VOLUME 23 · NUMBER 15 · MAY 20 2005

JOURNAL OF CLINICAL ONCOLOGY ORIGINAL REPORT

Home-Based Physical Activity Intervention for Breast Cancer Patients

Bernardine M. Pinto, Georita M. Frierson, Carolyn Rabin, Joseph J. Trunzo, and Bess H. Marcus

From the Centers for Behavioral and Preventive Medicine, Miriam Hospital and Brown Medical School, Providence; and Bryant College, Smithfield, RI.

Submitted March 10, 2004; accepted March 18, 2005.

Supported by National Cancer Institute grant No. CA 75452 (B.M.P.).

Portions of this paper were presented at the 24th Annual Meeting of the Society of Behavioral Medicine, Salt Lake City, UT, March 19-22, 2003.

Authors' disclosures of potential conflicts of interest are found at the end of this article.

Address reprint requests to Bernardine M. Pinto, PhD, The Miriam Hospital, Coro Bldg, Ste 500, One Hoppin St, Providence, RI 02903; e-mail: bpinto@lifespan.org.

0732-183X/05/2315-3577/$20.00

DOI: 10.1200/JCO.2005.03.080

ABSTRACT

Purpose
The efficacy of a home-based physical activity (PA) intervention for early-stage breast cancer patients was evaluated in a randomized controlled trial.

Patients and Methods
Eighty-six sedentary women (mean age, 53.14 years; standard deviation, 9.70 years) who had completed treatment for stage 0 to II breast cancer were randomly assigned to a PA or contact control group. Participants in the PA group received 12 weeks of PA counseling (based on the Transtheoretical Model) delivered via telephone, as well as weekly exercise tip sheets. Assessments were conducted at baseline, after treatment (12 weeks), and 6 and 9 month after baseline follow-ups. The post-treatment outcomes are reported here.

Results
Analyses showed that, after treatment, the PA group reported significantly more total minutes of PA, more minutes of moderate-intensity PA, and higher energy expenditure per week than controls. The PA group also out-performed controls on a field test of fitness. Changes in PA were not reflected in objective activity monitoring. The PA group was more likely than controls to progress in motivational readiness for PA and to meet PA guidelines. No significant group differences were found in body mass index and percent body fat. Post-treatment group comparisons revealed significant improvements in vigor and a reduction in fatigue in the PA group. There was a positive trend in intervention effects on overall mood and body esteem.

Conclusion
The intervention successfully increased PA and improved fitness and specific aspects of psychological well-being among early-stage breast cancer patients. The success of a home-based PA intervention has important implications for promoting recovery in this population.

J Clin Oncol 23:3577-3587. © 2005 by American Society of Clinical Oncology

INTRODUCTION

Data indicate that the psychological and physical sequelae of a breast cancer diagnosis and treatment can be significant and prolonged.[1-5] Many treatments for breast cancer are toxic in nature, increasing the risk for a number of medical problems and late treatment effects such as neuropathy[6] and cardiovascular and pulmonary disease.[6-8] In addition, some breast cancer survivors report somatic complaints, such as chronic fatigue,[1,3] weight gain,[1] and difficulty sleeping,[3] that linger for months or years after the end of treatment.

Physical activity (PA) has emerged as a viable intervention to attenuate many of these effects.[9,10] Unfortunately, studies indicate that most cancer patients either are not physically active or reduce PA during and after cancer treatment.[11-13] Those who adopt PA after treatment typically do not meet prediagnosis levels of PA[12,13] and are below recommended levels[14] of moderate-intensity or vigorous-intensity PA.[11]

A number of PA interventions have targeted cancer patients undergoing treatment.[15-19] In these studies, patients undergoing chemotherapy or radiation therapy have been randomly assigned to a moderate-intensity PA condition (eg, walking or exercise cycle training)[15-18] or a control condition (eg, assessment only or stretching and flexibility training). Findings from these studies indicate that (relative to controls) patients who received the PA interventions experienced multiple benefits, including improved fitness,[15-18] reduced fatigue,[17,20] and decreased sleep disturbances.[17]

A few studies have targeted patients who have completed treatment.[21-26] One recent study[22] randomly assigned 53 post-treatment breast cancer survivors to receive either 15 weeks of supervised, on-site training on cycle ergometers (three times a week; n = 25) or no treatment (n = 28). Patients randomly assigned to the PA condition demonstrated significantly improved cardiac fitness (as measured by peak oxygen consumption) and quality of life relative to controls.

Some studies focusing on participants who have completed treatment,[22,23] like those targeting patients undergoing treatment,[15,16] have involved supervised, on-site PA training. Thus, these findings may not generalize to patients who have limited access to exercise facilities because of transportation or scheduling difficulties. Some studies have attempted to overcome this barrier by providing home-based PA programs.[17,21,26] For example, one randomized, controlled trial with a heterogeneous group of pre- and post-treatment cancer patients compared the effects of group psychotherapy alone with group psychotherapy plus home-based, moderate-intensity exercise.[21] Findings indicated that, compared with the psychotherapy alone group, those in the exercise group demonstrated significantly improved functional well-being, decreased fatigue, and decreased body fat after 10 weeks.[21]

Although the results from these studies are impressive, another major shortcoming of the PA and cancer literature is the lack of a theoretical foundation. With few exceptions,[21,27] most PA interventions for cancer patients have not been based in a theory of behavior change. This study (Moving Forward) offered a home-based PA intervention to sedentary, early-stage breast cancer patients. The intervention was based on the Transtheoretical Model (TTM) of behavior change.[28] According to the TTM, individuals adopting a new behavior, such as PA, progress along the following continuum of five stages of change: precontemplation (ie, not considering PA adoption in the next 6 months), contemplation (considering PA adoption in the next 6 months), preparation (physically active but not regularly), action (regularly active for fewer than 6 months), and maintenance (regularly active for 6 months or more).[29] PA interventions based on TTM have demonstrated efficacy in noncancer populations.[30,31] The TTM was incorporated into the PA intervention by tailoring counseling to participants' stage of readiness to change.

The home-based aspect of the program has several advantages. It mitigates transportation and scheduling difficulties, is less expensive than supervised programs, and does not require participants to attend classes or maintain a health club membership to sustain PA. Finally, it should be noted that this intervention was offered to breast cancer patients who had completed medical treatment, which is a time when patients often look for ways to improve their well-being.

