rate for the age of each breast cancer survivor. A pulse watch recorder monitored the heart rate at least twice during the whole exercise period, and the exercise intensity was found to be within the desired limits. Furthermore, participants were instructed to control training intensity by the rate of perceived exertion based on Borg's scale. The intensity of the resistance exercises was gradually increased as the parameters set for each exercise included two to three sets of 8–12 repetitions. All sessions were done in a gymnastic hall with a controlled normal room temperature and a wooden floor. After finishing the 8-week supervised multimodal program, participants received an instructional DVD with the same exercise program.

Water exercise group

A modified version of the land exercise program (Table 1) adapted to the restrictions imposed by water was used for this group. The training intensity and muscle groups used were as similar as possible to the land exercise group. The water exercise group trained in a swimming pool with a water temperature of 30–32 °C. The duration of the exercise programs was selected because most investigators agree that a minimum 8-week intervention is necessary for training effects to occur in physiological variables such as body weight or body composition [29].

Usual-care group

These participants followed usual care recommended by their oncologist in relation to a healthy lifestyle. Breast cancer survivors received a document printable dossier from the oncologist where they found recommendations related to nutrition, lifestyle behaviors, and exercise.

Body composition outcomes

We conducted a bioelectrical impedance analysis with an eight polar tactile-electrode impedanciometer (InBody 720, Biospace). Weight (in kilograms) was measured, and body fat percentage and lean muscle mass (in kilograms) were estimated. Validity of this instrument has been reported elsewhere [25]. Height (in centimeters) was measured using a stadiometer (Seca 22, Hamburg, Germany). Body mass index was calculated: weight (in kilograms) divided by height (in square meters). Waist circumference (in centimeters) was measured twice with a tape measure (Gulick; Creative Health Products, Ann Arbor, MI, USA; range 0–150 cm) at a midpoint between the lower border of the ribs and the upper border of the iliac crest.

Upper limb swelling

Circumferential tape measurements of the forearm at 5 and 10 cm below the distal border of the lateral epicondyle of the humerus were obtained to determine the presence of lymphedema. This method is highly correlated (r=0.91) with the volume displacement method [33].

Quality of Life questionnaire

To assess specific quality of life in breast cancer, we used the Spanish version of European Organization for Research and Treatment of Cancer Breast Cancer-Specific Quality of Life questionnaire (EORTC QLQ-BR23) [43]. It consists of 23 items rated on a four-point scale ranging from 1 (not at all) to 4 (very much). The items assess therapy side effects, arm symptoms, breast symptoms, body image, and sexual functioning. Additionally, there are single items assessing sexual enjoyment, anxiety caused by hair loss, and future outlook. Scores range between 0–100 points. For scales evaluating function, a higher score represents a higher level of functioning. For scales evaluating symptoms, a higher score indicates more severe symptoms.

Statistics

Statistical analysis was performed using SPSS statistical software, version 19.0, and it was conducted following intention-to-treat analysis. Participants who dropped out before the completion of the study were asked to return for post-testing. When post-intervention data were missing, baseline scores of each patient were used. A one way ANOVA, chi-square, and Kruskal-Wallis tests were used to examine the differences in baseline socio-demographic and medical features between included and excluded patients, as well as between participants who completed the study and those who dropped out. Differences between adherences to the program in the two exercise groups were tested using an ANOVA test.

The main analysis examined whether differences (mean differences) at baseline, 8 weeks, and 6 months of follow-up existed between land exercise, water exercise, and control

Table 1 Description of exercise programs

			Water group	Land group
Week 1–4		Materials	Pool noodles and swimming belt	Small soft ball, mats and fit-ball
Main goal: improving overall fitness	10 min	Warm-up	Aerobic games, mobility and stretching exercises	Aerobic games, mobility and stretching exercises
	30–40 min	Aerobic exercise	Unspecific work during sessions	Unspecific work during sessions
		Strength exercise	Exercise program to develop strength using water resistance.	Exercise program to develop strength without weight.
			Medium velocity execution exercises and increase range of joint motion	Medium velocity execution exercises and increase range of joint motion
	10 min	Cool-down	Stretching, breathing and visualization exercises	Stretching, breathing and visualization exercises
Week 5–8		Materials	Pool noodles, pull buoy, swimming board	Fit-ball, elastic band, mats, and small soft ball
Main goal: specific training for improve aerobic, mobility and endurance conditions	10 min	Warm-up	Aerobic games, mobility and stretching exercises	Aerobic games, mobility, and stretching exercises
	30-40 min	Aerobic exercise	5-10 min of slow aerobic exercise (aqua running or swim)	10–25 min of fast working with arms movement two days per week
		Strength exercise	Exercise program to develop strength. Increase resistance with different materials and positions that require more body control.	Exercise program to develop strength. Increase resistance with different materials and positions that require more body control
	10 min	Cool-down	Stretching, mobility and massage in pairs	Stretching, mobility, and massage in pairs

