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Maintenance of Effects of a Home-Based Physical Activity Program among Breast Cancer Survivors

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Abstract

Purpose—Although physical activity (PA) adoption improves fitness and psychological well-being among cancer survivors, PA maintenance has not been examined. This paper presents follow-up of a home-based PA program for women treated for early-stage breast cancer.

Patients and Methods—Eighty-six sedentary women (mean age=53.14 years, SD=9.70) were randomly assigned to a PA or Contact Control group. The PA group received a 12-week telephone counseling program to adopt PA. Assessments were conducted at baseline, end-of-intervention (12-weeks), 6 and 9 months post-baseline.

Results—When comparing change from end-of-intervention (12 weeks) between groups, a significant reduction was observed in minutes of PA at 6 months ($t = -2.10, p < .05$), but there was no decrease in intervention effect at 9 months ($t = -.19, p = .84$). Similarly, post-intervention reductions in fatigue were lost at 6 months ($t = 3.27, p < .01$), but remained present at 9 months ($t = 1.65, p = .10$). PA group's fitness improvements were maintained at both follow-ups ($t = 1.04,$

$p = .30$ and $t = .05, p = .96$). The previously significant intervention effect on vigor was maintained at 6 months ($t = 1.32, p = .19$) but was significantly reduced at 9 months ($t = -2.15, p < .05$). PA participants were more likely to progress in motivational readiness at 6 (OR = 5.95, 95% CI = 2.30, 15.36) and 9 months (OR = 4.09, 95% CI = 1.69, 9.87); however, group differences in meeting PA guidelines were not maintained.

Conclusion—Some positive effects of a home-based PA intervention for breast cancer patients were maintained at 6 and 9 months.

Keywords

breast cancer; physical activity; maintenance

Introduction

Regular physical activity (PA) offers numerous psychological and physiological benefits for the general population [51] those suffering from chronic diseases [17,30,34,50], and subgroups of cancer patients [14,21,23,31,32,47,48]. Data from the Nurses' Health Study revealed that

breast cancer survivors who are physically active are at lower risk of dying from breast cancer [15]. However, few intervention studies have evaluated PA maintenance and associated effects. Some trials have included a follow-up assessment at 12 months, but involved a 12-month intervention, precluding the ability to assess long-term maintenance [47]. A diet and PA intervention with breast and prostate cancer survivors that did assess maintenance did not find significant effects for PA 6 months following the end of the (6-month) intervention [11]. Two recent trials with breast cancer survivors assessed maintenance of effects of an on-site supervised moderate-intensity program [10] and an on-site plus home-based program [34]: improved fitness and mood were maintained at the 6-month follow-up [10,34]. This paper addresses the issue of maintenance by presenting follow-up results from the Moving Forward study, a trial that investigated the feasibility and effects of a home-based PA intervention for early-stage breast cancer survivors.

The Moving Forward trial demonstrated that sedentary breast cancer survivors can adopt moderate-intensity PA during 12 weeks of telephone-delivered counseling [39]. The PA group reported significantly more minutes of moderate-intensity PA, showed significant improvements on a field test of fitness, reported greater progress in motivational readiness for PA, higher adherence to PA guidelines, reduced fatigue and increased vigor compared to controls [39]. The statistically significant results at post-treatment were also found in prior on-site supervised trials [9,22,23] and home-based PA programs [32,48] for breast cancer patients. This paper examined whether effects were maintained 3 and 6 months after the PA intervention (6 and 9 months post-baseline).

PA maintenance is a challenge even among non-cancer populations. Research among sedentary adults has shown that after successful PA adoption, less intensive interventions such as print or telephone can support long-term maintenance [4,7]. Castro and colleagues [7] studied 140 men and women aged 50–65 who received one year of telephone counseling to adopt higher or lower intensity exercise. After one year, participants were randomized to a second year of contact via telephone and mail or predominantly mail alone. Higher intensity exercisers who received mail had better exercise adherence than those who received counseling via the telephone and mail. Both strategies were effective in promoting maintenance in lower intensity groups. Bock and colleagues [4] conducted a PA trial that included a 6-month follow-up to their 6-month intervention comparing a tailored print intervention to a standard intervention in sedentary adults. Participants in the print arm maintained their level of activity over the follow-up. In sum, these results indicate that after successful adoption of PA, less intensive interventions can support long-term maintenance.