The purpose of the Moving Forward trial was to examine whether sedentary women who have been treated for early-stage breast cancer can adopt a home-based moderate-intensity PA program and to determine the effects of adopting such a regimen on PA, fitness, mood, physical symptoms (eg, fatigue and weight gain), and body esteem. We also examined treatment effects at 6 and 9 months after baseline. Our main hypotheses were that, when compared with controls after treatment, women who received the PA intervention would increase PA (as assessed by self-report and objective activity monitoring), demonstrate improved fitness (on a walk test), progress farther in motivational readiness to adopt moderate-intensity activity, and be more likely to meet Centers for Disease Control (CDC) and American College of Sports Medicine (ACSM) recommendations for moderate-intensity PA.[14,32] A final goal was to study the effects of exercise adoption on mood, fatigue, and body esteem at the end of the 12-week intervention.

PATIENTS AND METHODS

Design

We conducted a randomized controlled trial comparing a 12-week, home-based moderate-intensity PA program and a contact control condition (control). Eighty-six sedentary women who had completed treatment for stage 0 to II breast cancer were randomly assigned to either the PA group or the control group. Assessments were conducted at baseline, after treatment (12 weeks), and at follow-ups at 6 and 9 months after baseline. The Institutional Review Boards at the Miriam Hospital and Women and Infants Hospital approved the study.

Recruitment

Participants were recruited by various methods, including informational letters sent by oncologists to their patients, in-person recruitment at two hospital-based oncology clinics and one private practice, and mailings to work sites. Eligibility criteria included age $\geq$ 18 years, currently sedentary (exercised $<$ one time per week for 20 minutes at vigorous intensity or $<$ two times per week for 30 minutes at moderate intensity for the past 6 months), diagnosed with stage 0 to II breast cancer over the last 5 years, completed surgery, chemotherapy, and/or radiation, ambulatory (able to walk a mile without assistive devices), and willing to be randomized. Participants were excluded if they had a prior

history of cancer (exception: nonmelanoma skin cancer) or if they had a medical or current psychiatric illness that could make compliance with the study protocol difficult or dangerous (eg, cardiovascular disease, diabetes, or orthopedic problems that limit exercise training).

We completed 424 initial telephone screens to determine study eligibility. Of those screened, 86 individuals (20.3%) were eligible, interested, and eventually randomized; 37 (8.7%) were initially eligible but were not randomized (see Fig 1 for reasons); and 301 (71%) were not eligible. Of the 301 ineligible patients, 133 (44.2%) were ineligible for multiple reasons (such as high blood pressure, diabetes, and inability to complete walk test); 97 (32.2%) were ineligible because they were too active; and multiple other reasons each accounted for 3% or less of total ineligibility (medications, history of previous cancers, disabled, and so on).

Procedure

Participants obtained medical clearance from their primary physicians before study entry. They were stratified for age (< 50 years $v \geq 50$ years), cancer stage (stage 0 and I v stage II), and medical treatment (received v did not receive chemotherapy) and then assigned to the PA or control group. The stratification variables were selected because the literature shows that younger age[33,34] and receiving chemotherapy are associated with greater distress.[35]

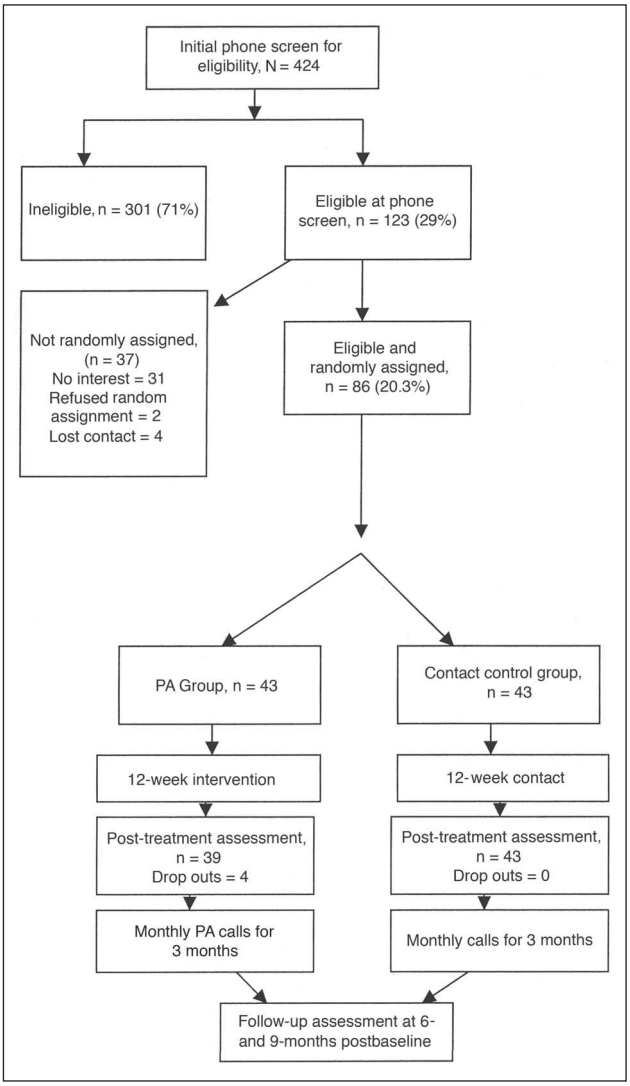

Fig 1. Flow diagram of participant recruitment and randomization. PA, physical activity.

Home-Based PA Intervention

After randomization, each PA participant received in-person instructions on how to exercise at a moderate-intensity level, how to monitor heart rate, and how to warm up before exercise and cool down after exercise. They were given home logs to monitor PA participation and a pedometer (Digiwalker; Yamax Corporation, Tokyo, Japan) to wear during walks for exercise. During the first few weeks of the intervention, participants were encouraged to exercise for at least 10 minutes on at least 2 days each week, and the goals were gradually increased over the 12 weeks to 30 minutes of accumulated PA per day on at least 5 days per week.[14,32] The program promoted moderate- intensity activities at 55% to 65% of maximum heart rate such as brisk walking, biking, swimming, or use of home exercise equipment.

Each participant received a weekly telephone call over 12 weeks from research staff to monitor PA participation, identify relevant health problems, problem solve any barriers to PA, and reinforce participants for their efforts. Activity counseling was tailored to each participant's motivational readiness.[36] Patients who were ready to become active (contemplation stage) were guided to set small, achievable goals, identify potential barriers and problem solve to achieve PA goals. Patients who were engaging in some level of PA (preparation stage) were encouraged to increase the frequency and duration over 12 weeks to achieve recommendations for moderate-intensity PA.[14,32] They received more specific information on how to increase PA in a safe and appropriate manner (eg, to reduce risk of lymphedema). At the weekly calls, subjects reported on the PA recorded on home logs, and they received feedback. If participants reported physical symptoms, such as chest pain, they were referred to their primary care physician for medical clearance. After the 12-week program was completed, monthly phone calls were provided for 3 months to prompt and reinforce regular PA.