groups in all outcomes. A 3×3 mixed-model repeated measure analysis of co-variance (ANCOVA) with time (baseline, after intervention, 6 months follow-up) as the within-subjects variable, intervention (land exercise, water exercise, and control group) as the between-subjects variable and baseline values of physical activity and studied variables, age, civil status, educational level, and clinical features, including type of hormone therapy, as covariates was used to examine the effects of the intervention on each variable. Separate ANCOVAs were conducted with each outcome as the dependent variable. The hypothesis of interest was intervention × time interaction. If a significant interaction was identified, planned pairwise comparisons (Bonferroni correction) were done to examine differences from baseline to post-intervention/follow-up among groups to investigate if any between-group differences were statistically significant. A $P<0.05$ was considered statistically significant.

Results

During the study period 132 patients with cancer agreed to attend the pre-screening. No differences in socio-demographic and medical features existed between the 98 patients (73 %) included and the 36 patients who were excluded or declined to participate. Participants who completed the study did not show differences in baseline scores on demographic and clinical outcomes (Table 2). Any subject who reported the beginning of a restriction caloric regimen during the study was excluded. Program's adherence was calculated as a proportion of exercise sessions completed relative to the number of sessions of the program. High adherence was considered 75 % for the overall study duration. No differences were shown between groups in program adherence at discharge (land exercise group = 84.8 % vs water exercise group = 91.9 %; $P=0.292$).

Effects of land and water exercise programs in body composition

The ANCOVA revealed a significant group × time interaction for body fat percentage ($F=3.376$; $P=0.011$). Pairwise comparisons revealed that those breast cancer survivors within the land exercise group exhibited a greater decrease of percentage of body fat than those within the water exercise ($P<0.001$) and control ($P=0.002$) groups both after treatment and at 6 months follow-up period (Fig. 1).

The ANCOVA found a significant group × time interaction for lean body mass ($F=3.566$; $P=0.008$): breast cancer survivors who received the land exercise program showed a greater increase of lean body mass as compared to those receiving the water exercise ($P<0.001$) and control ($P=0.009$) groups both after treatment and at 6 months follow-up period (Fig. 2).

A significant group × time interaction was also found for waist circumference ($F=4.553$; $P=0.002$). Pairwise

Table 2 Patient's characteristics and comparisons among the breast cancer survivor groups

Variable	Control (n=34)	Land exercise (n=31)	Water exercise (n=33)	P value
Age (year), mean (SD)	48 (8)	49 (8)	48 (7)	0.680
Time post-treatment, n (%)				
<12 months	26	21	28	0.145
>12 months	8	10	5	
Civil status, n (%)				
Married	22	21	25	0.511
Unmarried	6	4	5	
Divorced	6	6	3	
Educational level, n (%)				
Low	14	11	12	0.520
Medium	7	6	11	
University level	13	14	10	
Tumor stage, n (%)				
I	15	5	13	0.085
II	15	21	13	
IIIA	4	5	7	
Type of surgery, n (%)				
Tumerectomy	22	21	23	0.903
Mastectomy	12	10	10	
Hormone therapy				
Tamoxifen	12	12	15	0.102
Inhibitors aromatase	14	15	10	
Non treatment	8	4	8	
Physical activity[a] (h per week)	1.81±1.40 (95 % CI 2.04–3.26)	2.03±1.49 (95 % CI 1.48–2.58)	2.65±1.72 (95 % CI 2.04–3.26)	0.109

P values for comparisons among group based on chi-square and analysis of variance tests (ANOVA, P>0.05)

[a]P values for comparison among group based on Kruskall–Wallis test (P>0.05)

comparisons revealed an increase of waist circumference in control group as compared to the water (P=0.003) and land (P<0.001) exercise groups after treatment. No differences between the two exercises groups (P=0.992) were found after treatment (Fig. 3). Using ANCOVA, no significant group × time interactions for body weight (F=1.055; P=0.381) and body mass index (F=1.871; P=0.161; Table 3) were found.

