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EPIDEMIOLOGY

Changes in the Body Image and Relationship Scale following a one-year strength training trial for breast cancer survivors with or at risk for lymphedema

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Abstract The aim of this study was to evaluate the impact of a twice-weekly strength training intervention on perceptions of body image in 234 breast cancer survivors (112 with lymphedema) who participated in the Physical Activity and Lymphedema (PAL) trial. The study population included two hundred and thirty-four women randomly assigned to twice-weekly strength training or control group that completed the 32-item Body Image and Relationships Scale (BIRS) at baseline and 12 months. Percent change in baseline to 12-month BIRS total and subscale scores, upper and lower body strength, and general quality of life (QOL) were compared by intervention status. A series of multiple linear regression models including indicator variables for subgroups based on age, marital status, race, education, BMI, and strength change were used to examine differential intervention impact by subgroup. Strength and QOL variables were assessed as mediators of the intervention effect on BIRS. *Results*: Baseline BIRS scores were similar across intervention and lymphedema status. Significantly greater improvement in BIRS total score was observed from baseline to 12 months in treatment vs. control participants (12.0 vs. 2.0%; $P < 0.0001$). A differential impact of the intervention on the Strength and Health subscale was observed for older women (>50 years old) in the treatment group ($P = 0.03$). Significantly greater improvement was observed in bench and leg press among treatment group when compared to control group participants, regardless of lymphedema. Observed intervention effects were independent of observed strength and QOL changes. Twice-weekly strength training positively impacted self-perceptions of appearance, health, physical strength, sexuality, relationships, and social functioning. Evidence suggests the intervention was beneficial regardless of prior diagnosis of lymphedema. Strength and QOL improvements did not mediate the observed intervention effects.

Keywords Breast cancer survivors · Body image · Strength training · Lymphedema

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Introduction

Body image is a construct impacted by physical and psychological changes experienced as a result of breast cancer treatment. Surgeries leave scars, alter sensation, and may cause shoulder morbidity [1, 2]. Radiation can lead to skin discoloration, dermatitis, and soreness of the treated area [3, 4]. Chemotherapy may result in hair loss and weight gain [5], and hormonal therapies cause early menopause [6], body aches and pains, and vasomotor symptoms [7]. Both externally visible and internal changes resulting from cancer illness and treatment can affect individuals' perceptions of themselves. In adults, the more visible the alteration to the body, the more likely it is to be perceived

as a threat to one's body image [8]. A woman's ability to adjust to breast cancer illness and treatment can be compromised if she is greatly concerned about body image or satisfaction [9]. Further, in a 10-year survival analysis, favorable body image was shown to be associated with a reduced risk of mortality [10].

Body image [11, 12] and other outcomes, including cardiorespiratory fitness [13–16], body composition [15, 17], immune function [18], fatigue [15, 16, 19, 20], and QOL [11, 13–16, 20], have been shown to improve following aerobic exercise interventions for breast cancer survivors. Less is known regarding the impact of resistance or weight training on physiological and psychological outcomes. Prior weight training intervention trials in breast cancer survivors include the Weight Training for Breast Cancer Survivors (WTBS) study and the Supervised Trial of Aerobic Versus Resistance Training (START) study [21, 22]. These studies observed positive changes in body composition and QOL in the weight-lifting group compared to the control group [21–23]. However, the effect of these weight training interventions on body image is unknown. In women without cancer, twice-weekly strength training has been shown to improve body image, attitudes toward physical self, and upper and lower body strength [24]. Study participants expressed an attitude toward internal wholeness rather than feelings toward specific body parts. Rationale for these findings may be the observation that women are motivated to exercise in order to feel good about themselves and not because of their weight [25]. Additionally, functionality and ability of the body to perform tasks are important to one's concept of body image [8]. Therefore, it is reasonable to hypothesize that an increase in muscle strength (which would increase functional ability to perform tasks) might lead to improved perception of body image, as has been demonstrated [24]. Thus, interventions with potential to increase strength may improve perceptions of body image in breast cancer survivors.