Participants were mailed a PA and cancer survivorship tip sheet each week over the 12-week program. Finally, a feedback letter summarizing the participant's progress (eg, number of PA sessions, average duration of each session, and the participant's barriers to PA and suggestions to overcome them) was sent to the patient at weeks 2, 4, 8, and 12. Participants who reported no PA were sent a letter that summarized their barriers to PA and encouraged them to think about the benefits of becoming physically active.

Contact Control Group

The control participants were asked not to change their current level of activity during the 12 weeks. They received a weekly phone call from research staff for 12 weeks; during the call, the Symptom Questionnaire[37] was administered to monitor problems, such as headaches, that can affect normal activity of daily life. The goal of the calls was to match the frequency of contact with the PA group; there was no attempt made to match the duration of the telephone contact between groups. These women received the same cancer survivorship tip sheets as the PA group. After completing the final follow-up assessment, they received the PA tip sheets.

Intervention Delivery

All telephone calls to participants in both groups were audiotaped, and 25% of these tapes were reviewed by the principal investigator (B.M.P.) on a weekly basis to ensure fidelity to protocol.

Measures

Demographic information and disease and treatment variables were obtained at baseline. Participants provided consent for review of medical records to extract disease and treatment variables. At baseline and subsequent assessments, body weight and height were measured on a calibrated scale. These data were used to determine the body mass index (BMI). Body fat was estimated from skinfold thickness measured with calipers on the participant's nonsurgery side at the triceps, suprailiac crest, and quadriceps using Jackson-Pollack equations[38] to determine lean body mass and percent body fat. Participants received incentives, such as tee shirts and fanny packs, for completing the assessments. At baseline and after treatment, participants completed the following seven measures.

Seven-Day Physical Activity Recall. The Seven-Day Physical Activity Recall (7-Day PAR)[39] interviewer-administered measure was developed for the Stanford Five City Project[40] and administered per protocol.[41] It is widely used in assessment of occupational and leisure activity and has been validated in community-based surveys and experimental studies.[39] The 7-Day PAR assesses hours spent in sleep and moderate, hard, and very hard activity over the past week. Caloric expenditures are estimated based on the metabolic equivalents for the different activity classes, and a weekly energy expenditure can be determined. We were also interested in the weekly minutes of moderate-intensity PA, which is an outcome that has been used in national research trials of lifestyle PA programs.[42,43]

Rockport 1-mile walk test. Participants were asked to complete a validated field test of fitness, the Rockport 1-mile walk test, on an indoor track at all assessments.[44-46] Per protocol, participants were asked to walk as fast as possible. This field test yields the time taken to complete the walk.

Objective activity monitoring. All participants were asked to wear a Caltrac accelerometer (Muscle Dynamics, Torrance, CA).[47] The accelerometer has acceptable reliability[48,49] and validity.[50,51] At baseline and after treatment, all participants were given Caltracs to record activity for 3 days (2 weekdays and 1 weekend day). They were instructed to wear the Caltrac over the nondominant hip and to record Caltrac readings in a log in the morning and on retiring for the evening.

Stage of Motivational Readiness for PA. The Stage of Motivational Readiness for PA[29] measure assesses an individual's motivational readiness for PA. The Stage instrument has adequate reliability ($\kappa = .78$) and has concurrent validity with the 7-Day PAR.[36] It was revised to incorporate the guidelines on moderate-intensity PA. The instrument allows individuals to be classified into one of the following five stages: precontemplation, contemplation, preparation, action, and maintenance. For this study, regular PA was defined as at least 30 minutes of moderate-intensity exercise on $\geq$ 5 days per week.

Profile of Mood States. The Profile of Mood States (POMS),[52] a 65-item questionnaire, measures a variety of mood states including anger, tension/anxiety, depression, vigor, fatigue, confusion, and total mood disturbance. Reliability estimates range from 0.75 to 0.90.[53] Participants were asked to describe "how you have been feeling during the past week including today." Response options are presented on a scale of 0 to 4 (0 = not at all, 4 = extremely). The total mood disturbance scale is the sum of the scores across all six subscales with vigor scores weighted negatively. The vigor and total mood disturbances scores were of interest in this study.

Linear analog scale for fatigue. Fatigue was assessed using a linear analog scale.[54] Participants were presented with a 10-cm scale; the left anchor indicated least fatigue, and the right anchor indicated most fatigue. Participants were asked to place a vertical mark on the scale in a position to describe their level of fatigue. The score is the distance in millimeters from zero to the mark made by the participant. Higher scores indicate more severe fatigue.

Body Esteem Scale. The Body Esteem Scale[55] is a 35-item scale assessing a subject's evaluation of sexual attractiveness, weight concerns, and physical condition. Higher scores indicate higher esteem. Internal consistency ranges from 0.78 to 0.87. It was included because PA may improve body image among breast cancer survivors,[24] and body image is negatively affected by breast cancer treatments. Changes in body image that can accompany PA participation may also affect mood.

Analyses

Hypothesis testing was conducted on all participants who completed the baseline and post-treatment assessments at 12 weeks. Descriptive analyses were performed on all participants (intent-to-treat) randomly assigned to either group. χ^2 analyses or *t* tests, when appropriate, were used to compare the groups on medical, treatment, and demographic variables. Similar analyses were used to compare the retained sample versus dropouts. Several variables were dichotomized when comparing the groups because of the distribution of data. These variables were education (patients with less than a college education *v* college-educated patients), income (patients earning $<$ \$50,000 *v* $\geq$ \$50,000), marital status (partnered *v* not partnered), and employment status (patients working full time *v* working part time/retired/medical leave/homemaker). If there were significant group differences in these variables, they were included in subsequent analyses as covariates. Outlier analyses were conducted to identify participants with statistically significant high or low values on all PA outcomes. Significant outliers, when present, were removed before conducting subsequent analyses.

Multiple analyses of covariance (MANCOVAS) were conducted to examine group effects on minutes of weekly PA (7-Day PAR), the Rockport walk test, and weekly energy expenditure variables (7-Day PAR; unadjusted for weight). Post hoc analyses of variance and analyses of covariance (ANCOVAS) were conducted if significant group effects were found from the multiple analyses of variance or MANCOVAS. Separate analyses of variance and ANCOVAS were conducted to examine group effects on accelerometer data, BMI, and percent body fat.

χ^2 analyses were used to compare the number of participants in each group achieving CDC/ACSM criteria for moderate-intensity PA[14,32] at baseline and after treatment. The numbers of participants in each group achieving ACSM criteria for vigorous-intensity PA[56] at baseline and after treatment were also examined through χ^2 analyses.

