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Exercise and quality of life during and after treatment for breast cancer: results of two randomized controlled trials

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Abstract

Objective—To determine the effect of exercise on quality of life in (a) a randomized controlled trial of exercise among recently diagnosed breast cancer survivors undergoing adjuvant therapy and (b) a similar trial among post-treatment survivors.

Methods—Fifty newly diagnosed breast cancer survivors were recruited through a hospital-based tumor registry and randomized to a 6-month, home-based exercise program (n=25) or a usual care group (n=25). In a separate trial, 75 post-treatment survivors were randomized to a 6-month, supervised exercise intervention (n=37) or to usual care (n=38). Participants in both studies completed measures of happiness, depressive symptoms, anxiety, stress, self-esteem, and quality of life at baseline and 6 months.

Results—Forty-five participants completed the trial for newly diagnosed survivors and 67 completed the trial for post-treatment survivors. Good adherence was observed in both studies. Baseline quality of life was similar for both studies on most measures. Exercise was not associated with quality of life benefits in the full sample of either study; however exercise was associated with improved social functioning among post-treatment survivors who reported low social functioning at baseline (p<0.05).

Conclusions—Exercise did not affect quality of life in either recently diagnosed or post-treatment breast cancer survivors; however this may be due in part to relatively high baseline functioning among participants in both studies. Strategies for future research include limiting enrollment to survivors who report reduced quality of life on screening questionnaires and targeting survivor subgroups known to be at particular risk for quality of life impairment.

Keywords

Cancer; oncology; physical activity; patient reported outcomes; quality of life

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Introduction

Owing to high incidence of breast cancer and continually improving survival rates, there are now approximately 2.3 million breast cancer survivors in the US alone [1]. The psychological well-being and physical functioning of this population are therefore of considerable public health importance. Some breast cancer survivors experience fatigue [2]; depression and anxiety [3]; weight gain [4]; and reduced quality of life [5] after diagnosis and many decrease their level of physical activity [6]. Decreased activity and increased weight are of particular concern both because of negative effects of chemotherapy on the cardiovascular system [7] and because of the observed association between body mass and breast cancer mortality [8]. Physical activity, which is associated with improved breast cancer survival [9], has therefore been presented as a therapeutic strategy to address both the psychological and physical concerns faced by breast cancer survivors.

Trials of exercise among breast cancer survivors have generally used small samples and have varied widely in quality and in specifics such as exercise prescription, time since diagnosis, and choice of patient-reported outcomes. Recent systematic reviews and meta-analyses have reported clear benefits of physical activity for cardiovascular fitness and vigor among cancer survivors but generally modest or inconsistent effects for outcomes such as fatigue, mood, and quality of life [10,11]. A breast cancer-specific meta-analysis [12] found exercise to be associated with small but statistically significant improvements in quality of life, physical functioning, and fatigue. As noted by all three of these reviews, the conclusiveness of these syntheses is limited by the relative paucity of high-quality trials and the considerable variability in important factors such as study population and intervention dose.

Here we present patient-reported outcomes from two very similar randomized controlled trials, the Increasing or Maintaining Physical Activity during Cancer Treatment (IMPACT) Study and the Yale Exercise and Survivorship (YES) Study. Both were 6-month trials of moderate-to-vigorous sports/recreational physical activity versus usual care on quality of life, psychosocial functioning, and physical functioning among breast cancer survivors. The IMPACT Study tested a home-based approach among newly diagnosed survivors, while the YES Study examined a combined supervised-and home-based intervention for post-treatment survivors. The methodological similarities between the studies create an interesting opportunity for the comparison of the effect of exercise at two different time points in survivorship; therefore in this paper we present data from both studies side-by-side.

We hypothesized that because they were currently undergoing adjuvant treatment, IMPACT Study participants would report lower quality of life and poorer psychosocial and physical functioning than YES Study participants. We also hypothesized that both exercise interventions would be associated with benefits on quality of life, psychosocial functioning, and physical functioning relative to usual care.

Methods

All study procedures, including written informed consent, were reviewed and approved by the Yale University School of Medicine Human Investigation Committee. Details of the design of the YES Study have been published previously [13].