However, little is known about PA maintenance among cancer survivors. Moving Forward offered a home-based PA intervention based on the Transtheoretical Model of behavior change [43], an approach that has been used to promote PA adoption among non-cancer populations [4,24,26]. Primary hypotheses were that breast cancer survivors would be able to adopt a PA program over 12 weeks, demonstrate improved fitness, progress farther on motivational readiness to adopt regular PA, and be more likely to meet national recommendations for PA [51] compared to controls. We also hypothesized that PA adoption would have positive effects on mood and fatigue. Assessments were conducted at baseline, 12 weeks, 6 and 9 months post-baseline. The primary outcome was minutes of self-reported PA of at least moderate-intensity activity/week; all other outcomes were secondary. The purpose of this paper was to determine whether PA participants would maintain their gains (increased PA, improved fitness, mood, vigor and reduced fatigue) [39] at the 6 and 9-month assessments.

Methods

Design

Participants were randomized to either a PA program (PA) or a contact control condition (Control). Institutional Review Boards at the Miriam Hospital and Women and Infants Hospital approved the study. Recruitment, intervention delivery and assessments took place in Providence, RI between 1998 and 2003.

Recruitment

Participants were recruited by various methods including informational letters mailed by oncologists and in-person recruitment by research staff at two hospital-based oncology clinics [41]. Breast cancer survivors (Stage 0–2) were eligible if they were: at least 18 years of age, sedentary (i.e., exercised <once/week for 20 minutes at vigorous-intensity or <twice/week for 30 minutes at moderate-intensity for the past 6 months), diagnosed over the past five years, post-treatment (i.e., surgery, chemotherapy and/or radiation), ambulatory and willing to be randomized. Survivors were excluded if they had a prior history of cancer (with the exception of non-melanoma skin cancer), or a self-reported medical or psychiatric illness that could make compliance with the study protocol difficult or dangerous (e.g., cardiovascular disease).

Participant screening has been described previously [39,41]. Briefly, 424 telephone screens were conducted with all patients. If patients were eligible based on this screen, medical clearance was obtained from their primary physician. Ultimately, 86 (20.3%) breast cancer survivors were eligible, interested, and randomized; 37 (8.7%) met preliminary eligibility criteria, but were not randomized, and 301 (71%) were ineligible (most often due to medical comorbidities, inability to complete the walk test, or already being regularly physical active).

Procedure

Participants were stratified by age (≥ 50 years v. younger), cancer stage (0 or 1 vs. 2), and medical treatment (received v. did not receive chemotherapy) and urn randomized [49] to either a PA or a Control group. Age and chemotherapy were stratification factors since distress is higher among younger cancer survivors [36,52] or those treated with chemotherapy [2].

PA Intervention—Participants randomized to the PA group ($n = 43$) received in-person instruction on exercising at moderate-intensity (i.e., 55–65% maximum heart rate) in activities such as brisk walking. They were given home logs to monitor their PA and a pedometer (Digiwalker, Yamax Corporation, Tokyo, Japan) to wear during walks for exercise. Participants were encouraged to begin with a goal of exercising for at least 10 minutes/day on at least two days/week. Over 12 weeks, the goal was gradually increased to exercising for 30 minutes/day on at least 5 days/week [37,51].

Participants received weekly PA counseling via telephone [39] during which research staff monitored PA participation, problem-solved barriers, reinforced participants' efforts, and identified relevant health problems [39]. The counseling was tailored to each participant's motivational readiness [26]. This group also received mailed weekly tip sheets on PA and cancer survivorship. After completing the end-of-intervention assessments, participants received monthly calls for 3 months to prompt and reinforce regular PA; the content of monthly calls was similar to weekly calls (logging PA and wearing the pedometer was no longer required). These monthly calls stopped after 3 months, after which participants were asked to try to maintain regular PA.

Contact Control Group (Control)—Control participants ($n = 43$) were asked (at baseline) not to change their current level of PA during the 12 weeks. They received 12 weekly phone

calls followed by 3 monthly calls from research staff during which the Symptom Questionnaire [53] was administered to monitor problems, such as headaches, that can affect normal activity. Participants received the cancer survivorship tip sheets also provided to the PA group. Control group participants did not receive any specific information about exercise during the monthly calls and were not instructed to exercise.