χ^2 analyses were used to examine motivational readiness for PA after treatment and changes in motivational readiness over time. Changes in motivational stage for each participant were categorized as follows: (1) progression in stage of readiness, such as precontemplation to contemplation; (2) no change, that is, baseline and post-treatment motivational stage stayed the same, such as contemplation to contemplation; and (3) regression in stage of readiness, such as contemplation to precontemplation.

For the psychological outcomes, one MANCOVA was conducted on the three subscales of the Body Esteem Scale, and three separate ANCOVAs were conducted on POMS vigor, POMS total mood disturbance, and fatigue. To monitor the intervention dose that was delivered, *t* tests were conducted to determine whether there were significant group differences in the frequency and duration of telephone contact with research staff.

RESULTS

Sample Characteristics

Demographic and medical data for all randomized participants at baseline are listed in Table 1. Eight-six women were randomly assigned to either PA intervention (n = 43) or control (n = 43). The average age for the PA group was 53.42 years (range, 32 to 75 years; standard deviation [SD], 9.08 years) compared with 52.86 years (range, 31 to 76 years; SD, 10.38 years) in the control group. Both groups were, on average, within 2 years after diagnosis (PA group mean, 1.74 years; SD, 1.49 years; control group mean, 1.93 years; SD, 1.37 years). Both groups had a majority of participants who were white, highly educated, and working and had household incomes exceeding $50,000.

t tests and χ^2 analysis were used to examine group differences on demographic, medical, and treatment variables. Significant differences were found on one demographic variable and one treatment variable. Significantly more control group participants were on hormone treatment ($\chi^{2}_{1,86} = 5.950$, $P = .015$) and were less likely to have a partner than the participants in the PA group ($\chi^{2}_{1,86} = 4.807$, $P = .028$). Both of these variables were controlled for as covariates in subsequent analyses.

Four women, all from the PA group, dropped out during the 12-week program and did not provide data at the post-treatment assessment (reasons for drop out included no time, n = 1; could not be contacted to determine reasons, n = 2; and participation terminated, n = 1; the study team terminated one woman's participation because of symptoms of chest pain during exercise and her refusal to have these symptoms evaluated by her physician). The baseline values for the four drop outs were used for the respective post-treatment indices reported in this article. This conservative approach was used in the intent-to-treat analyses. The retained sample (n = 82) and the four dropouts did not differ significantly on demographic, medical, or treatment variables.

PA Behavior

MANCOVAs and univariate ANCOVAs were conducted to assess group differences on measures of PA, BMI, Caltrac accelerometer data, and percent body fat after treatment (Table 2). All analyses controlled for baseline values of the respective indices, marital status (partnered *v* not partnered), and hormone treatment status (tamoxifen *v* no tamoxifen). MANCOVA analyses were performed to examine group differences for minutes of weekly exercise (total, moderate-intensity minutes, and hard- plus very hard–intensity minutes; 7-Day PAR) and time taken to complete the Rockport walk test. Results indicate a significant group effect ($F_{1,69} = 8.09$, $P < .001$). A second MANCOVA was conducted to examine group differences on the 7-Day PAR energy expenditure variables. Results from this MANCOVA indicate a significant group effect ($F_{1,68} = 9.27$, $P < .001$).

Post hoc ANCOVAS were performed on each of the outcome variables. Findings indicate that the PA group engaged in significantly more total minutes of PA on the 7-Day PAR ($F_{1,71} = 13.50$, $P < .001$) than controls. This pattern of significant findings was replicated for the minutes of moderate-intensity PA and the Rockport walk test. PA participants reported higher weekly minutes of moderate-intensity PA ($F_{1,74} = 11.06$, $P < .001$) and were able to walk 1 mile in significantly fewer minutes than the control participants ($F_{1,68} = 21.12$, $P < .001$). Similarly, the PA group reported significantly higher total energy expenditure per week ($F_{1,74} = 11.09$, $P < .001$), moderate-intensity energy expenditure per week ($F_{1,70} = 11.06$, $P < .001$), and hard- plus very hard–intensity energy expenditure per week ($F_{1,74} = 4.69$, $P = .03$) compared with the control group. No significant between-group differences were evident from univariate ANCOVA analyses with caloric expenditure as measured by the Caltrac, BMI, or percent body fat.

We also conducted analyses of the PA group's pedometer readings (these participants were asked to wear the pedometer during their exercise over the 12 weeks). The group recorded a mean of 4,660.21 steps at week 1 (SD, 3,694.48 steps) and a mean of 17,675.64 steps at week 12 (SD, 7,631.78; n = 33 participants with data available at week 1 and week 12 of the intervention). A paired sample *t* test indicates that this increase was statistically significant ($t = 10.29$, $P = .001$).

Achievement of PA Recommendations

χ^2 analyses were calculated to examine differences between the number of PA and control group participants achieving PA guidelines at baseline and after treatment (Table 3). After treatment, PA group participants were significantly more likely than control group participants to engage in moderate-intensity PA at least 5 days of the week for 30 minutes each time ($\chi^{2}_{1,84} = 17.41$, $P = .001$).

Motivational Stage of Readiness

χ^2 analyses indicated that there was a significant difference between the groups on motivational readiness after treatment ($\chi^{2}_{4,88} = 30.28$, $P = .001$; Table 4). In addition, there were significant group differences in the change in motivational readiness from baseline to after treatment ($\chi^{2}_{2,86} = 28.28$, $P = .001$). It seems that 84% of the PA group progressed in motivational readiness from before to after treatment compared with 35% of the controls. Fifty-four

Table 1. Demographic and Medical Characteristics of the Sample

Characteristic	PA Intervention		Contact Control	
	No.	%	No.	%
Age, years				
Mean		53.42		52.86
Standard deviation		9.08		10.38
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	2	4.7	6	14.0
Married	34	79.1	26	60.5
Living with partner	2	4.7	1	2.3
Separated	0	0	1	2.3
Divorced	4	9.3	4	9.3
Widowed	1	2.3	5	11.6
Educational level				
High school diploma	7	16.3	8	18.6
Vocational/trade school	1	2.3	0	0
Some college	7	16.3	17	39.5
Associates degree	6	14.0	7	16.3
Bachelors degree	11	25.6	5	11.6
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	4	9.3	8	18.6
Homemaker	3	7.0	6	14.0
Medical leave	1	2.3	1	2.3
Household income				
Less than $10,000	0	0	2	4.7
$10,000-$19,999	0	0	2	4.7
$20,000-$29,999	0	0	8	18.6
$30,000-$39,999	4	9.3	3	7.0
$40,000-$49,999	7	16.3	2	4.7
Over $50,000	27	62.8	24	55.8
Body mass index, kg/m^2				
Mean		27.51		28.56
Standard deviation		5.04		5.50
Stage of cancer				
0	8	18.6	6	14.0
I	17	39.5	15	34.9
II	18	41.9	22	51.2
Time since diagnosis, years				
Mean		1.74		1.93
Standard deviation		1.49		1.37
Treatments				
Lumpectomy	12	27.9	7	16.3
Lumpectomy with node dissection	21	48.8	22	51.2
Mastectomy, simple and node dissection	4	8.3	14	32.6
Mastectomy with reconstruction	3	7.0	3	7.0
Radiation	28	65.1	31	72.2
Chemotherapy	24	55.8	24	55.8
Hormone treatment	21	48.8	32	74.4

NOTE. All randomized participants were included in this table. Eleven participants from the intervention and two participants from the control group did not answer the household income question.
Abbreviation: PA, physical activity.