Participants

The IMPACT Study included 50 recently diagnosed survivors aged 35–75 who had not yet begun or had only recently begun adjuvant treatment (completed fewer than 2 weeks of radiation or 2 cycles of chemotherapy). The YES Study included 75 non-diabetic, inactive (<90 min/week of moderate- to vigorous-intensity recreational physical activity), post-menopausal survivors aged 34–79 who had completed adjuvant therapy at least 12 months prior to randomization. To facilitate recruitment, a fairly broad range of survivors (1–10 years post-diagnosis) were considered eligible for the YES Study. Eligibility criteria for both studies are shown in Table 1. All participants in both studies were diagnosed with Stage 0–IIIA breast cancer, were nonsmokers, had no previous cancer diagnoses, and were free of other serious health problems. Women who had diabetes, were physically active, or were pre-menopausal were eligible for the IMPACT Study because the primary goal among these recently diagnosed survivors was maintenance or increase in activity levels. The YES Study focused on the efficacy of exercise on biological and psychosocial outcomes after breast cancer treatment, therefore women who were active at baseline were excluded, as were pre-menopausal women and women with diabetes.

Recruitment

Study staff used the Yale-New Haven Hospital Tumor Registry to obtain the names of Connecticut women diagnosed with breast cancer by any Yale-affiliated physician during the time period of interest (incident diagnoses for the IMPACT Study and diagnoses occurring 1–10 years ago for the YES Study). Staff contacted each woman's physician to obtain consent to recruit the patient for the study and approval for the patient to exercise. Unless disapproved by the physician, an invitation letter was then mailed to the participant, followed by a telephone call to assess interest and eligibility. If the participant was eligible and interested, a baseline meeting was scheduled for the next week. Each study also included a small number of self-referred women who contacted us after hearing about the study through the media or from a friend, family member, or physician. Self-referred women comprised 6% of IMPACT Study participants and 25% of YES Study participants; baseline characteristics did not differ between those who self-referred to each study and those who were recruited *via* registry. Overall recruitment rates were 15.4% for the IMPACT Study and 9.5% for the YES Study.

Data collection

Data collection for both studies involved a screening phone call, baseline interview, baseline clinic visit, 6-month exercise intervention or usual care group, and a 6-month follow-up visit. The structure of the protocol and methodology of data collection was identical for both studies, although the specific wording of screening and baseline questionnaires differed slightly due to differences in eligibility criteria. Structured interviews were used to collect

demographic information and medical history at baseline. At baseline and 6 months, participants completed psychosocial questionnaires, a 7-day exercise log, a pedometer, and a 7-day pedometer log and attended a clinic visit for physical measurements.

Randomization—A computer program randomly assigned each IMPACT and YES study participant with equal probability to the exercise group or the usual care group. The randomization code for each participant was obtained by the principal investigator (who was not involved in recruitment or data collection) only after baseline measures for that individual had been completed and staff conducting clinic visits did not have access to the randomization program. The participant was then informed of her assignment by the project manager. After randomization, YES exercise intervention participants were immediately scheduled for their first supervised exercise session, while IMPACT exercise participants were scheduled for a visit to obtain the exercise program materials and to discuss the home-based program with the study coordinator. Owing to the nature of the intervention, blinding was not possible.

Measures

Quality of life—Validated measures were used to assess quality of life at baseline and 6 months. Happiness was assessed using the 2-item Fordyce Happiness Measure [14] (HM), which measures the average level of happiness over the past week and the percentage of time an individual has felt happy, unhappy, or neutral over the past week. This measure has been shown to be reliable and valid [14] and to be sensitive to change over time [15,16]. Self-esteem was assessed using the Rosenberg Self-Esteem Scale [17].

Depression was measured with the Centers for Epidemiological Studies—Depression Scale [18] (CES-D). Anxiety was measured using the 20-item State-Trait Anxiety Index [19] (STAI), which differentiates between transient anxiety (‘state anxiety’) and more long-standing anxiety (‘trait anxiety’). Participants in the YES and IMPACT Studies completed only the state anxiety scale (STAI-YI) as trait anxiety was not expected to be modifiable. Stress was measured using Cohen’s 10-item Perceived Stress Scale [20], a reduction of the original 14-item version [21] that retains good psychometric properties [20].

The IMPACT and YES Studies also included two multi-dimensional instruments. The 36-item Functional Assessment of Cancer Therapy Form B [22] (FACT-B) measures physical, emotional, social, and functional well-being as well as issues specific to breast cancer survivors. The Medical Outcomes 36-Item Short Form Health Survey [23] (SF-36) contains eight subscales (physical functioning, physical roles, bodily pain, general health perceptions, vitality, social functioning, emotional roles, and mental health).

Physical activity—At baseline and 6 months, all participants recorded the type, duration, and perceived intensity of any recreational/fitness activity performed on each of seven consecutive days on the 7-Day Physical Activity Log (PAL) [24] and recorded daily steps on a 7-day pedometer log. Exercise group participants also completed the PAL (including average heart rate from each workout) for each of the 26 weeks of the intervention.

