Effects of Weight Training on Quality of Life in Recent Breast Cancer Survivors

The Weight Training for Breast Cancer Survivors (WTBS) Study

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BACKGROUND. Aerobic exercise training has been shown to have beneficial effects on quality of life (QOL) in breast cancer survivors. However, the effects of weight training on psychological benefits are unknown. We sought to examine the effects of weight training on changes in QOL and depressive symptoms in recent breast cancer survivors.

METHODS. A convenience sample of 86 survivors (4-36 months posttreatment) was randomized into treatment and control groups. The primary outcomes were changes in QOL (CARES short form) and depressive symptoms (CES-D) between baseline and month 6 in this randomized controlled trial.

RESULTS. Over 6 months the physical global QOL score improved in the treatment group compared with the control group (Standardized Difference = 0.62, $P = .006$). The psychosocial global score also improved significantly in the treatment group compared with the control group (Standardized Difference = 0.52, $P = .02$). There were no changes in CES-D scores. Increases in upper body strength were correlated with improvements in physical global score ($r = 0.32$; $P < .01$) and psychosocial global score ($r = 0.30$; $P < .01$). Increases in lean mass were also correlated with improvements in physical global score ($r = 0.23$; $P < .05$) and psychosocial global score ($r = 0.24$; $P < .05$).

CONCLUSION. Twice-weekly weight training for recent breast cancer survivors may result in improved QOL, in part via changes in body composition and strength. ***Cancer* 2006;106:2076–83.** © *2006 American Cancer Society.*

KEYWORDS: breast neoplasms, cancer survivors, exercise, psychological factor, quality of life, weight training.

Breast cancer is one of the most common types of cancer among women in the US, with more than 200,000 women diagnosed with invasive breast cancer each year.[1] Early-stage breast cancer has an excellent prognosis and the most recent estimate of the 5-year relative survival rate of all breast cancers is 88%.[1] However, breast cancer survivors suffer from several diseases and treatment late-effects, including depression,[2] sexual dysfunction,[3,4] chronic fatigue,[5] weight gain,[6] and sleep disturbance;[7] these late-effects all impact health-related quality of life (QOL).

Multiple intervention trials in breast cancer survivors have demonstrated positive physiological and psychological benefits from physical exercise. Aerobic exercise training had beneficial effects on cardiopulmonary function,[8,9] physical performance,[10,11] insulin sensitivity,[12] immune function,[13] chronic fatigue,[10,14,15] depression,[16] and QOL[8,9,14,17] in breast cancer survivors. However, the effects of weight training in breast cancer survivors on physiological and psychological benefits are unknown.[18,19] Weight training may be particularly useful

among breast cancer survivors for the purpose of improving psychological and physiological outcomes for several reasons. First, weight training has been shown to positively alter chronic disease risk factors among healthy women.[20–23] Second, adherence to exercise interventions is an issue for all populations and we have recently demonstrated the behavioral feasibility of twice-weekly weight training among midlife women who are not cancer survivors.[23] Finally, there is the potential that for breast cancer survivors, weight training might increase a sense of control over their lives during the 'watchful waiting' time frame between the end of active treatment and the 5-year mark postdiagnosis (e.g., psychological empowerment via physical strength increases).

To examine the effect of weight training on changes in QOL and depressive symptoms in breast cancer survivors, we used data from the Weight Training for Breast Cancer Survivors (WTBS) study, which was a randomized controlled trial designed to determine the effects of a twice-weekly weight training intervention on several outcomes in recent breast cancer survivors (4-36 months postadjuvant therapy).[24] For these analyses, we hypothesized that weight training would have beneficial effects on QOL and depressive symptoms in breast cancer survivors and that beneficial effects would be correlated with the changes in body composition and strength.