Table 2. Physical Activity, Fitness, and Weight at Baseline and After Treatment

Variable	PA Group					Contact Control						
	Baseline		After Treatment		Change Score	Baseline		After Treatment		Change Score	F	*P*
	Mean	SD	Mean	SD		Mean	SD	Mean	SD			
7-Day PAR												
Total weekly energy expenditure, kcal/kg/wk*	243.64	18.52	259.61	28.19	15.97	244.12	20.18	243.23	18.39	−0.89	11.09	.001
Moderate-intensity weekly energy expenditure, kcal/kg/wk*	5.07	5.80	12.84	10.45	7.77	3.92	5.20	5.14	5.76	1.22	11.06	.001
Hard+very hard weekly energy expenditure, kcal/kg/wk*	0.72	3.22	1.00	2.26	0.28	2.18	4.76	0.12	0.70	−2.06	4.69	.033
Total minutes of weekly exercise†	83.50	94.87	202.43	161.65	118.93	73.82	102.06	78.36	86.00	4.54	13.50	.001
Total minutes of moderate-intensity exercise†	76.12	86.96	192.57	156.83	116.45	58.78	77.97	77.15	86.40	18.37	11.06	.001
Total minutes of hard + very hard intensity exercise†	0.74	3.22	9.86	22.59	2.48	0.49	2.18	1.21	6.96	−3.02	4.56	.036
One-mile walk test, minutes†	17.45	2.05	16.34	2.09	−1.11	17.65	2.00	17.85	2.24	0.20	21.12	.001
Caltrac, kcal	37.83	26.97	37.50	14.25	−0.33	33.00	26.85	33.62	19.43	0.62	.846	.36
BMI, kg/m^2	27.01	4.65	27.66	5.01	0.65	28.26	5.33	29.01	5.62	0.75	1.38	.244
Percent body fat	38.31	5.20	37.53	4.79	−0.78	38.44	5.02	38.55	4.83	0.11	1.52	.22

NOTE. Footnote symbols indicate the variables that were examined through a MANCOVA.
Abbreviations: PA, physical activity; SD, standard deviation; 7-Day PAR, Seven-Day Physical Activity Recall; BMI, body mass index; MANCOVA, multiple analysis of covariance.
*Indicates MANCOVA that includes total weekly energy expenditure, moderate-intensity weekly energy expenditure, and hard plus very hard weekly energy expenditure.
†Indicates MANCOVA that includes total minutes of weekly exercise, minutes of moderate-intensity exercise, minutes of hard-plus very hard–intensity exercise, and the 1-mile walk test. Both of the MANCOVAs indicated significant group effects in favor of the PA group.

percent of the controls did not change their motivational readiness compared with 14% of the PA group; and 12% of the controls regressed in their motivational readiness compared with 2% of the PA group.

Table 3. Achievement of CDC/ACSM (moderate intensity) and ACSM (vigorous intensity) Criteria at Baseline and After Treatment

Criteria	PA Group (No.)	Contact Control (No.)	*P*
CDC/ACSM criteria at baseline			.33
No	42	41	
Yes	1*	0	
CDC/ACSM criteria after treatment			.001
No	28	41	
Yes	15	0	
ACSM criteria at baseline			.33
No	42	41	
Yes	1*	0	
ACSM criteria after treatment			.33
No	42	41	
Yes	1	0	

NOTE. The U.S. Surgeon General and the ACSM and CDC recommend that all adults in the United State accumulate at least 30 minutes of moderate-intensity physical activity (eg, walking briskly, heavy house work) on most, ideally all, days of the week.[14,32] The ACSM recommendation for vigorous-intensity physical activity is at least three times per week for at least 20 minutes each time.[56] Data from two control participants were excluded from these analyses because of discrepancies.
Abbreviations: CDC, Centers for Disease and Prevention Control; ACSM, American College of Sports Medicine; PA, physical activity.
*Two participants who reported sedentary behavior at the telephone screen for study eligibility reported higher levels of PA at the baseline assessment. This may be the result of reactivity to objective activity monitoring.

Psychological Outcomes

Analyses of the psychological outcomes were conducted after controlling for baseline values of the respective indices, marital status, and hormone treatment status. After treatment, there was a significant improvement in vigor among the PA group compared with the control group (ANCOVA $F_{1,81} = 12.65$, $P = .001$). There was a trend towards a beneficial effect in favor of the PA group on the POMS total mood disturbance scale (ANCOVA $F_{1,81} = 3.41$, $P = .069$). After treatment, these participants reported lower overall mood disturbance than the control group (Table 5). A significant group effect in favor of the PA group was also indicated on the fatigue scale (ANCOVA $F_{1,81} = 12.00$, $P = .001$). After treatment, these participants reported lower fatigue than the control group (Table 5). Finally, the MANCOVA on the three subscales of the Body Esteem Scale (sexual attractiveness, weight concerns, and physical condition) suggested a trend in favor of the PA group ($F_{1,78} = 2.15$, $P = .101$).

Intervention Delivery

Over the 12 weeks, research staff delivered a mean of 11.47 calls (SD, 0.83 calls) to the PA group and a mean of 11.58 calls (SD, 0.89 calls) to the control group. The mean duration of calls to the PA group was 13.97 minutes (SD, 6.21 minutes) versus 5.93 minutes (SD, 4.02 minutes) for the control group. There were no significant differences in frequency of contact between groups; the duration of calls differed significantly ($t_{864} = 22.44$, $P < .001$).

Table 4. Motivational Readiness at Baseline and After Treatment

Group	Baseline (No.)				After Treatment (No.)				Progression (No.)	Stable (No.)	Regression (No.)
	PC	C	P	A/M	PC	C	P	A/M			
PA group	3	23	17	0	0	4	8	31	36	6	1
Contact control	3	24	16	0	5	17	14	7	15	23	5

Abbreviations: PC, precontemplation; C, contemplation; P, preparation; A/M, action/maintenance; PA, physical activity.