Anthropometric measurements—Participants were weighed in light clothing, without shoes, at baseline and 6 months; measurements were rounded up to the next 0.1 kg. Height without shoes was measured using a stadiometer, rounding up to the next 0.5 cm. Total percent body fat was obtained with whole-body dual energy X-ray absorptiometry scans using a Hologic scanner (Hologic QDR 1500; Hologic, Waltham, MA, USA).

Exercise interventions—Both exercise interventions were based on the national recommendation of 30 min of moderate-to- vigorous physical activity 5 days per week [25]. Participants chose from a variety of sports/recreational activities, with most women performing walking as their main activity.

IMPACT Study exercise intervention—Owing to the feasibility issues presented by treatment side effects and the added time pressure of fitting chemotherapy and/or radiation sessions into a busy lifestyle, a home-based exercise program was used for the IMPACT Study. Based on the theory of planned behavior [26] and the transtheoretical model [27] the program was designed to promote self-efficacy and help participants overcome common barriers to exercise. At the beginning of the program, each participant received an educational book, a binder containing specialized weekly informational handouts [24], and a Polar heart rate monitor (used to maintain activity at 60–80% of predicted maximal heart rate in accordance with American College of Sports Medicine guidelines [28]). Participants recorded each session in the 7-Day PAL and returned these logs once per month.

Each participant was taught exercise techniques and principles during weekly phone-based meetings with a staff member designated to work with her. Calls lasted approximately 20 min and included detailed discussion of physical activity performed in the previous week and goal setting for the upcoming week. If the goal of 30 min of activity 5 days/week was not achieved, specific barriers and possible strategies to overcome them were discussed.

YES Study exercise intervention—The YES Study exercise intervention consisted of a supervised training program at a local health club. Participants exercised at the club during designated sessions 3 days/week, supervised by exercise physiologists from the study staff, and exercised an additional 2 days/week either at the health club or on their own. Participants wore Polar heart rate monitors during all exercise sessions to maintain the goal of 60–80% of predicted maximal heart rate and recorded each session in the PAL.

YES and IMPACT Study usual care groups—Participants assigned to the IMPACT and YES usual care groups were told that they could exercise on their own if they chose, but that the study's physical activity program would not be available to them. They received all exercise program materials at 6-month follow-up. Participants in both groups were also asked not to make significant changes in their dietary habits.

Statistical power and data analysis—The IMPACT and YES Studies were pilot studies whose sample sizes were chosen to provide adequate power to detect changes in weight, body composition, and other physical measures. Both samples, however, are comparable or larger than a number of previously published trials examining exercise and quality of life among breast cancer survivors.

Although the IMPACT and YES Studies shared many similarities, they differed with regard to length of time since diagnosis, type of intervention, and certain eligibility criteria. Data were therefore analyzed separately for each study using repeated measures analysis of variance (ANOVA). All analyses were conducted according to the intention- to-treat principle. Baseline QOL values were carried forward for the five IMPACT Study participants (three exercisers and two controls) and 10 YES Study participants (five exercisers and five controls) for whom 6-month data were unavailable.

Owing to the relatively high level of quality of life observed at baseline, secondary analyses were conducted to determine the effect of exercise on patient-reported outcomes among the subset of participants who reported lower functioning and well-being at baseline. Separate analyses were conducted for each outcome measure using a median split. Similarly, subgroup analyses were conducted to examine a possible relationship between changes in body composition and quality of life. All analyses were completed using SAS 9.1.

Results

IMPACT Study recruitment was conducted from July 2004 to May 2006 and data collection was completed in November 2006. YES Study recruitment was conducted from March 2004 to January 2006 and data collection was completed in July 2006.

Baseline characteristics

Both the IMPACT Study and The YES Study samples consisted primarily of middle-aged, well-educated, non-Hispanic Caucasian women who were overweight or obese (Table 2). The primary goal of the IMPACT Study was either maintenance or increase in physical activity, therefore both active and inactive women were eligible and physical activity levels varied greatly between participants at baseline. YES Study participants were sedentary at baseline due to eligibility criteria for the study. One YES Study participant dropped out of the study and requested that her data be deleted, therefore while 75 women were originally enrolled in the YES Study, analyses include only 74 women.

Adherence

Detailed information about adherence in the YES Study has been previously reported [13]. Throughout the 6-month intervention, YES Study exercise group participants averaged 123 min per week (SD=52) of moderate- to vigorous-intensity sports/recreational activity (range: 0–637). Although only 34% of YES Study exercisers met the study goal of 150 min/week (56% completed at least 120 min/week, or 80% of the study goal), the observed activity levels did represent a substantial increase over baseline activity in this previously sedentary sample. Women attended 67% of supervised exercise sessions and 96% reported exercising at home at least twice per week.