Measures

Assessments included demographic information (collected only at baseline), disease and treatment information via chart review at baseline. At each assessment, participants also completed the following:

Seven Day Physical Activity Recall(7 Day PAR) [3]—The 7 Day PAR is a valid interviewer-administered measure [3,44] assessing hours spent in moderate, hard, and very hard activity and sleep over the past week [45]. We were particularly interested in participation in at least moderate-intensity PA (minutes/week)[12,13].

Rockport One-mile Walk test—This validated field test of fitness [1,20,42] was completed on an indoor track. Participants were asked to walk as fast as possible; the time taken to complete the one-mile walk was used as a measure of fitness.

Stage of Motivational Readiness for PA [25]—This valid and reliable self-report measure assesses motivational readiness to adopt PA [25] as classified into five stages of change: Precontemplation, Contemplation, Preparation, Action, and Maintenance. Regular PA was defined as ≥ 30 minutes of moderate-intensity exercise on ≥ 5 days/week.

Profile of Mood States (POMS) [27]—This is a reliable 65-item measure of mood states such as anger, tension/anxiety, depression, vigor, fatigue, and confusion [28]. Participants indicated how often over the past week they experienced each mood descriptor on a scale from 0 (not at all) to 4 (extremely). A total mood disturbance score was calculated by summing scores across all six subscales and weighting vigor scores negatively. Vigor (an outcome associated with PA in prior research) [40] and Total Mood Disturbance scores were used as outcomes in this study, with higher scores representing greater vigor or mood disturbance respectively.

Fatigue—Participants indicated their level of fatigue by placing a vertical mark on a 10 cm linear analog scale [5]. The scale was scored by measuring the distance in millimeters from the left anchor (i.e., “0”) to the vertical mark. Higher scores represent greater fatigue. Similar scales have been shown to be valid and reliable in assessing fatigue [18,35].

Analyses

Hypothesis testing based *t*-tests and χ^2 analyses was used to examine group differences in demographic, medical, and treatment variables at baseline. Similar to our previous paper [39], descriptive variables that differed significantly at the 5% level were included in subsequent analyses as covariates.

The *lme* function of Splus 8.0.4 [16] was used to fit Linear Mixed Effects models (LME) with subject-specific random intercepts to longitudinal data collected from all 86 participants who completed a baseline assessment. In addition to POMS Total Mood Disturbance, POMS Vigor, and Fatigue measures, outcomes of interest included two PA measures: time in minutes required to complete the Rockport One-mile Walk test, and minutes/week of at least moderate-intensity PA as measured by the 7 Day PAR. Measurement points included end-of-treatment (12-weeks post-baseline) and two planned follow-ups during the maintenance period (6 and 9

months post-baseline). All outcomes were transformed into change scores from baseline. These raw change scores were subsequently adjusted within the LME framework for *a*) baseline values of the outcome, *b*) covariates showing between-group differences at baseline, and *c*) interactions of *a*–*b* with follow-up time, before being subjected to an ANOVA-like decomposition with group, time, and group-by-time fixed effects.

Time was coded such that group main effects correspond to between-group differences at end-of-treatment, and a group-by-time interaction test whether these differences were maintained over both the 6-month and 9-month follow-ups. Due to lack of power for detecting group-by-time interactions, no further simplification to a main-effects ANOVA model was employed, even when group by time interaction failed to attain significance. Likewise, regression-adjusted change scores were compared separately at each follow-up for all outcomes of interest, instead of being averaged across time points for those outcomes for which the group-by-time interaction failed to attain significance.

Regression adjustment allows us to express the typical longitudinal trajectories experienced by the PA and Control groups relative to a common origin, by removing any baseline variability between the two group means due to finite-sample randomization imbalances. These trajectories are depicted in Figure 1 based on model predictions for the mean change experienced by women who were partnered and received tamoxifen (N=41) when assigned to either the PA or Control groups; baseline values of the outcome and of any remaining continuous covariates required for constructing each plot were set to the overall sample means at baseline. Although estimating change from baseline to each of the three time points of interest (12-weeks, 6-months and 9-months post-baseline) requires the specification of a full covariate profile on which to base model predictions, between-group differences in change scores (PA-CC terms) in our model do not depend upon our choice of participant characteristics and, therefore, apply equally well to all participants—we have chosen to highlight these change scores in Table 2. Similarly, both within-group change scores (PA, CC terms) from end-of-treatment to 6-month and 9-month follow up, and between-group differences in these change scores (PA-CC terms) apply to the entire sample and have been summarized in Table 3.