MATERIALS AND METHODS

Study Design and Participants

The Weight Training for Breast Cancer Survivors (WTBS) study was a 6-month randomized controlled exercise intervention trial. There was a partial crossover during months 7-12 such that the treatment group continued training and the control group was provided the same 6-month intervention that had been provided to the treatment group. However, for the purpose of the present analyses, only the between-person 6-month randomized controlled trial results are presented. The full study design is described in detail elsewhere.[24] After baseline measures, participants were randomized into the treatment and control groups by using a blocked randomization procedure that balanced participants according to both age and baseline body fat percentage. The Institutional Review Board of the University of Minnesota and the Park Nicollett Research Foundation approved all study procedures.

A convenience sample of 86 women was recruited from among breast cancer survivors living in the Greater Minneapolis / St. Paul metropolitan area between October 2001 and June 2002. Recruiting methods and eligibility criteria have been described in detail.[24] Women with recurrence of breast cancer went off study ($n = 4$, 2 in the treatment and control groups, respectively).

Weight Training Intervention

The first 3 months of weight training were supervised by an American College of Sports Medicine and/or National Strength and Conditioning Association certified fitness professional in small groups of 4 participants. These small training groups met twice-weekly for 13 weeks, so that the trainers could teach the participants the safe and effective execution of all exercises in the protocol. After the first 13 weeks the participants continued to train on their own for an additional 13 weeks. Participants were encouraged to train with other survivors to foster friendships. Nine common weight-training exercises were performed using variable resistance machines and free weights (for muscles of the chest, back, shoulders, and arms, as well as the buttocks, hips, and thighs). In addition, participants were taught stretching exercises to perform before and after each weight-training session.

During the 6-month intervention, participants kept exercise logs at the recreation center, which were monitored by the fitness trainers. If a participant did not log at least 1 workout over a full week, a fitness trainer called to encourage her to complete a workout. Participants were instructed to allow normal seasonal variability in diet over the 6 months of weight training, but to not make any purposeful changes in diet that might result in gain or loss of body weight/fat. In addition, participants were asked not to make any changes in other elements of their exercise program (e.g., walking, bicycling, swimming) while incorporating weight training.

Measurements

Measurements in this study have been described in detail.[24] In brief, before study enrollment participants took the Physical Activity Readiness Questionnaire (PAR-Q), given with a telephone eligibility screen, to assess whether or not participation in exercise would be safe. In addition, each participant sent a form to her physician requesting written permission for participation. All other measurements were taken on all participants at baseline and 6 months later. Physiological measures were taken at the University of Minnesota General Clinical Research Center (GCRC) by trained staff blinded to participant status. Participants were asked to refrain from physical activity for 48 hours before all measurements. Body weight and height measurements, blood draws, and dual-energy X-ray absorptiometry (DEXA) for evaluating body composition were performed between 6:30 and 11:00 a.m., after a 12-hour fast, and between 5 and 11 days

after the start of menstrual flow for menstruating participants.

Anthropometric measurements included waist circumference, body weight, and height. Body weight was measured on a digital scale and body height on a mounted stadiometer, both calibrated weekly with daily checks (Scale-tronix 5005 stand-on digital scale; Scale-tronix, White Plains, NY). Body fat (percent and total), fat-free mass, and bone density were measured by DEXA in the total body scanning mode with a Lunar Prodigy DEXA apparatus (v. 2.15; Lunar Radiation, Madison, WI) calibrated monthly with daily checks.[25] Body fat percentage is expressed as percentage of nonbone tissue that was fat.