On average, IMPACT Study participants performed 144 (SD=75) minutes of activity per week throughout the 6 months (range: 0–253). Sixty-four percent met the goal of 150 min per week. Although direct supervision was not available in this home-based study, excellent compliance was observed with self-monitoring using detailed daily logs. Participants

returned an average of 23.1 (SD=8.1) weekly logs, with 18 (72%) of exercisers returning all 26 logs.

Retention

Of the 50 women enrolled in the IMPACT Study, complete 6-month data were available for 45 (90%); 22 exercisers and 23 usual care group participants. Of the 75 women randomized to the YES study, complete 6-month data were available for 67 (89%); 34 exercisers and 33 usual care group participants. No adverse events related to the intervention were observed in either study.

Baseline quality of life

Baseline and 6-month scores on patient-reported outcomes are shown in Tables 3a and b (IMPACT Study) and 3b (YES Study). With few exceptions, IMPACT and YES Study participants responded similarly on most of the patient-reported outcomes. On FACT-B, IMPACT Study participants reported poorer physical ($p<0.001$) and functional ($p<0.05$) well-being relative to YES Study participants but better social and family well-being ($p<0.05$). In contrast, on the SF-36, IMPACT Study participants reported poorer social functioning ($p<0.001$) but also less bodily pain ($p<0.05$) than YES participants.

Baseline scores on the HM were comparable to the normative mean (61.7, SD=17.8) [14]. Rosenberg Self-Esteem scores were similar to those observed by Courneya *et al*. [29] in a sample of 53 postmenopausal breast cancer survivors and by Segar *et al*. [30] in a sample of 24 breast cancer survivors.

On the CES-D, 15 IMPACT Study participants (30% of sample) and 13 YES Study participants (18% of sample) scored at or above the generally accepted cutoff of 16, suggesting a potentially elevated rate of depressive symptoms among IMPACT Study participants relative to YES Study participants ($p=0.09$) and the general population. Baseline anxiety scores on the STAI-Y were comparable to those reported among breast cancer survivors by Segar *et al*. [30] and slightly higher than those reported in a similar study by Kolden [31], however only 10% of IMPACT and 11% of YES Study participants scored at or above 50, regarded as the cut-off score indicating a high levels of anxiety. Participants in IMPACT and YES reported overall low-to-moderate stress levels, with means of 14.1 (SD=7.5) and 12.9 (S7.1), respectively, on a possible score range of 0–40. These are comparable to the normative score of 13.7 (SD=6.6) in a population-based sample of 1344 women reported by Cohen and Williamson [20].

FACT-B subscale and summary scores were reflective of moderate well-being and SF-36 scores in both studies were consistent with those for cancer patients in the general US population [32].

Quality of life changes

In contrast with some previous studies, quality of life remained extremely consistent from baseline to 6 months for exercise and usual care groups in both the IMPACT and YES Study and significant differences were observed between study arms. Adjusting for age, baseline

physical activity, stage at diagnosis, time since diagnosis, and treatment (chemotherapy versus no chemotherapy) did not affect the results.

We also conducted secondary analyses to examine the effect of the intervention specifically within those participants who reported low quality of life (below the sample median) at baseline. Within the IMPACT Study no effect of exercise was observed on any of outcomes among participants who scored in the bottom 50% of the sample at baseline. Within the YES Study, the intervention was associated with benefits on the FACT-B social/family well-being subscale ($p<0.001$) and the SF-36 social functioning subscale ($p<0.05$) but no effect was observed on other outcomes.

We also tested whether an effect of exercise might exist differentially depending on participant's success in losing weight or body fat during the intervention. Twenty-four IMPACT Study and 43 YES Study participants lost weight, while 26 IMPACT and 39 YES participants decreased their body fat during the intervention. Even among these subgroups, we did not observe an effect of exercise on any of the quality of life outcomes.

Discussion

Contrary to our hypotheses, we found that, on most measures, women who had been recently diagnosed with breast cancer reported quality of life generally comparable to that of breast cancer survivors who were 1–10 years post-treatment. The finding that YES Study participants (post-treatment survivors) had relatively little quality of life impairment is perhaps not surprising given that the average time since diagnosis was 3.5 years and most had been diagnosed with early-stage tumors. This is consistent with observational work showing high functioning and good quality of life in longterm (average 6.3 years since diagnosis) breast cancer survivors [33]. While YES Study participants ranged widely in their time since diagnosis, we did not find that this was a significant predictor of baseline quality of life scores.