In prior exercise interventions for breast cancer survivors, body image has been measured generically and without a disease-specific instrument. The need for development of a breast cancer-specific instrument was underscored by anecdotal reports of participants in the WTBS strength training intervention study [23], stating they experienced changes in body image relating to their sense of strength and health, social barriers, appearance, and sexuality that were important to them but not measured by the QOL survey completed for the study (CARES-SF [26]). As a result, the BIRS [27] was developed and tested for reliability and validity for use in the Physical Activity and Lymphedema (PAL) trial [28] and other studies of breast cancer survivors.

The PAL trial assessed the safety and efficacy of twice-weekly progressive strength training in breast cancer survivors with and at risk for lymphedema. The main outcomes were lymphedema flare-ups in women with lymphedema [29] and lymphedema onsets in women previously without lymphedema. Secondary outcomes included changes in strength, body composition, QOL, and perceptions of body image. The objective of this paper is to examine the effects of weight training on changes in perception of body image in PAL trial participants with and without lymphedema. We hypothesized that weight training would improve total body image and related subscales as measured by percent change in the BIRS from baseline to 12 months and improve measured strength and general QOL variables. We explored whether any subgroups of participants experienced differential intervention effects on measured perception of body image. We also hypothesized that 12-month changes in strength and general QOL would mediate the influence of weight training on improved perception of body image.

Methods

Design and participants

The PAL trial was a randomized controlled trial among breast cancer survivors with and at risk for lymphedema. In two parallel and concurrent arms determined by baseline lymphedema status (yes/no), women were randomized into a 1-year weight-lifting treatment group or wait-list control group. The study design is described in full elsewhere [28]. After baseline measures, a blinded staff member placed participants randomly into two equal-sized groups through a computerized process called minimization [30, 31]. Minimization balanced the treatment and control groups on six potential baseline confounders: lymphedema status (yes vs. no), age (<54 vs. ≥54 years), interlimb volume differences (<10%, 10–20%, >20%), number of lymph nodes removed (<6 vs. ≥6), obesity (BMI < 30 vs. ≥30 kg/m^2), months since diagnosis (<60 vs. ≥60), and history of radiation treatment (yes vs. no). Regulations of the University of Pennsylvania's human subjects' protection programs were followed. Women provided written informed consent and clearance from a physician prior to participation.

Breast cancer survivors were recruited within the Philadelphia metropolitan area. Recruitment methods and eligibility criteria are described elsewhere [32]. Briefly, two methods of recruitment were used: active and passive. Active recruitment involved approaching survivors directly through a letter from state and hospital cancer registries. Passive recruitment involved the use of print, broadcast media, and public events. Eligibility requirements included female gender, history of unilateral non-metastatic breast cancer diagnosis ≥1 year before study entry, body mass index ≤50 kg/m^2, currently cancer free, no medical conditions