Longitudinal logistic regression models were used to analyze categorical outcomes at each follow-up, with the standard errors of the regression coefficients corrected for within-subject dependence using Generalized Estimating Equations (GEE) with a working independence correlation matrix, as implemented in PROC GENMOD of SAS 8.2. [46]. Binary logistic regression was used to compare the number of participants in each group achieving CDC/ACSM criteria for moderate-intensity PA [37,51]. In addition, all logistic regression coefficients were adjusted for covariates showing between-group differences at baseline. Between-group differences in motivational readiness for PA at follow-up were analyzed using a proportional-odds ordinal logistic regression [38], that modeled the odds of stage progression from baseline to follow-up, controlling for baseline stage and any covariates showing between-group differences at baseline. Due to the small cell proportions for the Precontemplation and Maintenance stages, motivational readiness was coded using a 3-point Likert scale (Precontemplation/Contemplation=0, Preparation=1, Action/Maintenance=2).

Although our alternative hypotheses were one-sided, we based all significance tests on two-sided alternatives in order to capture observed intervention effects that departed from the pattern expected by the investigators. Reported *p*-values were not adjusted for multiplicity.

Results

Sample Characteristics

Demographic and medical data for all randomized participants at baseline are seen in Table 1. Eighty-six women were randomized to the PA (n=43, mean age=53.42 years, SD=9.08) or Control condition (n=43, mean age=52.86 years, SD=10.38). The sample was, on average, within two years of diagnosis and consisted largely of white, educated, employed women with household incomes >\$50K. Control group participants were more likely to be on hormone treatment ($\chi^2_{(1)} = 5.95, p=.01$) and less likely to be partnered than the PA group ($\chi^2_{(1)} = 4.80, p=.028$) [40].

Four women from the PA group dropped out during the 12-week program. In the Control group, two women dropped out before the 6-month assessment and another dropped out before the 9-month assessment. The remaining sample (n=79) and the dropouts did not differ significantly on demographic, medical, or treatment variables.

PA Behavior

LME models with group, time, and group-by-time effects were estimated separately for PA of at least moderate-intensity (minutes of moderate+hard+very hard intensity PA, as measured by the 7 Day PAR) and time taken to complete the Walk test.

Results showed a borderline significant group by time interaction for the 7 Day PAR ($F_{2,134} = 2.61, p=0.078$). Post-hoc comparisons of change scores from baseline (Table 2), indicated that participants would have exercised only 4.69 minutes longer at 6 months if assigned to the PA group rather than the Control group (95% CI -72.14, 82.11), with the between-group difference increasing to 94.02 minutes in favor of the PA group at 9 months (95% CI 17.16, 170.89). Therefore, although between-group differences at end-of-treatment of 102.91 minutes in favor of the PA group (95% CI 25.88, 143.61) appeared to vanish at 6 months - due to a reduction in the intervention effect by 98.32 minutes (95% CI 6.37, 190.09) - they were largely restored at 9-month follow up, with the overall attenuation in the intervention effects during the maintenance period limited to only 8.90 minutes (95% CI 82.96, 100.76). These changes are more readily apparent from studying Table 3, which uses the 12-week end-of-treatment time point as the reference: whereas the 6-month comparison is significant ($p=0.038$), the 9-month comparison is not ($p=0.849$). Additionally, Table 3 indicates that the shrinkage of the intervention effect at 6-month follow-up was only partly due to a decrease in the PA group of 38.83 minutes; a sudden increase in PA in the Control group of 59.49 minutes also contributed to the narrowing of the between-group difference in change scores.

No significant group-by-time interaction was detected for the Walk Test ($F_{2,127} = 0.67, p=0.514$), indicating that an end-of-treatment intervention effect of 96 seconds (1.60×60) in favor of the PA group (95% CI 41.4, 151.2) was maintained throughout the study period. Indeed, Table 2 shows that PA participants completed the Walk Test 65.4 (1.09×60) seconds faster than baseline at 6 months (95% CI= 12, 124.2), and 95.4 (1.59×60) seconds faster than baseline at 9 months (95% CI=37.2, 153.0). Table 3 confirms that the corresponding drops in the intervention effect since end-of-treatment of 30.6 seconds at 6 months ($p=0.301$) and of 1.2 seconds at 9 months ($p=0.963$) failed to attain significance.