Interestingly, good overall quality of life at baseline was also observed among IMPACT Study participants, who were randomized, on average, just 2.5 months after diagnosis. This high level of functioning was contrary to expectations but may be partially explained by the fact that the majority (64%) of IMPACT Study participants were randomized prior to initiation of adjuvant treatment. This hypothesis is supported by a recent trial among women undergoing chemotherapy that observed somewhat lower psychosocial functioning at baseline in a sample of survivors who had all completed 1–2 weeks of chemotherapy [34]. Findings from the IMPACT Study suggest that treatment itself, rather than the psychological strain of diagnosis, may be primarily responsible for depressive symptoms and anxiety among recently diagnosed survivors.

Exercise was not found to produce improvements in psychosocial functioning or quality of life in either the IMPACT or the YES Study. Both studies involved exercise prescriptions that were comparable to or higher than most other trials of aerobic exercise in breast cancer survivors. Furthermore, both studies observed good retention and adherence. It therefore seems likely that the lack of improvement from baseline to 6 months among exercise group

participants was not due to failure to adequately implement behavior change. A more likely possibility is that the participants were simply functioning well enough at the time of enrollment that further increases in quality of life would be difficult to obtain.

We did attempt to examine this by conducting secondary analyses for those participants who scored in the bottom 50% on each measure; no effect of the intervention was observed. Although these analyses featured only those women who had 'low' quality of life relative to other study participants, baseline scores even among this group did not reflect severe impairment. For example, the CES-D measures depressive symptoms, with higher scores reflecting more depression and a cut-off score of 16. The median baseline CES-D scores (11 in the IMPACT Study and 8 in the YES Study) are both well below the cutpoint, meaning that many of those women classified as high in depression using a median split were reporting low or moderate levels of depressive symptoms. Therefore even this subgroup may not be adequate for testing the effect of exercise for survivors who are experiencing depression or other kinds of quality of life impairment.

Participants in both studies were primarily non-Hispanic white, were well educated, and most had been diagnosed with early-stage tumors and therefore do not constitute a representative sample of the overall population of breast cancer survivors. Additionally, although most of our participants were recruited from tumor registries, given the sizable time commitment exercise trials require of participants, it is very possible that those women who elected to enroll in the study were higher functioning than breast cancer survivors in general. We did not collect quality of life data for potential participants who were either ineligible or uninterested in participating in the study, therefore the possibility of a psychosocial self-selection effect cannot be verified, but it is very plausible. By using a higher exercise dose and longer intervention duration than many previous trials [12], participation bias may be more pronounced in the IMPACT and YES Studies leading to a reduced ability to observe change in patient-reported outcomes.

The length of our interventions, while generally considered a methodological strength, is another potential reason for the lack of observed benefits. Several studies that have reported at least some benefits of exercise on quality of life used interventions that were less than 3 months in duration [29,30,35,36], consistent with the possibility that a benefit occurs early and fades with time. Gathering data at several time points can be difficult and costly; however, future studies may wish to consider the inclusion of multiple quality of life follow-up assessments to provide a clearer picture of how psychosocial functioning shifts over the course of exercise adoption and maintenance.

As with many intervention studies of physical activity among cancer survivors, the sample sizes of the IMPACT and YES Studies were sufficiently small that statistical power is a major concern. However, while hypothesis testing using cutoffs for statistical significance is the predominant method for assessing the effects of behavioral interventions, is also important to note the relevance of effect size. Our data consistently show not even a modest impact of exercise on outcomes measures, meaning that, in all likelihood, statistical tests would still support the null hypothesis even had our samples been substantially larger. Even if a very large sample had been available, resulting in ample statistical power, any difference

declared to be statistically significant would be too minor to be clinically relevant. Therefore, we do not feel that issues relating to statistical power explain or alter the appropriate interpretation of our data.

Earlier breast cancer diagnoses, treatment advances such as breast-conserving surgery, new chemotherapeutic agents, hormone therapies, and biologic therapy have, at least in part, altered the meaning and psychological impact of a diagnosis of breast cancer. Ninety-eight percent of women diagnosed with early-stage breast tumors can expect to survive at least 5 years, and a large percentage of these will survive much longer still [37]. Breast cancer survivors also benefit from arguably the widest variety of support groups, networks, and resources of any tumor type. Even survivors who do not participate in such activities may still benefit from cultural shifts that have transformed breast cancer survivorship from a private burden to a potential source of pride and self-growth.

Taken together, the changing implications of a breast cancer diagnosis and the tendency for self-selection in clinical trials suggests that future research in this area might benefit from specifically targeting those survivors who are experiencing psychosocial impairment or reduced quality of life. This could be accomplished by screening all potential participants for psychosocial functioning and enrolling only those who fall below a certain cutoff. While this would present obvious complications for expedient recruitment of participants, it would produce novel and informative data.