Effects of land and water exercise programs in the forearm circumference

A significant group × time interaction for 5-cm forearm circumference on the affected side was shown (F=3.290; P=0.019): patients within the land exercise group showed a greater decrease (P=0.024) of 5-cm forearm circumference on the affected side compared to those in the water exercise

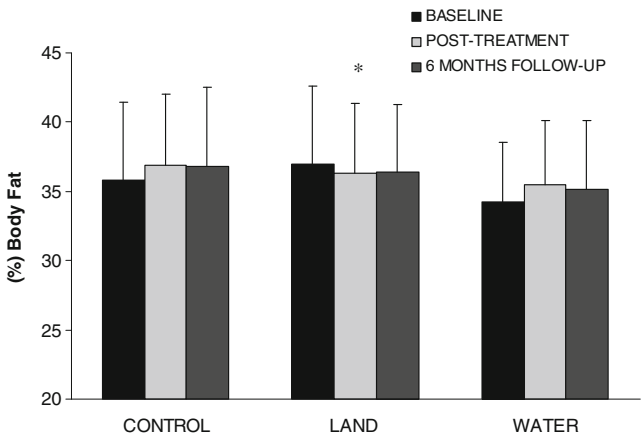

Fig. 1 Percentage body fat . *Asterisk* P<0.05 post hoc Bonferoni comparison

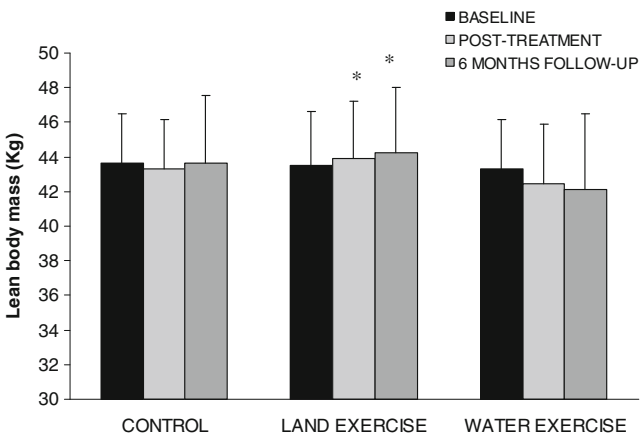

Fig. 2 Lean body mass (in kilograms). *Asterisk* P<0.05 post hoc Bonferoni comparison

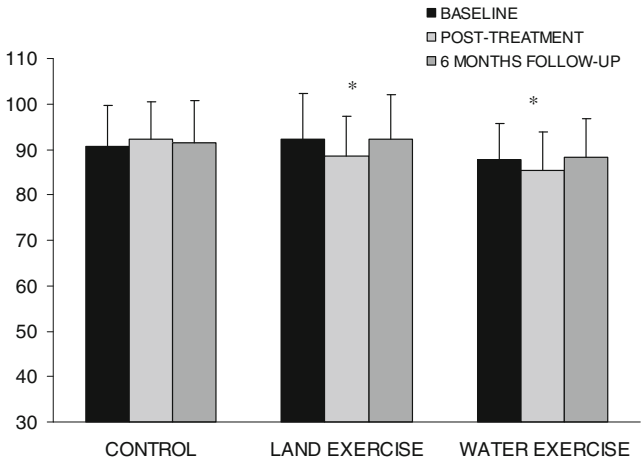

Fig. 3 Waist Circunference (in centimeters). *Asterisk* $P<0.05$ post hoc Bonferoni comparison

group after treatment (Table 3). No group × time interaction for 10-cm forearm circumference on the affected side was also reported ($F=2.270$; $P=0.079$).

Effects of land and water exercise programs on quality of life (EORTC QLQBR23)

The ANCOVA demonstrated a significant group × time interaction for breast symptoms ($F=9.048$; $P<0.001$): a greater decrease of breast symptoms were shown in breast cancer survivors receiving the water exercise group as compared to those patients receiving the land exercise ($P<0.01$) and control ($P<0.05$) groups both after treatment and at 6-month follow-up period (Table 4).

No significant group × time interactions for body image ($F=0.642$; $P=0.634$), sexual functioning ($F=1.919$; $P=0.110$), future perspective ($F=1.477$; $P=0.212$), systematic therapy side effects ($F=1.477$; $P=0.212$), and arm symptoms ($F=1.171$; $P=0.326$) were observed.

Discussion

Our study found an improvement in body fat and lean mass in breast cancer survivors who received a land exercise program as compared to breast cancer survivors who received a water exercise program or the group who received usual care. Further, in exercise groups within-group changes were also observed in waist circumference as compared to the control group. Finally, improvement in breast symptoms related to specific quality of life was greater in the water exercise group.