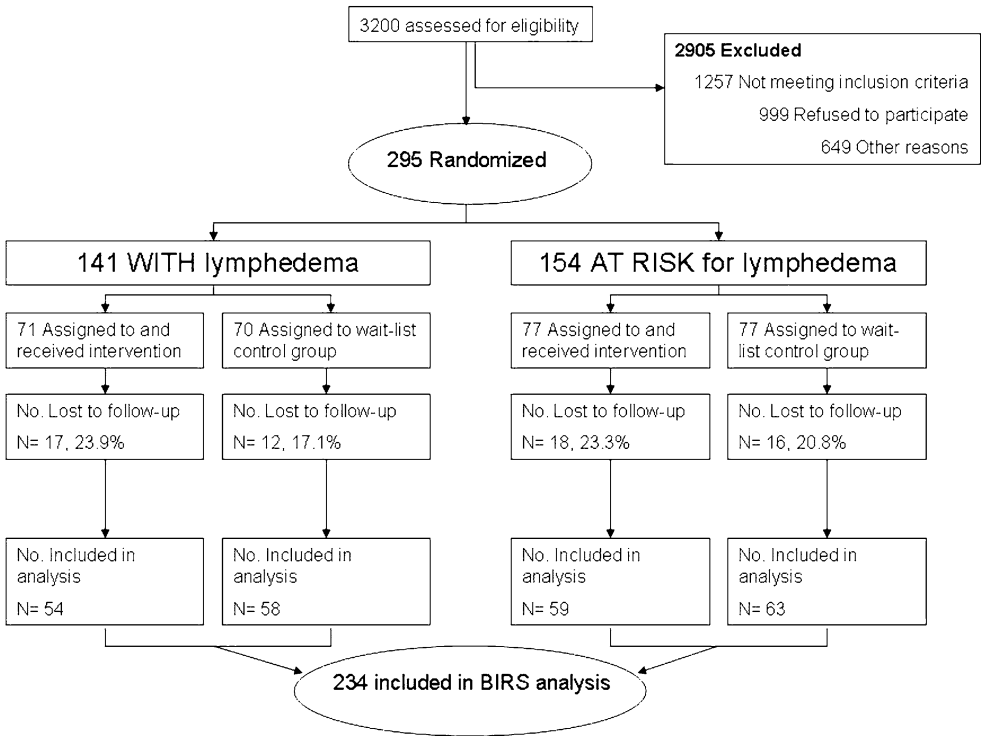

Fig. 1 Flow of participants through the study

limiting participation in an exercise program, no weight lifting in the year prior to study entry, not currently or recently pregnant or lactating, no plans for surgery or pregnancy or to move away from the area or be away for a month or more during the study period, and currently weight stable and not actively trying to lose weight (by self-report). Figure 1 presents the flow of participants in the study.

Weight training intervention

For the first 13 weeks, treatment group participants were instructed twice-weekly in groups of two to six survivors at a community fitness center (usually a YMCA). Certified fitness professionals employed by the fitness centers led the 90-min sessions, which included stretching, 10 min of cardiovascular warm-up, 'core' exercises to strengthen abdominal and back muscles, and weight-lifting exercises. During the first eight sessions, new weight-lifting exercises were introduced with little or no resistance. Resistance was increased for each upper body exercise at minimal increments (1/2 pound) after two sessions without change in lymphedema-related arm symptoms. If they experienced no change in lymphedema symptoms, no upper limit was placed on the weight to which women could progress. Upper body exercises included seated row, supine dumbbell press, lateral or front raises, bicep curls, and triceps pushdowns. Lower body exercises included leg press, back extension, leg extension, and leg curl. Three sets per exercise were performed at each session, ten repetitions per set. After 13 weeks, participants continued twice-weekly unsupervised exercise at the YMCA to 1 year. Fitness trainers called women who missed more than one session per week and asked those who missed more than two consecutive sessions to reduce resistance and rebuild slowly. Control group participants were asked not to change their level of exercise during study participation. Following study completion, control group participants were offered a 1-year fitness center membership with 13 weeks of supervised instruction.

Measurements

Body image

The instrument central to this analysis is the Body Image and Relationships Scale (BIRS), which measures self-perceptions of appearance, health, physical strength, sexuality, relationships, and social functioning. The BIRS was designed to capture elements of body image, strength, sexuality, and appearance unique to women diagnosed and treated for breast cancer. The instrument targets specific components of psychosocial adjustment and functioning for breast cancer survivors that have not been captured by existing QOL instruments. The 32-item instrument has demonstrated reliability and internal consistency in female breast cancer survivors [27]. Response options range on a five-point bipolar scale (1 = disagree strongly and 5 = agree strongly). Summing all items yields a total score; subscale scores for strength and health, social barriers, and