Another strategy is to target exercise trials toward specific subgroups of survivors. Despite overall improvements in the health and well -being of breast cancer survivors as a population, quality of life remains major concern for certain subgroups of survivors, including young women [38], women with a lower level of education [39], women who are diagnosed with later-stage breast cancer, and those who undergo chemotherapy [40], hormone therapy, or extensive and debilitating treatment regimens [41]. These survivors, who are at risk of greater quality of life impairment, constitute an appropriate and interesting target for future interventions aiming to improve well-being via physical activity.

Finally, there are many important questions regarding which survivors are most likely to receive clinically meaningful psychosocial benefit from exercise interventions. These could best be answered by a large randomized controlled trial with a diverse study sample and adequate statistical power for subgroup analyses and examination of potential effect modifiers.

In summary, the two randomized controlled trials reported here found that newly diagnosed breast cancer survivors were functioning just as well as post-treatment survivors and that structured, well-monitored exercise interventions did not impact quality of life in either sample. In addition to providing an opportunity for direct comparison of similar interventions on the same quality of life outcomes for newly diagnosed versus post-treatment survivors, our findings contribute to the current understanding of exercise and breast cancer by providing balance and counterpoint to a large number of similar trials that generally report modest benefits of exercise on quality of life. Issues of publication bias are of particular relevance in this field because reported effect sizes are usually small and

specific findings often vary considerably depending on the choice of outcome measure. Our findings suggest that, while exercise has clear and important health benefits for breast cancer survivors, the ability of physical activity to produce clinically meaningful benefits in psychosocial quality of life may be limited to certain subgroups of survivors.

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Table 1

Eligibility criteria for the IMPACT Study and YES Study

YES Study (*N*=75)	**IMPACT Study (*N*=50)**
Inclusion criteria	*Inclusion criteria*
Post-menopausal women	Pre- or post-menopausal women
Ages 40–75 years	Ages 35–75 years
AJCC Stages 0–IIIa breast cancer	AJCC Stages 0–IIIa breast cancer
1–10 years post-diagnosis	Recently diagnosed
≥12 months post completion of adjuvant treatment	Not yet begun or recently begun adjuvant treatment (≤2 weeks radiation or ≤2 cycles chemotherapy)
Physically able to exercise and physician consent to begin an exercise program	Physically able to exercise and physician consent to begin an exercise program
Sedentary activity pattern (<60 min/week)	Any activity level
Exclusion criteria	*Exclusion criteria*
Diagnosis of recurrent or other primary cancer event	Diagnosis of other recurrent or primary cancer event
Current smoker	Current smoker
Diabetes mellitus	
Current or planned enrollment in a structured weight loss program	

Table 2

Baseline characteristics of IMPACT (*N*=50) and YES (*N*=74) Study participants[a]

	IMPACT Study		YES Study	
	Exercise Mean (±SD) or %	**Usual care Mean (±SD) or %**	**Exercise Mean (±SD) or %**	**Usual care Mean (±SD) or %**
N	25	25	37	38
Demographics				
Age (yrs)	54.5 (8.2)	54.0 (10.9)	56.5 (9.5)	55.1 (7.7)
Non-Hispanic White	96%	92%	84%	84%
College degree or higher	68%	72%	60%	41%
Anthropometrics				
BMI (kg/m^2)	27.9 (5.3)	27.5 (5.4)	30.4 (6.0)	30.1 (7.4)
% body fat (DEXA)[2]	36.7 (5.9)	38.0 (6.1)	41.3 (6.4)	39.4 (5.9)
Physical activity				
PAQ[b] (MIN/DAY PA)	106 (98)	73 (93)	13 (24)	12 (20)
DAL[c] (MIN/DAY PA)	111 (104)	84 (89)	30 (41)	11 (25)
Pedometer steps/day	5637 (3051)	5437 (2392)	5145 (2312)	5342 (2744)
Time since d_x (weeks)	11.1 (4.5)	11.0 (5.2)	187.5 (114.2)	173.2 (135.2)
Stage				
Stage 0 (in situ)	8%	4%	11%	11%
Stage I	52%	36%	54%	27%
Stage II	32%	32%	27%	46%
Stage IIIa	0%	12%	8%	16%
Don’t Know	8%	16%	0%	0%
Surgery				
Lumpectomy	92%	72%	70%	54%
Unilateral mastectomy	0%	28%	19%	27%
Bilateral mastectomy	4%	0%	11%	28%
Unknown	4%	0%	0%	0%
Treatment				
Radiation	32%	32%	41%	24%

	IMPACT Study		YES Study	
	Exercise Mean (±SD) or %	**Usual care Mean (±SD) or %**	**Exercise Mean (±SD) or %**	**Usual care Mean (±SD) or %**
Chemotherapy	8%	20%	19%	19%
Radiation and chemotherapy	56%	44%	35%	43%
None	0%	4%	5%	14%
Unsure	4%	0%	0%	0%
Hormone therapy	56%	68%	57%	70%

[a] No differences between exercise and usual care groups at baseline. Exception: in IMPACT Study, exercisers were more likely to receive lumpectomy than usual care group participants ($p<0.05$).