Figure 1 can be a useful tool in comparing and contrasting the longitudinal trajectories of the two PA outcomes of interest. It reveals that while the PA group experienced a modest deterioration in walking speed at 6 months commensurate with the drop in its minutes of PA (7 Day PAR), the increase in minutes of PA in the Control group to translate into similar fitness gains on the Walk Test, thereby helping maintain the between-group differences at this particular time point. Using Cohen's nomenclature for effect sizes [8], PAR intervention effects

measured in baseline standard deviation units shrunk from large at end-of-treatment ($\delta = 1.08$) to small at 6 months ($\delta = 0.05$), but then rose again to large at 9 months ($\delta = .98$). Walk Test effects of large magnitude first observed at end-of-treatment ($\delta = 0.77$) remained moderate at 6 months ($\delta = 0.52$) and fully recovered their original value at 9 months ($\delta = 0.76$).

Achievement of PA Recommendations

Differences between the proportion of PA and Control group participants achieving PA guidelines [37,51] (i.e., accumulate at least 30 minutes of moderate-intensity PA on most, ideally, all days of the week; defined here, as at least ≥ 5 days/week) at 6 and 9 months were examined using GEE logistic regression. Although the PA Group was previously reported at end-of-intervention to be significantly more likely than the Control group to achieve PA recommendations [39], the PA intervention effect was not maintained at follow-up. Adjusting for marital status and hormonal treatment, the odds ratio of a participant meeting CDC/ACSM recommendations if assigned to the PA group - rather than the Control group - declined to 1.41 (95% CI = 0.41, 4.83) at 6 months, and 1.33 (95% CI = 0.34, 5.25) at 9 months. No significant group by time interaction was present ($\chi^2 = 0.94$).

Motivational Stage of Readiness

Significant group differences in change in stage progression from baseline to end-of-intervention were reported previously [39]. An ordinal logistic regression model used to analyze stage progression from baseline to follow-up showed no significant group-by-time interaction ($\chi^2 = 0.40$). When controlling for baseline stage, hormonal treatment, and marital status, adjusted group differences appeared highly significant ($p < 0.01$) at each follow-up: the odds of stage progression in the PA group were approximately six times higher relative to those in the Control group at 6 months (OR = 5.95, 95% CI 2.30, 15.36) and four times higher at 9 months (OR = 4.09, 95% CI = 1.69, 9.87). The estimated probability of progression among PA participants starting in Precontemplation/Contemplation was 58% at 6-months and 71% at 9-months, dropping to 52%, and 51% respectively for those starting in Preparation (Table 4). This should be compared to 19%, and 37% for Control participants in Precontemplation/Contemplation at baseline, and 15% and 20% for those entering the study in Preparation.

Psychological Outcomes

LME modeling did not indicate group ($p = 0.168$) or group-by-time ($p = 0.174$) effects on the POMS Total Mood Disturbance. Small effect sizes at end-of-treatment ($\delta = 0.35$) were only slightly deflated at 6 months ($\delta = 0.29$), and dissipated further at 9 months ($\delta = .04$). Between-group differences in change scores did not attain significance at any time point. Figure 1 reveals that both groups showed a comparable deterioration in mood between end-of-treatment and 6 months (POMS Total Mood Disturbance scores increased), and then a reverse course, with the Control group showing even sharper improvements in mood (Total Mood Disturbance scores decreased) than the PA group at 9 months; this helped erase any between-group differences observed up to that point.

Identical LME models fit to POMS Vigor scores revealed a time course that was almost a mirror image of that for the POMS Total Mood Disturbance scale (Figure 1), with a moderate effect size at end-of-treatment ($\delta = 0.66$) shrinking further at 6 months ($\delta = 0.39$) and then weakening significantly at 9 months ($\delta = 0.15$). However, despite the strong negative correlation between these two POMS scales, the intervention effect for POMS Vigor was larger to begin with and declined at a more rapid pace over time. As a result, the corresponding group-by-time interaction did attain borderline significance for this outcome ($p = 0.052$). Hypothesis tests of between-group differences at each time point confirmed that intervention effects were very highly significant at end-of-treatment ($p = 0.002$), became borderline significant at 6 months ($P = 0.067$) and lost significance at 9 months ($p = 0.488$).