Table 1 Sample items of the Body Image and Relationships Scale

Strength and health	I felt physically capable of all the things I wanted to do
	My body was strong
	I felt uncomfortable or embarrassed because I was out of shape
Social barriers	Hot flashes prevented me from doing things I wanted to do
	Physical symptoms from breast cancer treatment (surgery, chemotherapy, radiation) prevented me from doing things I wanted to do
	I restricted my social activities because of changes in my physical appearance that I attribute to my breast cancer surgery
Appearance and sexuality	I have felt sexually attractive
	I was uncomfortable with or embarrassed by the appearance of my body
	I felt like I had some control over how healthy I was

appearance and sexuality are generated as well, a higher score indicating greater impairment. Strength and health items assess perceived physical impairment, including decreased energy and control of health, as a result of treatment. The social barriers subscale assesses perceptions of impairment in social interactions. Appearance and sexuality items gauge enjoyment or satisfaction with sexual activity and physical appearance and altered perception of one's body as related to treatment. Example items from each subscale are displayed in Table 1.

General QOL

The PAL intervention QOL assessment at baseline and 1 year included the SF-36, Version 2 [33], a widely used generic health profile. It is appropriate for use with adults of all ages, has extensive age and gender-specific norms, and has been used extensively in breast cancer survivors [34–36]. The SF-36 provides subscale scores for eight domains of health-related QOL – mental health, physical health, emotional role function, physical role function, social health, pain, vitality/energy, health perceptions, physical and mental health summary scores, and one health transition item.

Additional measures

Baseline and 12-month anthropometry included weight via calibrated digital scale and height via mounted stadiometer (baseline only). Upper and lower body strength measurements by one repetition maximum tests (One Repetition Maximum = 1-RM) were assessed using the bench press and leg press. 1-RM tests, the standard for evaluating increases in muscular strength [37], are safe for most populations when properly supervised [37–39]. Measurements were completed at the University of Pennsylvania at baseline and 12 months by trained research staff blinded to participant treatment status. Participants were paid up to $145 for measurement visits, and parking was provided. Full details of the PAL measurement protocols have been described elsewhere [28].

Statistical analysis

Baseline participant characteristics were compared across treatment and control groups and between participants who completed versus those who did not complete the 12-month BIRS data. Student *t*-tests were used for comparisons of continuous variables and chi-square tests (or Fisher 2-sided exact tests) for categoric variables. Multiple linear regression models were used to examine the between group differences in percent change from baseline to 12 months for the BIRS, QOL, and strength outcomes. All models controlled for baseline values of the outcome. Percent change was calculated as follows: [((12-month score–Baseline score)/Baseline score) ·100%]. Percent change was used because it facilitates comparison of the magnitude of intervention effects for individuals at higher versus lower baseline scores. The earlier analyses were performed for the overall cohort and separately for subjects with and without lymphedema at baseline, due to the hypothesized influence of decreased function that is associated with lymphedema. Then, a series of multiple linear regression models were used by including indicator variables of categoric subgroups (age (<50/50+), marital status (living as married/single), race (white/nonwhite), education (college graduate, some college, none), BMI (<25, 25–30, >30), and data-driven tertiles for change in strength) and treatment allocation as a second independent variable, as well as an interaction term (subgroup characteristic multiplied by intervention status). A significant interaction term would indicate a differential intervention effect across subgroup values. All models were run within lymphedema strata. To test whether the influence of treatment allocation on percent changes in BIRS total and subscores was mediated by changes in strength or general QOL variables, the Sobel-Goodman test [40] and regression models of multiple mediators [41] were conducted. The Sobel-Goodman test determines the significance and influence of mediating variables individually, while the regression of multiple mediators returns a coefficient for multiple mediators, allowing computation and comparison of the products of specific indirect effects with the total indirect

effect. One regression model included the SF-36 Physical Composite Score (PCS) and Mental Composite Score (MCS) percent change variables, the other included bench press and leg press percent change variables. For all analyses, adjusting effects in the overall cohort for lymphedema status did not alter results (data not shown); presented results for the overall cohort are not adjusted for lymphedema. The probability level for statistical significance was set at $P < 0.05$ for all comparisons. All statistical analyses were done using Stata 10.0 Software [42].