[b] Physical Activity Questionnaire (moderate-vigorous sports/recreational activity).

[c] 7-Day Daily Activity Log (moderate-vigorous sports/recreational activity).

Table 3

(a). Quality of life at baseline and 6-month followup in the IMPACT Study (*N*=50) and (b) quality of life at baseline and 6-month followup in the YES Study (*N*=74)

	Exercise (*n* =25)			Usual care (*n* =25)			ΔBaseline 6-M group difference mean (±SD)
	Baseline mean (±SD)	6 Month mean (±SD)	Δ Baseline 6-M Mean (±SD)	Baseline mean (±SD)	6 Month mean (±SD)	Δ Baseline 6-M mean (±SD)	
(a)							
Happiness	60.7 (21.2)	70.2 (16.9)	9.5 (27.1)	63.5 (19.9)	71.1 (15.6)	7.5 (20.6)	−2.0 (24.1)
Self-esteem	34.8 (4.2)	34.3 (4.9)	−0.6 (4.6)	35.2 (3.8)	34.5 (3.6)	−0.6 (3.0)	−0.1 (3.9)
Depression[a]	10.7 (7.3)	7.9 (7.1)	−2.8 (9.2)	12.2 (6.5	10.0 (7.6)	−2.2 (6.4)	0.5 (8.0)
Anxiety[a]	32.0 (11.0)	30.7 (9.4)	−1.2 (12.9)	36.4 (11.1)	32.0 (10.8)	−4.4 (9.0)	−3.2 (11.1)
Stress[a]	13.0 (7.2)	9.5 (5.4)	−4.0 (8.1)	15.1 (7.7)	12.6 (7.2)	−2.4 (5.8)	1.6 (7.1)
FACT-B components:							
FACT-G	85.6 (13.1)	89.3 (11.1)	3.7 (7.3)	86.2 (13.4)	89.5 (11.8)	3.4 (15.0)	0.3 (11.8)
Physical well-being	21.6 (6.2)	23.9 (4.2)	2.3 (5.6)	22.3 (5.3)	23.5 (3.3)	1.2 (4.9)	−1.1 (5.3)
Emotional well-being	19.5 (3.1)	21.1 (2.4)	1.6 (3.1)	19.2 (3.0)	20.6 (3.1)	1.4 (2.0)	−0.3 (2.6)
Social/family well-being	24.2 (3.2)	22.7 (3.8)	−1.3 (3.3)	23.8 (3.7)	23.1 (5.0)	−0.5 (3.3)	0.8 (3.3)
Functional well-being	20.8 (5.2)	21.4 (5.4)	0.6 (6.9)	20.3 (5.0)	21.9 (3.4)	1.6 (3.5)	1.0 (5.4)
Breast cancer subscale	26.5 (6.3)	27.1 (6.2)	0.6 (3.7)	24.6 (5.8)	25.7 (6.8)	1.1 (4.5)	0.5 (4.1)
SF-36 subscales:							
Mental health	50.2 (9.5)	52.4 (6.6)	2.3 (11.0)	47.9 (9.6)	50.2 (8.1)	2.3 (7.6)	−0.0 (9.5)
Social	42.4 (11.8)	48.7 (10.2)	6.3 (13.5)	41.9 (10.0)	47.4 (10.2)	5.4 (12.3)	−0.9 (12.9)
Vitality	51.8 (8.8)	51.7 (9.6)	−0.1 (9.1)	48.1 (9.9)	51.0 (9.0)	2.9 (10.1)	3.0 (9.6)
Roles (emotional)	47.8 (11.2)	51.1 (8.6)	3.4 (14.5)	44.8 (12.5)	49.1 (11.4)	4.2 (12.9)	0.8 (13.7)
Physical	51.0 (6.2)	49.5 (8.8)	−1.5 (7.4)	48.1 (7.6)	50.4 (5.4)	2.3 (5.7)	3.9 (6.6)[b]
Pain	46.7 (12.7)	51.6 (10.4)	4.9 (12.1)	45.6 (12.2)	48.7 (10.8)	2.9 (14.2)	−2.0 (13.2)
General	49.9 (9.9)	51.4 (8.5)	1.5 (6.4)	47.6 (8.1)	49.0 (8.2)	1.4 (7.0)	−0.1 (6.7)
Roles (physical)	39.6 (11.7)	44.9 (11.7)	5.4 (14.0)	37.0 (11.6)	42.7 (13.1)	5.7 (14.1)	0.3 (14.1)