DISCUSSION

The findings from this study demonstrate the efficacy of Moving Forward, a home-based intervention promoting moderate-intensity PA among early-stage breast cancer patients. Results indicate that participants receiving the 12-week intervention, delivered via telephone, successfully increased moderate-intensity PA and overall PA participation compared with the contact control group. Findings also demonstrate that intervention participants were more likely than controls to progress in their motivational readiness to adopt PA and were more likely than controls to meet CDC/ACSM recommendations for moderate-intensity PA. These findings are encouraging because they indicate that PA counseling can be delivered effectively via brief weekly phone contacts and that intensive, on-site interventions are not required to increase PA among early-stage breast cancer survivors. This has important implications for the future dissemination of this type of intervention.

A noteworthy finding was that PA group participants improved significantly on a field test of fitness; after intervention, they were able to complete the 1-mile walk test in significantly less time than required by control group participants. These data indicate that the increases in PA participation in the PA group translated into improvements in fitness. The ability to improve fitness via an intervention delivered by telephone is a strength of this intervention.

Along with the reported increases in moderate-intensity PA, there were significant group differences in energy expenditure in hard- and very hard–intensity PA. Closer inspection of the data, however, indicates that this difference seems to be the result of a decline in energy expenditure through hard and very hard activities by the control group from baseline to after treatment. Further research is needed to understand the reason for this decline and to determine whether the Moving Forward intervention actually protected against a similar decline in the PA group.

The PA intervention did not demonstrate significant effects on an objective measure of PA or two anthropomorphic measures. It is unclear why the Caltrac data are inconsistent with the PA data reported on the 7-Day PAR. As noted in Results, pedometer readings corroborate the increase in PA among PA group participants reported on the 7-Day PAR. It is possible that the discrepancy between Caltrac and PAR data may be attributed in part to technical difficulties encountered by participants when using the Caltracs (anecdotal reports). It is also worth noting that some investigators require participants to wear objective activity monitors for 7 days (instead of 3 days), although this procedure has not been adopted universally. Despite the lack of significant intervention effects on objective PA data, the PA group's improved performance on the walk test after

Table 5. POMS, BES, and Fatigue at Baseline and After Treatment

Variable	PA Group					Contact Control						
	Baseline		After Treatment		Change Score	Baseline		After Treatment		Change Score	F	*P*
	Mean	SD	Mean	SD		Mean	SD	Mean	SD			
POMS vigor	17.86	5.59	20.58	5.70	2.72	15.33	5.81	15.81	5.39	0.48	12.80	.001
POMS total mood disturbance	11.77	27.33	8.02	20.69	−3.75	21.14	25.31	16.51	28.75	−4.63	3.41	.069
Fatigue	42.47	23.54	27.08	21.41	−15.39	41.66	25.04	42.28	26.20	0.62	12.00	.001
BES sexual attractiveness*	41.74	7.15	42.45	9.24	0.71	40.86	6.95	40.12	6.30	−0.74	2.93	.09
BES weight concerns*	26.67	8.79	27.02	9.02	0.35	24.29	7.82	25.03	7.42	0.74	1.83	NS
BES physical condition*	28.05	7.36	30.26	7.82	2.21	27.05	6.37	27.23	6.76	0.18	5.83	.02

Abbreviations: PA, physical activity; SD, standard deviation; POMS, Profile of Mood States; BES, Body Esteem Scale; MANCOVA, multiple analysis of covariance.
*Indicates the variables that were examined through a MANCOVA. The MANCOVA included the BES sexual attractiveness, physical condition, and weight concerns subscales.

treatment increases confidence in the validity of self-reported PA (ie, 7-Day PAR data).

Two anthropomorphic measures (BMI and percent body fat) also failed to show an intervention effect. This was not unanticipated because the intervention focused on PA and was not aimed at weight loss. Adults are recommended to exercise for at least 60 minutes on most days of the week to achieve weight loss.[57] For long-term weight loss, it is recommended that overweight and obese adults exercise 200 to 300 minutes per week or expend more than 2,000 kilocalories per week in leisure-time PA.[58] Also, an intervention would need to target dietary intake, in addition to increasing PA participation, to effect changes on these measures of body weight and composition. Likewise, the Institute of Medicine recommends expending energy in the range of 1.6 to 1.7 times the resting energy to maintain an ideal BMI (ie, BMI of 18.5 to 25 kg/m^2).[57] Therefore, an intervention would need to target dietary intake, in addition to increasing PA participation beyond the goals set for this study, to effect changes on these measures of body weight and composition.

The effects on PA and fitness from Moving Forward are largely consistent with findings from previous PA interventions with cancer populations.[15-19,21,22] Also similar to the Moving Forward trial, other interventions have not produced significant changes in body weight[19] or percent body fat.[22] Thus, PA interventions for cancer survivors seem to be effective in increasing PA participation and enhancing physical fitness, although these interventions do not produce changes in body weight and composition.

After treatment, participants who received the PA intervention reported higher levels of vigor and lower levels of fatigue than control participants. The latter finding is consistent with prior PA interventions for cancer populations[17,26] as well as an intervention that combined PA and group psychotherapy for cancer patients.[21] Increased vigor and reduced fatigue are noteworthy outcomes because the experience of enhanced vitality may serve as an intrinsic motivator to remain physically active. In addition, there was a trend towards improvement in body esteem among the PA group, which is consistent with prior research with an on-site supervised exercise program for breast cancer survivors.[24] The effects of increased PA on body esteem is worthy of further examination given the deleterious effects of cancer treatments.

The difference in total mood disturbance scores between the PA and control groups was of borderline significance. It is important to note that the telephone counseling provided to the PA group did not specifically target mood or include strategies to improve emotional adjustment. Thus, the trend on mood disturbance scores is likely to reflect one of the many beneficial effects of increased PA. Additionally, it is possible that PA must become more habitual and established before a group difference on mood disturbance scores is detected. Some prior PA interventions with cancer populations have produced significant improvement in psychological adjustment.[17,18,25] These interventions also offered other components that more directly affected mood, such as the provision of a support group.[18] Furthermore, it is possible that the decrease in mood disturbance scores for PA group participants (relative to controls) in this trial did not reach statistical significance because of a floor effect; the sample reported low levels of mood disturbance at baseline (in part because patients with psychiatric disorders were not eligible for the study).