Results

The flow of study participants is shown in Fig. 1. Briefly, 3,200 breast cancer survivors contacted the study to express interest ($N = 2,201$) or decline ($N = 999$). Of these, 506 were eligible by telephone screen: 371 attended an orientation session and signed a consent form, and 295 were randomized. Of these, 141 had clinically diagnosed lymphedema prior to study entry. The rate of participants lost to follow-up was 7.7% ($N = 22$) for the trial main outcomes and 20.7% ($N = 61$) for complete baseline and 12-month BIRS scores. Median attendance for the 12-month intervention was 82%. The lack of significant increases in strength in the control group supports a lack of contamination in the control group. Table 2 describes the baseline characteristics of all participants with complete baseline and 12-month follow-up BIRS scores ($N = 234$). The mean age was 56.5 years (range 36–80). By design, time since diagnosis differed across baseline lymphedema status. The mean number of lymph nodes removed was greater among women with baseline

Table 2 Description of participants at baseline [mean (SD) or *N* (%)] for all subjects with 12-month follow-up for BIRS total score

Variables	With lymphedema ($N = 112$)		Without lymphedema ($N = 122$)	
	Treatment ($n = 54$)	Control ($n = 58$)	Treatment ($n = 59$)	Control ($n = 63$)
Demographics and characteristics				
Age (years)	56 (9)	58 (9)	55 (7)	57 (8)
Education				
HS or less	8 (15)	12 (21)	4 (7)	9 (14)
Some college	17 (31)	20 (34)	20 (34)	18 (29)
College or more	29 (54)	26 (45)	35 (59)	36 (57)
Race				
White	31 (57)	34 (59)	42 (71)	52 (83)
Black	23 (43)	22 (38)	13 (22)	11 (17)
Other	0 (0)	2 (3)	4 (7)	0 (0)
Occupation				
Professional	15 (28)	17 (29)	21 (36)	25 (40)
Clerical/service	7 (13)	8 (14)	12 (20)	9 (14)
Unemployed	2 (4)	1 (2)	2 (3)	2 (3)
Other/unknown	19 (35)	10 (17)	15 (25)	14 (22)
Retired	11 (20)	22 (38)	9 (15)	13 (21)
Strength				
Bench press	43 (16)	39 (11)	40 (12)	40 (11)
Leg press	185 (65)	161 (58)	165 (45)	175 (48)
Cancer history				
Time since diagnosis (months)	78 (42)	89 (45)	37 (14)	42 (15)
Cancer stage				
DCIS	0 (0)	6 (10)	1 (2)	1 (2)
1	13 (24)	8 (14)	22 (37)	22 (35)
2	20 (37)	14 (24)	19 (32)	17 (27)
3	4 (7)	11 (19)	6 (10)	2 (3)
Unknown	17 (32)	19 (33)	11 (19)	21 (33)
# Nodes removed	15 (8)	15 (8)	8 (6)	9 (7)
Chemotherapy (% yes)	85	79	71	67
Radiation (% yes)	83	78	75	73

Table 3 Baseline BIRS and SF-36 scores by treatment and lymphedema status for participants with baseline and 12-month follow-up