The same LME model fit to VAS-Fatigue measurements showed very highly significant group-by-time effects ($F_{2,147} = 5.36, p = 0.006$). Participants would have experienced fatigue levels lower by 9.47 units (95% $CI = 0.28, 18.66$) at 9 months had they been randomized to the PA group, rather than to the Control group. Although favoring the PA group by 2.44 units, the between-group difference at 6 months was not statistically significant (Table 2). Effects sizes for Fatigue declined from large ($\delta = 0.69$) at end-of-treatment to small ($\delta = 0.10$) at 6 months, only to recover to moderate ($\delta = 0.39$) at 9 months. Figure 1 reveals that VAS-Fatigue was the psychological outcome most strongly correlated with the minutes of PA over time, with the two sets of trajectories almost a mirror image of each other.

Discussion

The results indicate that a brief, home-based intervention can help previously sedentary breast cancer survivors maintain moderate-intensity PA and some of the associated benefits. As previously reported, immediately after receiving the intervention, these women reported increased PA, showed improved fitness and improvements on some psychological measures, relative to controls [39]. The results reported here indicate that a number of those gains were maintained during the months following the end of the 12-week program.

Following the 12-week intervention, the PA group continued to show greater participation in PA, improved fitness, and higher probability of progressing in readiness to adopt PA relative to Controls. As noted, if assigned to the PA group (rather than the Control group) a participant would have exercised an additional 103 minutes at 12 weeks, 4.7 minutes at 6 months and then 94 minutes at 9 months. It is encouraging that the increased PA found immediately after the end of the intervention is maintained several months later, although the dip in the intervention effect at 6 months is puzzling. As noted, some of this decreased effect was due to a sudden increase in activity among Control group participants. It may be that after the weekly contact with the interventionist ceased, participants in the PA group allowed their activity to lapse due to a diminished sense of accountability and then, over time, realized that it was incumbent upon them to take responsibility for maintaining their PA. It is encouraging to note that despite this temporary decrease in PA, intervention effects on fitness were maintained throughout the follow-up period. Likewise, PA participants were six times more likely to have progressed in their readiness to adopt PA at the 6-month follow-up and four times more likely to have progressed at the 9-month follow-up relative to Controls. This also suggests that, overall, PA participants were on a positive trajectory with respect to PA adoption. Thus, increased PA and the resulting improvement in fitness appear to be maintained for several months following the end of the PA intervention. However, PA group participants were no longer significantly more likely to meet PA recommendations than Control participants at either follow-up.

Improvements on some psychological measures were also maintained during follow-up. PA participants reported less fatigue than Control participants at 9 months, though the difference at 6 months was not significant. Fatigue levels followed a similar pattern to that seen for PA and therefore the temporary decrease in intervention effects on fatigue may reflect the decrease in PA at 6 months. Group effects previously found on the Vigor subscale of the POMS were in decline (and borderline significant) at 6 months and then disappeared at 9 months; it is not clear why this effect was not maintained, but future research might explore the possibility that women report increased vigor while adopting/increasing PA, but not when PA levels plateau. Finally, the Total Mood Disturbance measure, which had not shown group effects at the end of intervention (i.e., 12 weeks), did not show significant intervention effects during the follow-up period.

The effects on PA are similar to those in theoretically-grounded PA interventions for healthy adults. At a 12-month follow-up, men and women performed an average of 160 minutes of PA

[4] (in Moving Forward, the PA group performed 173 minutes at 12 months), and at 2-year follow-up older women (mean age = 56 years) walked an average of 2.85 times/week for approximately 30 minutes/walk [7]. Data on mood and fatigue were not reported in these trials.

The Moving Forward intervention may have helped participants successfully maintain PA and associated benefits. The intervention focused on brisk walking, a form of PA that requires few resources. In addition, the intervention was based on the TTM, a theory of behavior change whose constructs have been associated with PA maintenance. These findings suggest that a brief, theoretically grounded intervention can produce sustainable physical and psychosocial benefits among cancer survivors. Future research efforts should focus on testing the intervention in other cancer populations (e.g., late-stage patients) and intervention dissemination.