The primary limitation of this study was the relatively high exclusionary rate that may limit the generalizability of the findings. Because the study involved home-based PA, it was important to maintain stringent inclusion and exclusion criteria. For example, patients were excluded from the study if they had been diagnosed with later-stage breast cancer, cardiac disease, diabetes, or other medical illness that may have made home-based exercise potentially unsafe. This rendered a smaller population of potentially eligible patients and, consequently, a smaller sample. In addition, this study involved an actively recruited sample of patients who were able to obtain physician consent and willing to be randomized. Furthermore, the sample was relatively homogeneous with regard to race/ethnicity and socioeconomic status; this too may limit the generalizability of the findings. It is possible that additional effects would have been detected on measures of mood if the sample had included patients with less favorable prognoses or a poorer mood at baseline.

That this intervention was home based has important implications for its portability. Ultimately, the goal is to develop interventions that can be implemented in community settings so that the greatest number of survivors can benefit. The ability to translate this intervention into a community setting is enhanced by the fact that it did not require specific exercise equipment or face-to-face PA supervision by professionals. Likewise, the relatively brief duration of telephone contacts (requiring minimal staff burden) increases the likelihood that support staff in a health care setting or community volunteers could successfully deliver the intervention after proper training. Thus, this intervention represents an important step toward developing PA interventions that can reach a large number of cancer survivors.

Another strength of this prospective, randomized, controlled study of a home-based PA intervention was that the intervention dose delivered (average of 11.47 calls to the PA participants) was close to the total intended dose (12 calls), and there was no significant group difference in the frequency of contact. The duration of calls did differ significantly between groups; however, matching the duration of contact was not a goal of the trial.

In sum, this study demonstrated the efficacy of a home-based intervention in increasing participation in moderate-intensity activity and improving fitness among early-stage breast cancer survivors. The breast cancer survivors who received the PA intervention in this trial not only increased their PA and improved their fitness, but they also demonstrated improvement on some psychological measures; they reported increased vigor and reduced fatigue, with a trend towards improvement in body esteem. Future research will be needed to establish the generalizability and maintenance of these results. It will be important to assess whether this intervention can be readily translated to other cancer populations (eg, prostate or colorectal cancer) or whether modifications must be made because these populations may, for example, be older or less motivated. Future research might also test whether the intervention can be safely and effectively implemented with cancer patients diagnosed with late-stage disease. Extended follow-ups are needed to determine whether PA interventions, such as Moving Forward, affect medical outcomes, such as rates of recurrence and late treatment effects.

Acknowledgment

We thank the late Maryl Winningham, PhD, for her expert advice, research staff (Lynn Bucknam, Julie Parsons, Catherine McMahon, Mary Roberts, Beverly Procopio, and Robin Cram) for study implementation, and Barbara Doll for manuscript preparation.

Authors' Disclosures of Potential Conflicts of Interest

The authors indicated no potential conflicts of interest.

REFERENCES

1. Beisecker A, Cook MR, Ashworth J, et al: Side effects of adjuvant chemotherapy: Perceptions of node-negative breast cancer patients. Psychooncology 6:85-93, 1997

2. Bleiker EM, Pouwer F, van der Ploeg HM, et al: Psychological distress two years after diagnosis of breast cancer: Frequency and prediction. Patient Educ Couns 40:209-217, 2000

3. deJong N, Courtens AM, Abu-Saad HH, et al: Fatigue in patients with breast cancer receiving adjuvant chemotherapy: A review of the literature. Cancer Nurs 25:283-297, 2002

4. Holzner B, Kemmler G, Kopp M, et al: Quality of life in breast cancer patients: Not enough attention for long-term survivors? Psychosomatics 42:117-123, 2001

5. Psychological Aspects of Breast Cancer Study Group: Psychological response to mastectomy: A prospective comparison study. Cancer 59:189-196, 1987

6. Loescher LJ, Welch-McCaffrey D, Leigh SA, et al: Surviving adult cancers. Part 1: Physiologic effects. Ann Intern Med 111:411-432, 1989

7. Cardinale D, Sandri MT, Marinoni A, et al: Myocardial injury revealed by plasma troponin I in breast cancer treated with high-dose chemotherapy. Ann Oncol 13:710-715, 2002

8. Taghian AG, Assaad SI, Niemierko A, et al: Risk of pneumonitis in breast cancer patients treated with radiation therapy and combination chemotherapy with paclitaxel. J Natl Cancer Inst 93:1806-1811, 2001

9. Courneya KS, Friedenreich CM: Physical exercise and quality of life following cancer diagnosis: A literature review. Ann Behav Med 21: 171-179, 1999

10. Pinto BM, Maruyama NC: Exercise in the rehabilitation of breast cancer survivors. Psychooncology 8:191-206, 1999

11. Pinto BM, Trunzo JJ, Reiss P, et al: Exercise participation after diagnosis of breast cancer: Trends and effects on mood and quality of life. Psychooncology 11:389-400, 2002

12. Courneya KS, Friedenreich CM: Relationship between exercise during treatment and current quality of life among survivors of breast cancer. J Psychosoc Oncol 15:35-57, 1997

13. Courneya KS, Friedenreich CM: Relationship between exercise pattern across the cancer experience and current quality of life in colorectal cancer survivors. J Altern Complement Med 3:215-226, 1997

14. US Department of Health and Human Services: Physical Activity and Health: A Report of the Surgeon General. Atlanta, GA, US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Promotion, US Government Printing Office, 1996

15. Dimeo F, Fetscher S, Lange W, et al: Effects of aerobic exercise on the physical performance and incidence of treatment-related complications after high-dose chemotherapy. Blood 90:3390-3394, 1997

16. MacVicar MG, Winningham ML, Nickel JL: Effects of aerobic interval training on cancer patients' functional capacity. Nurs Res 38:348-351, 1989

17. Mock V, Dow KH, Meares CJ, et al: Effects of exercise on fatigue, physical functioning, and emotional distress during radiation therapy for breast cancer. Oncol Nurs Forum 24:991-1000, 1997

18. Mock V, Burke MB, Sheehan P, et al: A nursing rehabilitation program for women with breast cancer receiving adjuvant chemotherapy. Oncol Nurs Forum 21:899-907, 1994

19. Segal R, Evans W, Johnson D, et al: Structured exercise improves physical functioning in women with stages I and II breast cancer: Results of a randomized controlled trial. J Clin Oncol 19:657-665, 2001

20. Dimeo F, Rumberger BG, Keul J: Aerobic exercise as therapy for cancer fatigue. Med Sci Sports Exerc 30:475-478, 1998

21. Courneya KS, Friedenreich CM, Sela RA, et al: The group psychotherapy and home-based physical exercise (GROUP-HOPE) trial in cancer survivors: Physical fitness and quality of life outcomes. Psychooncology 12:357-374, 2003

22. Courneya KS, Mackey JR, Bell GJ, et al: Randomized controlled trial of exercise training in postmenopausal breast cancer survivors: Cardiopulmonary and quality of life outcomes. J Clin Oncol 21:1660-1668, 2003