Upper and lower body strength were assessed by 1-repetition maximum tests (the maximum amount of weight that can be lifted once: 1 Repetition Maximum = 1 RM) for the bench press (upper body strength) and leg press (lower body strength) at the University of Minnesota Recreation Center (URC), as previously described.[24]

QOL Outcomes

Overall QOL was assessed by the cancer rehabilitation evaluation system short form (CARES-SF),[26] which was designed to assess the rehabilitation needs and day-to-day problems of cancer patients. All items contained on the short form are included in the original CARES (139-item).[27] The CARES-SF contains 5 subscales for physical (10 items), psychosocial (17 items), medical interaction (4 items), marital (6 items), sexual (3 items), and miscellaneous subscales (19 items), for a total of 59 items. Together, these items are used to generate a single global score as well as 5 subscales, which represent the following domains: physical (the physical changes and disruption of daily activity caused by the disease), psychosocial (psychological issues, communication, and relationship problems), medical interaction (problems interacting and communicating with the medical team), marital (problems associated with a significant marital-type relationship), and sexual (problems related to interest and performance of sexual activity). The questionnaire is scored on a 5-point Likert scale (0 = 'not at all,' 1 = 'a little,' 2 = 'a fair amount,' 3 = 'much,' 4 = 'very much') assessing the applicability of the problem statement to the patient within the last month. Items of the CARES-SF were combined into a global summary score. Both the global summary score and individual subscale scores range from 0 to 100 and lower scores indicate fewer problems. A higher score is associated with a worse QOL. We are reporting the results as percent change, where a positive change indicates a decrease in the score and, therefore, a better QOL.

Depressive symptoms were measured with the Center for Epidemiologic Studies-Depression Scale (CES-D).[28] The 20 items of CES-D are scored on a standard 4-point scale (0 to 3) for each item, with a potential range of 0 to 60. A score = 16 was regarded as a mild depressive disorder.[28] This survey was designed to measure the severity of depression in the general population, but has been used in several studies of cancer populations, including breast cancer.

Statistical Analysis

Baseline characteristics of participants across the treatment and control groups were compared using Student *t*-tests for continuous outcomes (with Scatterthwaite approximation if the variances were indicated as heterogeneous) and chi-square tests (or Fisher 2-sided exact tests) for categorical outcomes.

Between-women comparisons of those randomized to treatment vs. control for changes in CARES-SF and CES-D scores across months 0-6 were made using Student *t*-tests after determining that adjustment for potential confounders did not alter the results. Confounders examined included postmenopausal status, baseline levels of sport and leisure physical activity, baseline level of energy intake (kilocalories), and 6-month changes in physical activity and energy intake. Standardized differences were calculated as follows: [(6-month change in treatment group − 6-month change in control group) ÷ standard deviation for change in total sample]. These standardized differences facilitate comparison of the magnitude of the intervention effect in this study compared with other exercise interventions in cancer survivors.

Pearson correlation coefficients were used to evaluate associations between changes in body composition and strength and changes in CARES-SF scores. All probability values were tested with the 2-tailed test, and all statistical analyses were done using SAS 9.1 (Statistical Analysis System v. 9.1, Cary, NC).

RESULTS

The flow of participants through the study is illustrated in Figure 1. Briefly, 238 breast cancer survivors were assessed for eligibility by phone, and 86 were randomly assigned to the treatment (n = 43) or the control (n = 43) groups. Seventy-nine of 86 participants completed the trial after the first 6 months of intervention (91.9% participant retention). Participants were lost to follow-up due to breast cancer recurrences (n = 4) and personal reasons (n = 3), such as lack of time and lack of continued interest in the study.

Table 1 describes baseline characteristics of the 82 participants who completed baseline measures and did not have any recurrences over the study. Overall,