Though this is a promising intervention that was tested in a trial that had high retention of study participants and high rates of intervention delivery [39], it is too early to address its dissemination potential. The findings from this study may not generalize to the full population of breast cancer survivors as the exclusionary rate for study participation was high (i.e., those with serious medical and psychiatric co-morbidities were excluded), there was a low representation of ethnic minorities and those with lower socio-economic status, and participants were well educated. The high exclusion rate and the restricted sample suggest that the intervention may be difficult to disseminate to diverse cancer populations per frameworks such as the “RE-AIM” approach [19], in particular, the “reach” of the intervention may be limited. However, as data accumulates on positive effects of PA among cancer survivors and on the safety profile of such interventions, it is possible that a wider population of cancer survivors may be offered such home-based interventions.

To conclude, PA is widely recognized to decrease risk for cardiovascular disease [51], fatigue [32] and depression [6]; all risks to which breast cancer survivors are particularly vulnerable. In addition, there is some evidence that PA may protect against breast cancer recurrence [15]. These health benefits are likely to be accrued when PA is maintained. Our results indicate that breast cancer survivors receiving a home-based PA intervention were able to maintain PA and some of the benefits achieved during PA adoption.

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Figure 1.

Table 1
Demographic and Medical Characteristics of the Sample

	PA Intervention (n=43)		Contact Control (n=43)	
	No.	%	No.	%
Race/Ethnicity				
White	42	97.7	40	93.0
African American	0	0	1	2.3
Native American	0	0	1	2.3
Asian/Pacific Islander	0	0	1	2.3
Marital Status				
Single/Separated/Divorced/Widowed	7	16.3	16	37.2
Married/Living with Partner	36	83.8	27	62.8
Educational Level				
High School/Vocational/Trade School	8	18.6	8	18.6
Some College/College Degree	24	55.9	29	67.4
Graduate School	11	25.6	6	14.0
Employment Status				
Employed Full Time	23	53.5	24	55.8
Employed Part Time	12	27.9	4	9.3
Retired/Homemaker/Medical Leave	8	18.6	15	34.9
Household Income				
≤999	0	0	12	28.0
\$30,000–\$49,999	11	25.6	5	11.7
≥000	27	62.8	24	55.8
Cancer Stage				
0	8	18.6	6	14.0
1	17	39.5	15	34.9
2	18	41.9	22	51.2
Treatments				
Lumpectomy	33	76.7	29	67.5
Mastectomy	7	15.3	17	39.6
Radiation	28	65.1	31	72.2
Chemotherapy	24	55.8	24	55.8
Hormone Treatment	21	48.8	32	74.4
Mean Age (years)	53.42		52.86	
SD	9.08		10.38	
Mean Body Mass Index (BMI)	27.51		28.56	
SD	5.04		5.50	
Mean Years since Diagnosis	1.74		1.93	
SD	1.49		1.37	

Note: All randomized participants were included in this table. Five PA group participants and two Control group participants did not answer the household income question.

Table 2
Physical Activity and Fitness at Baseline and Follow-Up (adjusted group means at 6 and 9 months post-baseline).

Variable	Baseline		PA Group Follow-up			Contact Control Follow-up			Group Difference		
	Mean	SE	Mean	SE	Change	Mean	SE	Change	Mean	SE	P
Total minutes of moderate-intensity exercise [†]											
6 months	62.85	9.65	120.95	34.34	58.10	108.59	32.55	45.74	12.36	41.23	0.765
9 months			161.24	27.50	98.39	85.40	26.07	22.55	75.84	33.02	0.024
One-mile walk test, minutes [†]											
6 months	17.73	0.21	16.79	0.26	-0.94	17.71	0.24	-0.02	-0.92	0.31	0.004
9 months			16.80	0.27	-0.93	17.54	0.25	-0.19	-0.74	0.32	0.023
Total weekly energy expenditure (kcal/kg/wk) [*]											
6 months	245.63	2.05	267.86	5.85	22.23	256.06	5.53	10.43	11.80	7.02	0.097
9 months			265.87	6.23	20.24	247.98	5.89	2.35	17.89	7.48	0.019
Moderate-intensity weekly energy expenditure (kcal/kg/wk) [*]											
6 months	4.29	0.65	5.51	2.66	1.22	6.54	2.51	2.25	-1.03	2.15	0.748
9 months			9.66	1.84	5.37	4.31	1.74	0.02	5.35	2.21	0.018

Abbreviations: PA=Physical Activity; SE=Standard Error; 7-Day PAR=7 Day Physical Activity Recall.