23. Dimeo FC, Tilmann MH, Bertz H, et al: Aerobic exercise in the rehabilitation of cancer patients after high dose chemotherapy and autologous peripheral stem cell transplantation. Cancer 79:1717-1722, 1997

24. Pinto BM, Clark MM, Maruyama NC, et al: Psychological and fitness changes associated with exercise participation among women with breast cancer. Psychooncology 12:118-126, 2003

25. Segar ML, Katch VL, Roth RS, et al: The effect of aerobic exercise on self-esteem and depressive and anxiety symptoms among breast cancer survivors. Oncol Nurs Forum 25:107-113, 1998

26. Oldervoll LM, Kaasa S, Knobel H, et al: Exercise reduces fatigue in chronic fatigued Hodgkin's disease survivors: Results from a pilot study. Eur J Cancer 39:57-63, 2003

27. Courneya KS, Friedenreich CM, Sela RA, et al: Correlates of adherence and contamination in a randomized controlled trial of exercise in cancer survivors: An application of the theory of planned behavior and the five factor model of personality. Ann Behav Med 24:257-268, 2002

28. Prochaska JO, DiClemente CC: Stages and processes of self-change of smoking: Toward an integrative model of change. J Consult Clin Psychol 51:390-395, 1983

29. Marcus BH, Rossi JS, Selby VC, et al: The stages and processes of exercise adoption and maintenance in a worksite sample. Health Psychol 11:386-395, 1992

30. Marcus BH, Bock BC, Pinto BM, et al: Efficacy of an individualized, motivationally-tailored physical activity intervention. Ann Behav Med 20:174-180, 1998

31. Peterson TR, Aldana SG: Improving exercise behavior: An application of the stages of change model in a worksite setting. Am J Health Promot 13:229-232, 1999

32. Pate RR, Pratt M, Blair SN, et al: Physical activity and public health: A recommendation

from the Centers for Disease Control and Prevention and the American College of Sports Medicine. JAMA 273:402-407, 1995

33. Parker PA, Baile WF, de Moor C, et al: Psychosocial and demographic predictors of quality of life in a large sample of cancer patients. Psychooncology 12:183-193, 2003

34. Vinokur AD, Threatt BA, Caplan RD, et al: Physical and psychosocial functioning and adjustment to breast cancer: Long-term follow-up of a screening population. Cancer 63:394-405, 1989

35. Amir M, Ramati A: Posttraumatic symptoms, emotional distress and quality of life in long-term survivors of breast cancer: A preliminary research. J Anxiety Disord 16:191-206, 2002

36. Marcus BH, Simkin LR: The stages of exercise behavior. J Sports Med Phys Fitness 33:83-88, 1993

37. Winningham M: Developing the Symptom Activity 27: An instrument to evaluate perception of symptom effects on activity. Oncol Nurs Forum 20:330, 1993 (abstr 231)

38. Jackson AS, Pollock ML: Generalized equations for predicting body density of women. Med Sci Sports Exerc 12:175-182, 1980

39. Blair SN, Haskell W, Ho P, et al: Assessment of habitual physical activity by a seven-day recall in community-survey and controlled experiments. Am J Epidemiol 122:794-804, 1985

40. Sallis JF, Haskell WL, Wood PD, et al: Physical activity assessment methodology in the Five City Project. Am J Epidemiol 121:91-106, 1985

41. Sarkin JA, Campbell J, Gross L, et al: Project GRAD seven day physical activity recall interviewer's manual. Med Sci Sports Exerc 29: S91-S102, 1997

42. Dunn AL, Garcia ME, Marcus BH, et al: Six-month physical activity and fitness changes in Project Active, a randomized trial. Med Sci Sports Exerc 30:1076-1083, 1998

43. Dunn AL, Marcus BH, Kampert JB, et al: Comparison of lifestyle and structured interventions to increase physical activity and cardiorespiratory fitness: A randomized trial. JAMA 281: 327-334, 1999

44. American College of Sports and Medicine: ACSM Fitness Book. Champaign, IL, Leisure Press, 1992

45. Kline GM, Procari JP, Hintermesiter R, et al: Estimation of VO_{2max} from a one-mile track walk, gender, age and bodyweight. Med Sci Sports Exerc 19:253-259, 1987

46. Pober DM, Freedson PS, Kline GM, et al: Development and validation of a one-mile treadmill walk test to predict peak oxygen uptake in healthy adults ages 40 to 79 years. Can J Appl Physiol 27:575-589, 2002

47. Wong TC, Webster JG, Montoye HJ, et al: Portable accelerometer device for measuring human energy expenditure. IEEE Trans Biomed Eng 28:467-471, 1981

48. Montoye HJ, Washburn R, Servais S, et al: Estimation of energy expenditure by a portable accelerometer. Med Sci Sports Exerc 15:403-407, 1983

49. Washburn RA, Cook TC, LaPorte RE: The objective assessment of physical activity in an occupationally active group. J Sports Med Phys Fitness 29:279-284, 1989

50. Schutz Y, Froidevaux F, JeQuier E: Estimation of 24 hour expenditure by a portable accelerometer. Proc Brit Nutr Soc 47:23A, 1987 (abstr)

51. Gretebeck R, Montoye HJ, Porter W: Comparison of the doubly labeled water method for measuring energy expenditure with Caltrac accelerometer readings. Med Sci Sports Exerc 23:s60, 1991 (abstr 356)

52. McNair DM, Lorr M, Droppelman LF: Profile of Mood States: Manual. San Diego, CA, Educational and Testing Service, 1971

53. McNair DM, Lorr M, Droppelman LF: EDITS Manual for the Profile of Mood States: Manual. San Diego, CA, Educational and Testing Service, 1992

54. Boyd NF, Selby PJ, Sutherland HJ, et al: Measurement of the clinical status of patients with breast cancer: Evidence for the validity of self assessment with linear analogue scales. J Clin Epidemiol 41:243-250, 1988

55. Franzoi SL, Shields SA: The Body Esteem Scale: Multidimensional structure and sex differences in a college population. J Pers Assess 48:173-178, 1984

56. American College of Sports and Medicine: American College of Sports Medicine Position Stand: The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness in health adults. Med Sci Sports Exerc 22:265-274, 1990

57. Institute of Medicine: Dietary Reference Intakes for Energy, Carbohydrates, Fiber, Fat, Protein and Amino Acids (macronutrients). Washington, DC, National Academies Press, 2002

58. American College of Sports Medicine: Appropriate intervention strategies for weight loss and prevention of weight regain for adults. Med Sci Sports Exerc 33:2145-2156, 2001