Variable	All				LE only				No LE			
	Tx		Control		Tx		Control		Tx		Control	
	n	Mean (SD)	*n*	Mean (SD)	*n*	Mean (SD)	*n*	Mean (SD)	*n*	Mean (SD)	*n*	Mean (SD)
BIRS												
Total	113	80.8 (18.5)	121	76.8 (17.3)	54	80.7 (20.0)	58	78.2 (16.9)	59	81.0 (17.2)	63	75.6 (17.7)
Total items = 32												
Possible score = (32–160)												
Strength and health												
Total items = 12	113	33.7 (9.5)	121	31.9 (8.6)	54	33.5 (9.2)	58	32.9 (7.6)	59	33.9 (9.8)	63	31.0 (9.4)
Possible score = (12–60)												
Social barriers[a]												
Total items = 9	111	16.6 (6.5)	119	15.4 (5.9)	52	17.0 (7.6)	57	15.9 (6.2)	59	16.4 (5.5)	62	15.1 (5.7)
Possible score = (9–45)												
Appearance and sexuality[a]												
Total items = 11	104	30.1 (6.1)	111	28.6 (5.7)	47	30.5 (6.8)	54	28.8 (5.9)	57	29.7 (5.6)	57	28.4 (5.5)
Possible score = (11–55)												
SF-36[b]												
Mental composite	113	52.1 (9.4)	120	53.9 (7.5)	54	52.6 (8.8)	58	54.7 (7.1)	59	51.6 (10.0)	62	53.1 (7.9)
Total items = 35												
Possible score = (0–100)												
Physical composite	113	48.4 (8.9)	120	48.2 (8.8)	54	46.9 (8.9)	58	46.7 (9.4)	59	49.7 (8.7)	62	49.5 (8.0)
Total items = 35												
Possible score = (0–100)												

LE lymphedema

[a] The sample size is smaller because of incomplete items, participants were reminded that they could choose not to answer questions that made them uncomfortable when completing surveys at each time point

[b] High score is better

lymphedema; the range was 1–38. Baseline data show that minimization balanced the groups across treatment allocation and within lymphedema status; none of the differences were statistically significant. Tests comparing the 234 women with complete baseline and 12-month data to the 61 women with incomplete data lost to follow-up indicate no differences in variables listed in Table 2 (results not shown).

Table 3 shows baseline BIRS and SF-36 composite scores by treatment allocation and within lymphedema status; baseline score were comparable. The baseline mean BIRS total and Social Barriers subscores of women lost to follow-up differed statistically from those with complete follow-up data (BIRS total mean = 85.1 vs. 78.8, P value = 0.03; Social Barriers mean = 18.6 vs. 16.4, P value = 0.05). Their scores did not differ by lymphedema status. Table 4 shows the baseline to 12-month percent change in BIRS scores, SF-36, and 1-RM strength measures. For the overall BIRS score, changes of 12.0 vs. 2.0% ($P < 0.0001$) were observed from baseline to 12 months in treatment versus control participants. Changes in overall and subscale scores for the BIRS were similar when analyzed within lymphedema status. Significant changes from baseline to 12 months were observed in the bench and leg press in treatment versus control participants, and within lymphedema status. The only significant difference in SF-36 percent change over 12 months was in the mental summary score for treatment versus control participants with lymphedema.

Multiple linear regression models testing the differential impact of the intervention on BIRS total and subscale scores found few significant interactions (results not shown). The interaction between age and treatment allocation was significant, with older women (>50 years old) in the treatment group experiencing a significantly improved strength and health score ($P = 0.03$), the main effect for age subgroup was not significant. Sobel-Goodman tests and regression models with multiple mediators found no significant influence of changes in strength or general QOL variables on 12-month changes in BIRS total score and subscale scores (results not shown).

Discussion

Results indicate the PAL strength training intervention had beneficial effects on self-perceptions of appearance, health,

Table 4 12-month score and percent change for BIRS, SF-36, and 1-RM outcomes by treatment and lymphedema status

