

Running head: INCREASING PHYSICAL ACTIVITY IN CANCER SURVIVORS

Motivational Interviewing to Increase Physical Activity
in Long-Term Cancer Survivors: A Randomized Controlled Trial

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Abstract

Background: Physical activity can confer many benefits on cancer survivors, including relief of persistent symptoms related to cancer treatment.

Objectives: Evaluate the effect of a motivational interviewing (MI) intervention on increasing physical activities and improving aerobic fitness, health, and fatigue in long-term cancer survivors. A secondary purpose was to evaluate whether the effect of MI on physical activities depended on self-efficacy for exercise.

Method: Fifty-six physically inactive adult cancer survivors (mean 42 months since completion of treatment) were randomly assigned to intervention and control groups. The MI intervention consisted of one in-person counseling session followed by two MI telephone calls over six months. Control group participants received two telephone calls without MI content. Outcomes were measured at baseline, 3 months, and 6 months and analyzed using multi-level modeling.

Results: The MI intervention explained significant group differences in regular physical activities (measured in caloric expenditure per week), controlling for time since completion of cancer treatment ($p < .05$). Aerobic fitness, physical and mental health, and fatigue were not different between groups. In the intervention group, individuals with high self-efficacy for exercise at baseline increased their physical activity more than those with low self-efficacy ($p < .05$). In the control group, increases in physical activity did not depend on self-efficacy.

Discussion: MI may be useful to increase physical activity in long-term cancer survivors, especially in persons with high self-efficacy for exercise. Multi-level modeling analysis revealed individual changes that would not have been shown by analysis of group means. Future studies with larger samples or more intense MI interventions may show changes in aerobic fitness, physical and mental health, and fatigue.

The 10 million cancer survivors in the U.S. range from those recently diagnosed to survivors many years beyond cancer treatment (National Cancer Policy Board, 2006). Cancer survivors report a number of emotional, physical, and cognitive symptoms that may be related to the after-effects of cancer treatment or to the disease itself (Ganz, Rowland, Desmond, Meyerowitz, & Wyatt, 1998; Nail, 2001). One of these is fatigue, a symptom that often persists well beyond the treatment period (Curt et al., 2000; Nail, 2001, 2002).

A number of studies have demonstrated that physical activity decreases fatigue and improves physical functioning, health, and quality of life during, or immediately after, cancer treatment (Dimeo, 2002; Knols, Aaronson, Uebelhart, Franssen, & Aufdemkampe, 2005; Schwartz, Mori, Gao, Nail, & King, 2001; Thorsen et al., 2005). Recent research suggests that physical activity may have similar beneficial effects for cancer survivors who are more than 6 months beyond cancer treatment (Courneya et al., 2003), but few randomized trials of physical activity interventions have been conducted in long-term cancer survivors (Courneya, 2003; Knols et al., 2005; Schmitz et al., 2005).

Though physical activity has multiple benefits, many adults, including cancer survivors, are unable to maintain habitual physical activities. Thus, an important public health goal is to develop strategies to help people, with and without cancer, adopt physical activity habits and maintain activities long-term. Motivational Interviewing (MI) may be such a strategy. MI is a client-centered counseling procedure designed to help clients discover and overcome their own barriers to changing a health behavior. In contrast to many educational interventions, MI counselors maintain a neutral tone intended to help individuals explore their own solutions to implementing behavioral change, rather than offering advice or education.

The transtheoretical model, a framework for understanding behavioral change as a process of moving through stages of readiness, has played an important role in the development of MI (DiClemente & Velasquez, 2003; Prochaska & Velicer, 1997). According to the transtheoretical model, individuals cycle back and forth through several stages of change: precontemplation (not thinking about becoming more active), contemplation (considering a change), preparation (making small changes), action (actively engaging in a new behavior), and maintenance (continuing the new activity over time). A counselor trained in MI uses questions to assess individual stage of change at different times during the intervention period and then uses appropriate messages and strategies tailored to that stage. A key concept of MI is that an individual's self-efficacy, or belief that he or she can accomplish a behavior change, is a predictor of treatment outcome (Marshall & Biddle, 2001; Miller & Rollnick, 2002). Perceived self-efficacy, derived from the framework of social cognitive theory, refers to individual's belief that he or she can organize and carry out actions, an essential component of undertaking a new activity and continuing to engage in that activity. Unless people believe that they can complete a task and that completing this task can produce the outcomes they desire, they have little incentive to act or to persevere in the face of difficulties (Bandura, 1977, 1986).