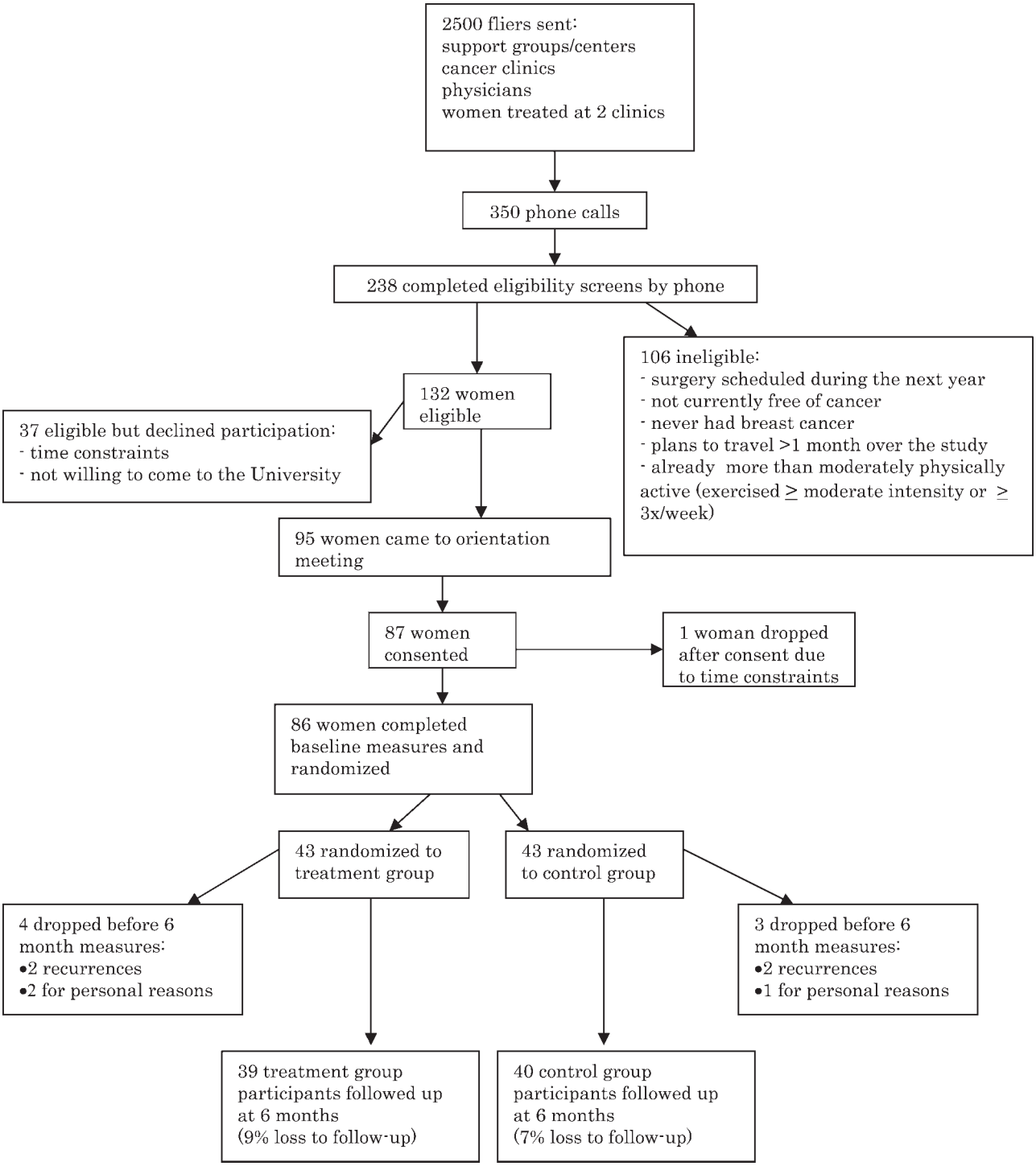

FIGURE 1. Flow of participants through the study.

the 2 groups were balanced in terms of demographic, medical, energy intake, and physical exercise variables at baseline.