Variable	Tx			Control			*P* value**
	n	12-month mean (SD)	% Δ mean (SD)	*n*	12-month mean (SD)	% Δ mean (SD)	
*BIRS**							
Total							
All	113	70.2 (17.8)	12.0 (16.7)	121	74.7 (18.2)	2.0 (15.4)	<0.0001
LE	54	70.0 (19.5)	12.0 (18.2)	58	78.0 (18.3)	−0.4 (14.3)	<0.0001
No LE	59	70.4 (16.3)	12.0 (15.5)	63	71.5 (17.7)	4.1 (16.2)	0.03
Strength and health							
All	113	27.8 (8.9)	14.9 (22.8)	121	30.5 (8.9)	2.7 (19.4)	<0.0001
LE	54	27.7 (9.3)	15.7 (24.7)	58	32.8 (8.8)	−0.2 (16.9)	<0.0001
No LE	59	27.9 (8.7)	15.3(21.2)	63	28.2 (8.5)	6.2 (21.2)	0.08
Social barriers							
All	111	14.8 (5.5)	5.4 (34.2)	119	14.9 (6.1)	−1.8 (35.5)	0.31
LE	52	14.7 (5.8)	6.5 (34.8)	57	15.8 (6.5)	−4.5 (37.1)	0.17
No LE	59	14.9 (5.2)	4.4 (33.8)	62	14.1 (5.8)	0.7 (34.0)	0.98
Appearance and sexuality							
All	104	27.5 (6.1)	7.3 (16.6)	111	28.4 (6.2)	−0.7 (18.1)	0.004
LE	47	27.8 (7.0)	7.6 (18.9)	54	28.8 (6.2)	−1.4 (19.7)	0.04
No LE	57	27.3 (5.3)	7.2 (14.6)	57	28.1 (6.2)	−0.2 (16.7)	0.04
*SF-36**							
Mental composite							
All	112	53.2 (9.6)	3.3 (18.6)	120	53.8 (8.7)	0.4 (15.5)	0.30
LE	54	54.3 (9.6)	3.3 (11.9)	58	53.3 (9.0)	−2.5 (12.9)	0.02
No LE	58	52.2 (9.5)	3.3 (23.2)	62	54.2 (8.5)	3.1 (17.2)	0.92
Physical composite							
All	112	50.7 (8.2)	6.1 (17.9)	120	49.1 (9.3)	3.4 (19.5)	0.12
LE	54	48.7 (8.9)	5.5 (18.8)	58	47.1 (10.4)	2.5 (21.7)	0.50
No LE	58	52.4 (7.0)	6.6 (17.1)	62	51.0 (7.8)	4.1 (17.3)	0.10
Strength 1-RM							
Bench press							
All	113	52.9 (15.3)	33.2 (40.8)	119	40.9 (11.8)	7.6 (43.7)	<0.0001
LE	54	52.2 (18.0)	30.5 (35.6)	58	38.9 (12.3)	5.0 (23.6)	<0.0001
No LE	59	53.5 (12.5)	35.7 (45.0)	61	43.0 (11.0)	10.2 (56.1)	0.006
Leg press							
All	113	223.4 (59.6)	33.2 (33.9)	119	175.1 (53.5)	7.9 (26.6)	<0.0001
LE	54	235.9 (68.1)	32.5 (33.6)	58	162.4 (54.3)	7.6 (22.7)	<0.0001
No LE	59	211.9 (48.3)	33.8 (34.2)	61	187.3 (50.2)	8.2 (29.9)	<0.0001

+% change indicates improvement, −% change indicates decline

LE lymphedema

* Sample sizes vary by subscore and instrument, because participants were given the option to leave an item blank if it made them feel uncomfortable. Total score was generated accounting for missing items

** Comparison between groups in difference in percent change is adjusted for baseline value of outcome

physical strength, sexuality, relationships, and social functioning, as measured by the Body Image and Relationships Scale. Significant 12-month changes were also observed in upper and lower body strength, as has been previously reported following a strength training intervention in women without cancer [24]. The potential for strength increases to mediate the effect of weight training on perception of body image was examined, given findings that women report exercising to feel good about themselves [25] and not to increase the attractiveness of a particular body

part [24]. However, tests of mediation were not significant, and the mechanism of the PAL intervention's impact on improved perception of body image remains unclear.