The primary purpose of this prospective randomized controlled trial of 56 cancer survivors was to test whether MI would help long-term cancer survivors increase their participation in regular physical activities of their own choosing. A secondary purpose was to evaluate whether the effect of MI on change in physical activity depended on individual levels of self-efficacy for exercise. In addition, we evaluated the effect of MI on other outcomes associated with increased physical activity: aerobic fitness, physical health status, mental health status, and fatigue. Outcomes were evaluated using multi-level modeling, which allowed analysis

of individual variance that cannot be evaluated using traditional ANOVA analysis of group means.

Method

Participants

Participants were recruited from the community using advertising and word of mouth. Eligible participants were cancer survivors aged 18 years or older, who completed treatment at least 6 months prior to enrollment, and who were fatigued, underactive (engaged in planned exercise fewer than 3 days a week for 20 minutes per session), and willing to try to increase their regular physical activity. People were ineligible if they had prior transplant treatment for cancer, current immunosuppressive therapy, medical conditions that contraindicated moderate exercise, cognitive difficulties, or psychiatric disorders. This study was funded by the Lance Armstrong Foundation and procedures were approved by the University Institutional Review Board.

Procedures

Initial screening by telephone was followed by an individual enrollment appointment, at which each participant signed an informed consent, completed baseline surveys, and performed a 6-minute walk test. Height and weight were measured. At the completion of the baseline measurements, a Physical Activity Counselor assigned each participant to either the intervention or the control group according to a computer-generated randomization list. The Physical Activity Counselor conducted the motivational interviewing intervention and outcome measurements and was not blinded to group assignment. The target sample size of 56 participants was sufficient to detect an effect size of .83 on the outcomes with a power of .80 and alpha level of .05, allowing for 10% attrition.

Motivational Interviewing Intervention

Participants assigned to the intervention group received an individual counseling session immediately following group assignment. Each session was approximately 30 minutes and consisted of conversations consistent with MI (Miller & Rollnick, 2002), tailored according to the needs of each participant. The overall goal was to encourage all participants to advance toward a goal of 30 minutes of moderate intensity planned physical activity on most days of the week, but some participants started with more modest goals. Each intervention participant received a pedometer and was shown how to use it, but participants were not required to walk if they preferred another form of moderate intensity exercise.

Two weeks after the initial counseling session, the Physical Activity Counselor telephoned each participant to troubleshoot any problems with the pedometer, followed by two MI telephone calls at 2 months and 4.5 months after enrollment, to help solve problems in adopting the new physical activity program. Participants assigned to the control group were asked to maintain their current levels of physical activity, though they were not required to do so. They did not receive pedometers or in-person counseling, but received two social telephone calls from the Physical Activity Counselor at 2 months and 4.5 months. Participants in both groups received yellow plastic LiveStrong® bracelets from Lance Armstrong Foundation and were paid \$10 at each of the three measurement sessions.

The Physical Activity Counselor was a master's-prepared research assistant who received 8 hours of group training and 6 hours of individual training by an experienced MI trainer who had met the requirements of the Motivational Interviewing Network of Trainers (*Motivational Interviewing*, 2005). During the study, the trainer also evaluated a sample of recorded MI sessions with participants and discussed them with the Physical Activity Counselor.

Outcome Variables

The outcomes were measured at enrollment, 3, and 6 months. Survey measures were sent to participants prior to the 3- and 6-month measurement appointments; participants could choose to complete surveys at home and bring to the appointments or complete the surveys during the measurement appointment, when height, weight, and the 6-minute walk test were measured.

Regular physical activities. Physical activities were measured by the Community Healthy Activities Model Program for Seniors (CHAMPS) Physical Activity Questionnaire for Older Adults (Stewart et al., 2001), which is appropriate for sedentary adults of all ages. The CHAMPS questionnaire asks about sedentary, low, moderate, and vigorous activities during the last 4 weeks. We deleted one item 2 about participation in an adult day center, leaving 40 items scored in hours/week. Scores were converted to caloric expenditure per week (kcal/wk) in all activities. Higher scores indicate higher levels of regular physical activities.