Table 2 presents the CARES-SF scores (mean ± SD), by treatment allocation, at baseline and 6 months, as well as the changes over 6 months. Standardized differences are also presented for all CARES-SF scores. Physical global score improved by 2.1% in the treatment group compared with a worsening by 1.2% in the control group, with a standardized difference of 0.62 ($P = .006$). Psychosocial global score also statistically significantly improved in the treatment

TABLE 1
Baseline Characteristics of Breast Cancer Survivors*

Variable	Immediate treatment	Delayed treatment	*P*
Age, y (%)	53.3 (8.7)	52.8 (7.6)	.79
Caucasian (%)	39 (98)	41 (100)	.99
Education (%)			
Some college or vocational training	8 (20)	7 (17)	.89
College degree	22 (55)	22 (54)	
Graduate or professional degree	10 (25)	12 (29)	
Postmenopausal	34 (85)	32 (78)	.42
Breast cancer stage (%)			
DCIS	7 (18)	5 (12)	.63
Stage I	16 (43)	16 (39)	
Stage II	13 (34)	18 (44)	
Stage III	2 (5)	2 (5)	
Time since first diagnosis, y	1.73 (min = 0.58, max = 3.59)	2.02 (min = 0.44, max = 11.42)	.34†
Time since last treatment session, y	1.21 (min = 0.28, max = 2.84)	1.09 (min = 0.25, max = 3.12)	.45
Treatment types			
Radiation	25 (66)	26 (65)	.91
Chemotherapy	25 (66)	30 (73)	.48
Axillary dissection	33 (87)	39 (95)	.25‡
Hormone blocker treatment (%)			
Tamoxifen	30 (77)	27 (66)	.27
Anastrazole	3 (8)	5 (12)	.72‡
Other	0 (0)	1 (2)	
Energy intake (Kcals)	1577 (721)	1495 (568)	.58
Leisure physical activity score (units)	2.53 (0.48)	2.58 (0.52)	.70
Sport physical activity score (units)	3.23 (0.69)	3.18 (0.63)	.75

* Adapted with permission from Schmitz et al.[24] Data are presented as the mean (SD, standard deviation) or mean (range) for continuous variables and frequency (percentage) for categorical variables.
† Scatterthwaite test.
‡ Fisher 2-sided exact test.

TABLE 2
CARES-SF Score Changes over 6 or 12 Months of Weight Training

	Baseline		6 mo		Δ 0-6 mo	Difference between groups in mean change	Standardized differences	*P* for 0-6 mo diffs.*
Variables	*N*	Mean ± SD	*N*	Mean ± SD	Mean ± SD			
CARES global score								
Weight training group	40	46.4 ± 8.5	39	44.2 ± 8.7	−2.3 ± 4.5	1.7	0.39	.08
Control group	41	48.1 ± 8.7	40	47.4 ± 9.4	−0.6 ± 4.0			
Physical global score								
Weight training group	40	46.4 ± 7.2	39	44.2 ± 5.6	−2.1 ± 5.6	3.3	0.62	.006
Control group	41	47.1 ± 6.8	40	48.3 ± 7.7	1.2 ± 4.5			
Psychosocial global score								
Weight training group	40	48.0 ± 7.5	39	45.6 ± 8.2	−2.5 ± 4.4	2.2	0.52	.02
Control group	41	48.7 ± 8.7	40	48.2 ± 8.2	−0.3 ± 3.9			
Medical interaction global score								
Weight training group	40	53.0 ± 4.6	39	53.8 ± 5.3	0.7 ± 4.8	−1.3	0.30	.18
Control group	41	53.9 ± 6.1	40	53.2 ± 6.0	−0.6 ± 3.9			
Marital global score								
Weight training group	40	50.4 ± 6.9	39	49.2 ± 6.5	−1.2 ± 4.2	−0.3	0.05	.82
Control group	41	51.7 ± 6.5	40	50.0 ± 6.2	−1.5 ± 6.8			
Sexual global score								
Weight training group	40	52.8 ± 8.6	39	51.0 ± 7.5	−1.7 ± 4.8	1.5	0.30	.19
Control group	41	53.5 ± 6.6	40	53.5 ± 8.0	−0.2 ± 5.2			

* *P* from test for comparing the changes in the weight training group to the changes in the control group over 6 months.