NOTE: Footnote symbols indicate the variables examined through Multiple Analysis of Covariance (MANCOVA).

[†]Indicates MANCOVA including total minutes of moderate intensity-exercise, and one-mile walk test minutes.

^{*}Indicates MANCOVA including total weekly energy expenditure, and at least moderate-intensity weekly energy expenditure.

Table 3
Motivational Stage at Follow-up (at 6 and 9 months post-baseline) given Group Assignment and Stage at Baseline.

Treatment Group	Baseline	Time	Stage Proportions at Follow-up			Progression [†]		Regression ^{††}	
			PCS/CS	Prep	A/M	Rate	Odds [*]	Rate	Odds [*]
Contact Control	PCS/CS	6 months	0.81	0.13	0.06	0.19	0.24	---	---
Contact Control	PCS/CS	9 months	0.63	0.24	0.13	0.37	0.59	---	---
Contact Control	Prep	6 months	0.59	0.26	0.15	0.15	0.18	0.59	1.43
Contact Control	Prep	9 months	0.50	0.30	0.20	0.20	0.25	0.50	0.99
PA Group	PCS/CS	6 months	0.42	0.32	0.26	0.58	1.40	---	---
PA Group	PCS/CS	9 months	0.29	0.33	0.38	0.71	2.40	---	---
PA Group	Prep	6 months	0.19	0.29	0.52	0.52	1.08	0.19	0.23
PA Group	Prep	9 months	0.19	0.30	0.51	0.51	1.04	0.19	0.24

Abbreviations: PCS/CS=Precontemplation/Contemplation; Prep=Preparation; A/M= Action/Maintenance; PA=Physical Activity.

[†] Progression indicates movement at follow-up into a motivational stage higher than the one at study entry.

^{††} Regression indicates movement at follow-up into a motivational stage lower than the one at study entry.

* Odds = Rate/(1-Rate).

Table 4
Psychological Outcomes at Baseline and Follow-up (adjusted group means at 6 and 9 months post-baseline)

Variable	Baseline			PA Group at Follow-up			Contact Control at Follow-up			Group Difference		
	Mean	SE		Mean	SE	Change	Mean	SE	Change	Mean	SE	P
POMS Total Mood Disturbance												
6 months	16.83	3.10		20.12	4.33	3.29	27.77	4.08	10.94	-7.65	5.23	0.148
9 months				14.92	3.85	-1.91	16.09	3.64	-0.74	-1.17	4.66	0.803
POMS Vigor												
6 months	16.12	0.63		16.30	0.96	0.18	14.22	0.91	-1.90	2.08	1.16	0.080
9 months				17.93	1.01	1.81	17.36	0.96	1.24	0.57	1.22	0.640
Fatigue VAS												
6 months	46.22	2.71		34.86	4.51	-11.36	40.36	4.29	-5.86	-5.50	5.43	0.310
9 months				32.75	4.08	-13.47	45.32	3.87	-0.90	-12.57	4.91	0.010
BES sexual attractiveness*												
6 months	41.80	0.79		42.92	1.10	1.12	39.25	1.05	-2.55	3.67	1.33	0.007
9 months				43.07	0.97	1.27	39.57	0.92	-2.23	3.50	1.17	0.004
BES weight concerns*												
6 months	24.90	0.96		28.21	1.28	3.31	23.63	1.22	-1.27	4.58	1.55	0.004
9 months				27.85	1.15	2.95	23.85	1.10	-1.05	4.00	1.39	0.005
BES physical condition*												
6 months	26.83	0.75		27.68	1.12	0.85	25.43	1.06	-1.40	2.25	1.35	0.100
9 months				27.69	1.05	0.86	26.26	1.01	-0.57	1.43	1.28	0.268

Abbreviations: PA= Physical Activity; SE= Standard Error; POMS=Profile of Mood States; VAS=Visual Analog Scale; BES=Body Esteem Scale.

* Indicates the BES subscales that were examined through a multiple analysis of covariance (MANCOVA).

Higher POMS Total Mood Disturbance scores indicate greater mood disturbance.

Higher POMS Vigor scores indicate greater vigor. Higher Fatigue scores indicate greater fatigue.

Higher BES scores indicate more positive self-evaluations.