Aerobic fitness. Aerobic fitness was measured by distance (in feet) walked in the 6-minute walk test (Guyatt et al., 1985; Lipkin, Scriven, Crake, & Poole-Wilson, 1986; Meyer et al., 1997; Zugck et al., 2000), conducted on a circular measured course in an indoor exercise facility. Participants were told the object of the test was to walk as far as possible in six minutes, but they could stop to rest and then continue, if needed. The tester used a protocol for instructions, timing, and verbal encouragement during test. Longer distances in the 6-minute walk test indicate higher levels of aerobic fitness.

Physical health status and mental health status. Health status variables were measured by the Short-form 36 (SF-36, v.2) Physical Component Summary (PCS) and Mental Component Summary (MCS) (Ware, 2005). The PCS includes scales of physical functioning, role-physical, pain, general health. The MCS includes scales of vitality, social functioning, role-emotional, and

mental health. The PCS and MCS scores were transformed to norm-based scoring, in which scores had a mean of 50 and a standard deviation of 10 in the 1998 U.S. population (Ware, 2005). Scores range from 0-100, with higher scores indicating better physical or mental health status.

Fatigue. Fatigue was measured by the Schwartz Cancer Fatigue Scale (Schwartz, 1998), a 6-item scale developed to specifically measure cancer fatigue during the previous 2-3 days. The summed score ranges from 6 to 30, with higher scores indicating more fatigue.

Descriptive Variables

Self-efficacy for regular physical activities. Self-efficacy was measured by a 6-item measure of self-efficacy for physical activity (Nigg & Riebe, 2002). Participants indicate confidence they can exercise on a 5-level Likert scale (from not at all confident to completely confident) for six barriers (for example, bad weather). Summed scores range from 6-30, with higher scores indicating higher self-efficacy for exercise.

Descriptive variables. Descriptive variables were measured by surveys and measurements at the baseline enrollment appointment, including demographic variables, medical conditions, months since ending cancer treatment, and type of cancer. Height and weight were measured at baseline, 3 months, and 6 months. Stage of change for exercise was measured using the 6-item Physical Activity State Assessment measure developed for the NIH Behavior Change Consortium (Behavior Change Consortium, 2005).

Statistical Analysis

Multi-level modeling (MLM) capitalizes on multiple times of measurement to explicitly examine (a) individual variation around average trajectory over time, and (b) predictors of individual change. The key statistical advantage over other methods is that it controls for the

dependencies among the repeated measurements. The key design advantage is that it allows for differences in the number of times of measurement across individuals when random missingness exists, so cases with missing data can be included in the analyses (Raudenbush & Bryk, 2002).

In this study, MLM analysis using HLM 6 software (Raudenbush, Bryk, & Congdon, 2004), was used to examine five separate growth curve analyses – one for each outcome variable. At Level 1, each individual's change was represented by an individual intercept (baseline value) and slope (rate of change) and by whether the intercept and slope varied significantly from the population mean intercept and slope. For outcome variables with no significant individual variance around the population mean slope, ANOVA analysis was conducted because group means were the best estimate of variance. For outcome variables with significant individual variation around the population mean slope, Level 2 MLM models were run to evaluate whether group assignment, explained the individual variance in rate of change (Raudenbush & Bryk, 2002).

All Level 2 analyses were conducted controlling for months since completion of cancer treatment, because the broad range (1-17 years) in this sample raised the possibility that there might be a between-individual effect of recent versus remote treatment on willingness to engage in activities. In addition, for the physical activity outcome, an interaction analysis was conducted to determine whether the effect of group assignment on physical activity depended on individual self-efficacy for exercise at baseline. We did not add additional covariates to our models because three predictors—group, time since cancer treatment, and self-efficacy (for the physical activity outcome)—were reasonable for the sample size in this study, and because the randomization scheme successfully distributed key characteristics equally between the two groups.

Statistical analysis was conducted using intention-to-treat methods. For MLM analyses, maximum likelihood estimation was used to account for missing data. For ANOVA analyses, mean imputation was used for missing data if at least 75% of items were answered on a survey measure. If fewer than 75% of items were answered on a survey, or if measure was missing completely, cases were not included in ANOVA.

Results

Participant Flow

Fifty-six cancer survivors were enrolled between July and December 2004, and the study ended in July 2005. Figure 1 shows the flow of participants through the trial.

Description of Participants at Baseline

Participants were primarily female, white, breast cancer survivors with a mean 42 months since completing cancer treatment (Table 1). Almost all were planning to begin an exercise program within the next six months, indicating they were in the “contemplation” stage. There were no statistically significant differences between the groups in baseline characteristics.