	Exercise (*n* =37)			Usual care (*n* =37)			
	Baseline mean (±SD)	**6 Month mean (±SD)**	**Δ Baseline 6-M Mean (±SD)**	**Baseline mean (±SD)**	**6 Month mean (±SD)**	**Δ Baseline 6-M mean (±SD)**	
(b)							
Happiness	65.6 (21.8)	68.6 (22.4)	3.0 (18.0)	68.3 (23.4)	68.1 (22.7)	−0.1 (19.1)	−3.1 (18.6)
Self-esteem	34.2 (5.5)	34.5 (5.2)	0.4 (4.4)	33.2 (5.7)	33.4 (5.9)	0.2 (2.9)	−0.1 (3.8)
Depression[a]	9.3 (6.0)	9.6 (9.3)	0.3 (6.4)	9.2 (8.6)	10.8 (10.1)	1.7 (6.3)	1.4 (6.4)
Anxiety[a]	32.8 (9.9)	32.1 (12.3)	−0.7 (9.2)	33.6 (13.6)	34.1 (15.4)	0.5 (5.8)	1.3 (7.7)
Stress[a]	12.8 (6.9)	12.9 (6.2)	0.2 (5.7)	13.1 (7.5)	13.8 (8.5)	0.8 (6.4)	0.6 (6.1)
FACT-B components:							
FACT-G	90.3 (11.9)	91.2 (12.6)	0.6 (7.5)	88.6 (14.2)	86.2 917.4)	−2.4 (9.8)	−3.0 (8.7)
Physical well-being	25.0 (2.5)	25.1 (2.7)	0.1 (2.8)	24.6 (3.5)	24.0 (4.1)	−0.5 (3.1)	−0.6 (3.0)
Emotional well-being	20.2 (3.2)	20.5 (3.0)	0.3 (2.2)	20.3 (3.9)	19.8 (4.2)	−0.5 (3.3)	−0.8 (2.8)
Social/family well-being	21.8 (6.2)	22.3 (4.9)	0.6 (4.6)	21.8 (5.5)	20.6 (7.2)	−1.0 (3.2)	−1.6 (4.0)
Functional well-being	23.4 (3.3)	23.1 (4.7)	−0.3 (3.7)	22.0 (4.6)	21.5 (5.3)	−0.5 (3.4)	−0.2 (3.5)
Breast cancer subscale	25.7 (5.1)	26.7 (5.8)	1.0 (3.0)	23.3 (7.3)	24.1 (5.9)	0.8 (3.4)	−0.2 (3.2)
SF-36 subscales:							
Mental health	49.8 (8.4)	50.6 (10.9)	0.8 (6.6)	48.2 (11.1)	47.4 (12.0)	−0.9 (8.7)	−0.7 (5.7)
Social	48.8 (9.6)	49.5 (12.0)	0.7 (10.5)	50.4 (9.0)	50.5 (9.6)	0.1 (6.8)	−0.6 (8.8)
Vitality	50.3 (8.8)	51.9 (9.0)	1.6 (6.6)	49.4 (10.9)	50.6 (10.0)	1.2 (7.1)	−0.4 (6.8)
Roles (emotional)	49.4 (11.3)	50.2 (10.4)	0.9 (12.0)	48.2 (11.1)	47.4 (12.0)	−0.9 (8.7)	−1.7 (10.5)
Physical	50.2 (6.6)	50.0 (6.4)	−0.2 (5.1)	48.0 (7.5)	48.0 (7.6)	0.0 (4.4)	0.2(4.7)
Pain	52.5 (8.7)	50.3 (9.1)	−2.2 (11.3)	50.9 (9.4)	50.8 (9.0)	−0.1 (7.0)	2.0 (9.4)
General	49.8 (7.2)	50.0 (8.8)	0.3 (5.7)	51.5 (8.0)	51.7 (8.4)	0.2 (4.4)	−0.1 (5.1)
Roles (physical)	48.2 (9.9)	49.7 (9.3)	1.5 (11.9)	47.6 (9.6)	49.5 (7.8)	1.9 (9.1)	0.4 (10.6)

[a] Lower score indicates better quality of life.

[b] $p<0.05$.