TABLE 3
Correlations between CARES-SF Score Changes and Body Size and Strength Changes over 6 Months of Weight Training

Variables	Body mass index, kg/m^2	Body fat, %	Total lean mass, kg	Trunk lean mass, kg	Arm lean mass, kg	Leg lean mass, kg	Bench press, lbs	Leg press, lbs
CARES global score	−0.13	−0.31†	0.26‡	0.25‡	0.19	0.06	0.22	0.17
Physical global score	−0.10	−0.26‡	0.23‡	0.25‡	0.03	0.09	0.32†	0.17
Psychosocial global score	0.06	−0.12	0.24‡	0.25‡	0.25‡	0.00	0.30†	0.11
Medical interaction global score	0.02	−0.06	0.04	−0.06	0.04	0.01	−0.23‡	0.12
Marital global score	−0.03	−0.15	0.10	0.04	0.04	0.22	0.01	0.04
Sexual global score	−0.11	−0.09	0.11	0.02	0.04	0.14	−0.11	0.04

† $P < 0.01$
‡ $P < 0.05$

compared with the control group (2.5 vs. 0.3%, standardized difference of 0.52, $P = .02$). There was no relation between weight training and changes in either the CES-D score or the frequency of depression (score = 16, data not shown).

Table 3 shows the Pearson correlations between changes in body composition and strength and changes in CARES-SF scores. Changes in bench press were significantly correlated with changes in physical global score ($r = 0.32$; $P<.01$) and psychosocial global score ($r = 0.30$; $P<.01$). Changes in total lean mass were also correlated with changes in CARES global score ($r = 0.26$; $P<.05$), physical global score ($r = 0.23$; $P<.05$), and psychosocial global score ($r = 0.24$; $P<.05$). There was no association of changes in CARES-SF scores with changes in leg lean mass and leg press.

DISCUSSION

The WTBS study is the first randomized study to evaluate the effects of weight training on depression and QOL among breast cancer survivors. The results show that weight training had beneficial effects on physical and psychosocial QOL scores; these improvements were associated with increases in lean muscle mass and upper body strength. These findings may be consistent with the hypothesis that improvements in QOL scores were mediated through improvements in physical strength and muscle mass.

In a recent metaanalysis,[19] we reported strong qualitative evidence that physical exercise improved QOL among cancer survivors posttreatment (weighted mean standardized difference = 0.30, $P = .17$, based on 5 studies). These prior studies focused primarily on aerobic activity. Previous randomized exercise intervention studies specifically among breast cancer survivors have reported that physical exercise such as walking,[14] aerobic exercise,[8,9,17] Tai Chi,[29] and upper extremity exercise[30] had beneficial effects on QOL. For instance, the Rehabilitation Exercise for Health After Breast Cancer (REHAB) trial[9] assessed the effects of a 15-week aerobic exercise intervention on postmenopausal breast cancer survivors and the results showed beneficial effects on changes in happiness, self-esteem, fatigue, and several subcomponents of overall QOL. The present study adds to these prior studies in that it provides evidence that weight training, as well as aerobic exercise, may improve QOL in breast cancer survivors. In addition, the magnitude of the standardized differences noted in the present trial—0.39 for the global QOL score and 0.62 and 0.52 for physical and psychosocial subscores, respectively—are larger than the weighted mean standardized difference noted from prior studies of 0.30.

We hypothesized that women would feel 're-empowered' psychologically by becoming more physically powerful. The direct correlations between the improvements in upper body strength, lean mass, and QOL may be consistent with this hypothesis. The mechanism by which weight training may improve QOL in breast cancer survivors may be a sense of return to feeling in control of their bodies that may translate into feeling greater efficacy in other areas of life. In the present study, changes in physical global score and psychosocial global score significantly correlated with changes in bench press but not in leg press, whereas both bench press and leg press in breast cancer survivors were significantly increased after 6 months of weight training;[24] the percentage changes in bench press 1-RM tests over the first 6 months were 63% in immediate vs. 12% in delayed treatment groups ($P<.001$), and the leg press 1-RM increases were 38% for immediate and 9% for delayed treatment groups over the first 6 months ($P<.001$). Therefore, upper body exercise may have beneficial effects on physiological and psychosocial QOL in breast cancer survivors. A recent randomized study showed that self-reported physical functioning, gen-

eral health, and vitality in breast cancer patients with lymphedema increased after participating in an 8-week upper extremity exercise program, which further supports this hypothesis.[30]