Our results are in agreement with previous studies reporting a favorable effect of land exercises on percentage of body fat [14, 20], especially aerobic interventions which had no effect on lean body mass [10]. Nevertheless, our multimodal land exercise program is closer to a combination of aerobic and resistance exercise getting results in percentage fat and lean body mass [17]. Current results within our multimodal land exercise group, but not within the water group, could confirm the ability of land exercises to reduce

Table 3 Changes in adiposity and the forearm circumference in breast cancer survivors

Moment	Control	Land exercise	Water exercise	*P*
Affected side foream circumference 10 cm (cm)				
Pre-intervention	24.05±2.12	23.61±1.85	23.50±2.28	0.069
Post-intervention	24.15±2.26	23.78 ±1.98	24.11±2.41	
6-month follow-up	24.45±2.14	24.30±1.80	23.84±2.66	
Affected side foream circumference 5 cm (cm)				
Pre-intervention	25.53±1.94	25.65±1.70	25.43±2.26	0.019*
Post-intervention	25.90±2.26	25.27±1.91[a]*	25.75±2.22	
6-month follow-up	25.86±2.10	25.84±1.63[a]*	25.57±2.30	
Waist circunference (cm)				
Pre-intervention	90.57±9.04	92.38±8.26	87.69±9.35	0.001*
Post-intervention	92.14±9.85[a]	88.55±8.61	85.39±9.83	
6-month follow-up	91.39±7.98	92.24±8.53	88.20±8.64	
Weight (kg)				
Pre-intervention	68.27±8.74	69.70±8.84	66.52±10.16	0.381
Post-intervention	68.85±9.50	69.55±8.87	66.40±10.04	
6-month follow-up	69.00±7.36	70.02±8.60	66.31±9.68	
Body mass index (kg × m^{-2})				
Pre-intervention	26.99±3.69	27.34±3.65	26.20±3.66	0.161
Post-intervention	27.29±3.88	27.28±3.71	26.42±3.79	
6-month follow-up	27.36±3.12	27.58±3.42	26.36±3.75	

Mean±standard desviation. *P* derived from ANOVA test

*$P<0.05$

[a]Post hoc comparison

Table 4 Function and symptom scores from EORTC QLQ-BR23 questionnaire in breast cancer survivors

	Control (n=34)	Land exercise (n=31)	Water exercise (n=33)	P
Body Image[a]				
Pre-intervention	59.92±31.32	65.39±31.90	67.70±29.02	0.634
Post-intervention	75.39±26.41	72.32±28.24	79.68±17.95	
6 months follow-up	78.96±27.71	85.71±17.54	84.63±19.29	
Sexual Functioning[b]				
Pre-intervention	64.70±32.21	67.90±28.08	75.75±18.20	0.111
Post-intervention	77.41±20.85	74.07±24.16	72.72±15.48	
6 months follow-up	86.27±23.74	75.30±22.81	74.74±19.14	
Future perspective[c]				
Pre-intervention	39.21±23.30	25.64±16.39	31.48±17.81	0.268
Post-intervention	46.07±22.83	33.33±23.33	48.14±32.31	
6 months follow-up	42.15±31.04	20.51±15.59	48.14±26.02	
Systematic therapy side effects[d]				
Pre-intervention	33.65±19.37	34.98±17.13	32.89±12.28	0.212
Post-intervention	31.94±17.81	29.54±16.62	29.09±15.36	
6 months follow-up	30.79±21.81	25.91±16.55	34.56±13.81	
Breast symptoms[e]				
Pre-intervention	41.66±25.58	43.93±25.99	33.61±19.26	<0.001*
Post-intervention	43.52±21.67	56.14±24.97	16.94[g]*±11.47	
6 months follow-up	30.79±21.81	54.38±22.90	15.83[g]*±10.47	
Arm symptoms[f]				
Pre-intervention	43.88±26.85	47.82±19.65	40.22±23.83	0.326
Post-intervention	46.11±25.58	43.47±15.68	32.56±22.20	
6 months follow-up	41.66±25.58	30.43±31.64	30.65±21.13	

Data are expressed as means ± standard deviations. P derived from ANOVA test

*P<0.05

[a] Five patients missing within the control group, four in land exercise, and three in water exercise

[b] Responses from patients who had been sexually active within the last month: n=17 patients in the control group, 20 in land exercise and 22 in the water exercise