Based on the findings of previous aerobic [11, 13–16, 20] and strength training [22, 23] interventions, it was hypothesized that strength training would have a beneficial effect on general QOL and that general QOL may mediate the influence of the intervention on improved perceptions of body image, given that body image has been shown to be linked to QOL in studies of breast cancer survivors [43]. An explanation for both the lack of significant change observed in general QOL and lack of mediation is that all participants were at or near published SF-36 U.S. norm summary scores at baseline, suggesting their level of QOL was not susceptible to improvement. Observing baseline norm summary scores in this population is consistent with the findings of Ganz et al., in that QOL is high in breast cancer survivors many years after their initial diagnosis [44].

No association was observed between lymphedema status and decreased BIRS scores at baseline or improvement at 12 months. It was hypothesized that measured perception of body image would vary by lymphedema status, given previous findings that side effects of lymphedema, such as limb swelling, discomfort and impaired arm function [45], and decreased range of motion, are associated with poorer QOL [46, 47]. In addition to being a functional impairment, lymphedema is also a visual reminder of breast cancer treatment and difficult to conceal – qualities consistent with altered body image in people with chronic conditions [8]. Whether the women with lymphedema in the PAL study are unique in their perception of body image is unknown, as there is no normative body image data specific to breast cancer survivors with or without lymphedema. The improvement in BIRS total score was 12.0% for intervention participants with and without lymphedema. From these results, one may conclude the intervention was beneficial regardless of prior lymphedema diagnosis.

Strengths of the PAL trial include the randomized controlled design, large sample size, length of exercise intervention, and use of a novel disease-specific instrument to capture perceptions of body image in breast cancer survivors. Sample size and length of intervention in previous strength training interventions after breast cancer treatment ranged from 6-to-242 women and 7 weeks to 6 months [22, 48] when compared to a sample size of 295 women and a 12-month intervention in this study. The BIRS instrument was specifically designed to capture experiences unique to women diagnosed and treated for breast cancer that relate to appearance, health, physical strength, sexuality, relationships, and social functioning [27], which have not been collected effectively in existing QOL instruments. The importance of these experiences grew from WTBS study [23] focus groups, and participant comments on body image changes; notably, as body image relates to social barriers, sense of strength and health, appearance, and sexuality; all of which may have been altered by breast cancer and its treatments.

Limitations of the PAL trial deserve mention. Sixty-one participants (20.7%) were lost to follow-up for the BIRS analysis, while only 7.7% were lost to follow-up for the main safety and onset outcomes. One explanation for lost to follow-up variation in the different outcomes is the nature and timing of assessing the safety and onset outcomes. Lymphedema flare-ups and onset were captured as they occurred, while BIRS administration occurred at set data collection time points. The women lost to follow-up were observed to have significantly poorer baseline mean BIRS total and Social Barriers subscores when compared to those with complete data. One explanation for this finding is that women with more social barriers may be more likely to drop out of a small-group-based exercise intervention, hence their poorer score. The present study observed a significant effect of strength training on the overall BIRS score and no effect of strength training on social barriers among breast cancer survivors. Unfortunately, the differential loss to follow-up among women initially reporting more social barriers and lower overall body image introduces a selection bias that limits the ability to conclude that these findings are generalizable to women with initially poorer scores for social barriers and overall BIRS index.

In conclusion, elements of body image, including self-perceptions of appearance, health, physical strength, sexuality, relationships, and social functioning, improved with twice-weekly strength training in breast cancer survivors regardless of prior diagnosis of lymphedema. These findings may have clinical relevance and utility given the observed association between external and internal changes induced by cancer treatment and altered body image [8], as well as evidence supporting the association of favorable body image and long-term survival and mortality [10]. The BIRS is a newly developed instrument that uniquely measures self-perceptions of body image in breast cancer survivors, and no comparative normative data exist at this time. Physical activity interventions for breast cancer survivors should utilize the BIRS in order to draw conclusions regarding the impact of various types of physical activity on body image. Longer follow-up of the PAL cohort would aid in understanding potentially modifiable physiologic and psychosocial factors related to the construct of body image in breast cancer survivors.

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