Depressive symptom measured by CES-D was not associated with weight training in breast cancer survivors, whereas a previous study showed that aerobic exercise had beneficial effects on changes in scores of depression and anxiety.[16] In studies of patients who are depressed (noncancer survivors), some studies have reported that weight training, as well as aerobic exercise, had beneficial effects in reducing depressive symptoms,[31,32] whereas another study showed only aerobic exercise, and not weight training, improved depressive symptoms.[33] Because only 12.4% ($n = 10$) of the WTBS study participants had depression (score ≥ 16) at baseline, although the prevalence of depression in breast cancer survivors was about the same as previous report,[34] our ability to assess the effect of weight training on depressive symptoms was limited. Furthermore, to evaluate mood state we used a symptom scale rather than an affects balance mood scale such as the Positive and Negative Affects Scale (PANAS), the Derogatis Affects Balance Scale (DABS), and the Profile of Mood States (POMS). Because affects balance may be a much more sensitive measure than symptomatic distress in the medical and community population, further research on these mood scales may lead to better understanding of weight training.

Strengths of the present study include that the women were screened before study entry to be less than moderately physically active, the randomized controlled design with an intention to treat analysis, and measurement of QOL and depressive symptoms with standardized questionnaires used in breast cancer survivor populations. Furthermore, this intervention was larger and longer than most exercise interventions that have been conducted in breast cancer survivors. Sample size and term of interventions of previous randomized trials of exercise after breast cancer treatment were 12 to 60 women and 7 to 15 weeks,[35] compared with a sample size of 86 women and a 6-month intervention in the present study.

Limitations of the present study warrant discussion. Although significant improvements in QOL scores were observed after 6 months intervention in this study, it is not clear whether or not the 2.1% improvement of physical global score and 2.5% improvement of psychosocial global score in the weight training group are clinically relevant. However, 80% of participants in the treatment group improved in physical global score or psychosocial global score after 6 months intervention, whereas 51% of participants in the control group did ($P<.01$). Furthermore, through the course of the intervention, study staff recorded logs of interactions with the participants. Anecdotally, the participants felt that the weight training increased ability, self-confidence, strength, speed, and endurance, and improved body aches, appearance, and sleep quality. For instance, they reported that "I can open jars by myself now," "I have increased range of motion," "I feel confident to move heavier things around the house," "I am trying new activities," "I have increased foot speed and strength in tennis game / improvements in running and golf game," "I have more energy than I have ever had," "My joints are not as achy when I workout," "I have better posture," and "I sleep better." These qualitative data support that the improvement of physical and psychosocial scores may be clinically meaningful. Moreover, although the study assignment was blinded to the people doing the measurements, it was not blinded to the participants. There could have been unknown "placebo" influences that were relevant in the active treatment group. However, improvements in QOL were significantly associated with increases in lean muscle mass and body strength in this study, which may reduce the possibility of the "placebo" influences.

In conclusion, twice-weekly weight training for recent breast cancer survivors may increase physical and psychosocial QOL, in part via changes in body composition and strength. QOL in long-term breast cancer survivors is likely modified by various physiologic and psychosocial factors such as type of breast cancer, treatment, management of long-term breast-related symptoms, life stress, general health perception, and socioeconomic status.[36–39] Additional interventions of greater sample size, longer duration, and longer follow-up are therefore needed to ascertain the long-term effects of weight training in breast cancer survivors.

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