[c] Four patients missing in the control group, six in land exercise, and four in water exercise

[d] Four patients missing in the control group, six missing patient in the land exercise, and five in the water exercise

[e] Five patients missing in the control group, four in land exercise, and three in water exercise

[f] Four missing patients in the control group, six in the land exercise, and five in water exercise

[g] Post hoc comparison

sarcopenic obesity induced in breast cancer survivors [11]. Our land-exercise may be more adequate than water exercise program for increasing muscle mass, thereby increasing muscle anabolism. However, previous studies were performed on land, and there is a lack of data concerning the body composition changes induced after specific water training in breast cancer survivors. In a relevant study including healthy elderly women, a significant decrease (8 %) in skin-fold thickness was reported 3 months after finishing a water-based exercise [41]. It is possible that our water exercise program lacked sufficient duration to obtain some improvements in body composition. Another potential explanation is that it may be more difficult to control the exercise parameters and the intensity in water than on land. Future studies with longer duration and an exhaustive control of exercise parameters are needed to further confirm these results.

Our results also agree with previous studies where subjects participating in exercise maintained body weight, whereas those who did not participate in exercise increased weight [38]. Effects of buoyancy and resistance provided by water increase the energy cost and create an environment that requires high levels of energy which could lead a reduction in body weight with respect to land exercise group which were not confirmed in our study. Longer duration of the supervised intervention that is purposed in our study (8-week) could be needed to obtain significant changes in weight and body mass index as confirmed by a recent meta-analysis [13, 36, 39]. Similarly, we found a reduction in waist circumference in both exercise groups as compared

to the control group which registered an increase. Waist circumference is a proxy measure of abdominal fat mass and a strong predictor of obesity-related morbidity and mortality [35]. Both exercise programs were able to avoid the increase in these parameters observed in the control group probably because moderate-to-vigorous exercise interventions have been associated with reduction of adiposity in breast cancer survivors [24]. Regardless of this, these effects were not maintained at 6 months follow-up period after the exercise program. A more complex intervention combining dietary control with exercise advice may be needed to maintain the benefits of supervised exercise programs on body composition [5].

The land exercise program did not improve specific quality of life which is in agreement with previous studies [2, 7]. Surprisingly, breast cancer survivors receiving water exercise exhibited an improvement in the symptoms scale. Current results are similar to previous studies evaluating specialized exercise modalities such as Tai chi [40] or dance therapy [6]. However, this improvement in the water exercise group was not maintained during the follow-up period generating doubts about the economic efficiency of these types of programs for improving quality of life [16]. One explanation for the improvement in symptoms and absence of body composition changes in the water exercise group may be related to the existence of a more enjoyable and comfortable atmosphere, which may help the patient to focus on pain and movement restriction, thus improving breast symptoms with less effect on another aspects of the program, such as aerobic, which produces more effect on body composition.

An interesting result of the study was that breast cancer survivors performing the multimodal progressive exercise in water or land were less likely to experience increase in arm swelling than breast cancer survivors in the control group. The majority of breast cancer survivors do not develop lymphedema; however, they alter the use of their arms and upper body activities because of fear of developing lymphedema [1]. Our results confirm the findings of previous studies supporting the use of upper quadrant exercise programs [44]. Our data support the use of different forms of exercise in at-risk women with lymphedema when started gradually and increased cautiously [21, 27, 36]. This study may help to clarify clinical advice to breast cancer survivors who have completed cancer treatment on the safety of beginning an aquatic or land multimodal exercise program.

We should recognize some methodological considerations. First, the sample was collected 6 months after discharge; therefore, our results should not be generalized for all breast cancer survivors. Secondly, although we controlled the training load of both exercise programs, diversity is evident in the different modes of exercises. Third, an overestimation of the body composition results may be possible [3], but in our opinion, this topic did not influence the magnitude of changes induced by the exercise programs. Fourth, the fact that this was a controlled trial without randomization process could be considered a limitation of the study, although the observation that there was no significant difference between baseline measurements reduced impact of this limitation. Finally, a mixed intervention with exercise and dietary control is recommended to control body composition in this population, so relevance of these results should be interpreted with caution and incorporated in new studies that determine effectiveness of mixed intervention to control body composition.

In conclusion, multimodal exercise programs combining resistance and aerobic exercise conducted either on land or water are well tolerated by breast cancer survivors. Land exercise produces a decrease in body fat and an increase in lean body mass, and water exercise improves specific breast symptoms suffered by breast cancer survivors.

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Conflict of interest The authors declared no conflict of interest.

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