Delivery of the Intervention

The Physical Activity Counselor completed all initial counseling sessions (average 24 minutes length, range 14-50 minutes) and completed 98% of scheduled telephone calls. Calls were considered not completed if they did not occur within one day before or seven days after the targeted date, or after ten attempts did not result in a completed call. Telephone calls to intervention group participants averaged 10 minutes, and calls to control group participants averaged 4.5 minutes.

There were no deviations from the trial protocol as planned. However, for one month during the intervention period, the Physical Activity Counselor was unable to work and another

research assistant, trained in MI, conducted 21 intervention and control telephone calls and 11 3-month measurement appointments.

Changes in Outcomes

Group mean scores on outcome variables at baseline, 3 months, and 6 months are shown in Table 2. At baseline, the intervention and control groups had similar mean scores on all outcome measures except mean level of participation in all regular physical activity (measured in kcal/wk) was significantly lower ($p = .04$) in the intervention group than in the control group. There were no outliers in the data.

Regular physical activities. Results of the Level 1 MLM model showed that both the intercept ($B = 2331.46, p < .001$) and the linear slope ($B = 432.37, p < .05$) were significantly different from zero. On average, the level of regular weekly physical activities for all participants was 2331.46 kcal/wk at baseline, and increased nearly 865 kcal/wk (37%) across the 6-month study. Table 3 shows that there was significant individual variation in both the intercept and slope to be explained in a Level 2 model. As an example of individual variances compared with group mean, Figure 2 shows 12 individual intercepts and slopes for physical activities along with the group mean trajectory and slope. This figure is provided as an illustration of the importance of considering individual variation, rather than simple group means, an advantage of MLM analysis over ANOVA. The 12 trajectories were selected to show the maximum differences in our sample, and are shown for illustrative purposes only.

In the Level 2 model, group assignment accounted for 30% of the variance in the intercept and 47% of the variance in the linear slope, controlling for months since completion of cancer treatment. As shown in Table 4, group assignment was significantly associated with regular physical activities at baseline (intercept) and rate of change (slope). Individuals in the

intervention group started with lower levels of regular physical activities, but increased at a significantly faster rate over time, compared to control group individuals (Figure 3).

Self-efficacy for engaging in regular physical activities. An interaction analysis was conducted on the MLM Level 2 model to determine whether the association between group assignment and regular physical activities depended on individual level of self-efficacy for exercise at baseline. Controlling for time since completion of cancer treatment, high-efficacy individuals in the intervention group increased their physical activity levels faster over 6 months than did low-efficacy individuals in the intervention group ($B = 121.35, p < .05$). In the control group, self-efficacy did not affect levels of physical activity (Figure 4).

Aerobic fitness. Results of the Level 1 MLM model showed that both the intercept ($B = 1542.97, p < .001$) and the linear slope ($B = 59.24, p < .001$) were significantly different from zero. On average, the number of feet walked in 6 minutes for all participants was 1542.97 at baseline and increased nearly 120 feet (8%) across the study. Table 3 shows that there was significant individual variation in both the intercept and slope to be explained in a Level 2 model; however, that model showed that group assignment was not significantly associated with variation around the mean slope (Table 4).

Mental health status. Results of the Level 1 MLM model showed that both the intercept ($B = 45.65, p < .001$) and the linear slope ($B = 3.12, p < .01$) were significantly different from zero. On average, the level of mental health status for all participants was 45.65 at baseline and increased 6 points (13%) across the study, Table 3 shows that there was significant individual variation in both the intercept and slope to be explained in a Level 2 model; however, that model showed that group assignment was not significantly associated with variation around the mean slope (Table 4).

Physical health status. Results of the Level 1 MLM model showed that both the intercept ($B = 42.98, p < .001$) and the linear slope ($B = 1.57, p < .001$) were significantly different from zero. On average, the level of physical health status for all participants was 42.98 at baseline and increased 3 points (7%) across the study. As there was no significant individual variation in the slope to be explained in a Level 2 model, an ANOVA analysis of group mean trajectory adequately represented the data. That analysis showed that the group x time interaction was not significant for physical health, (Wilk's lambda $\Lambda = .89, (F(2,38) = 2.42, ns)$).

Fatigue. Results of the Level 1 MLM model showed that both the intercept ($B = 15.20, p < .001$) and the linear slope ($B = -2.11, p < .001$) were significantly different from zero. On average, the level of fatigue status for all participants was 15.20 at baseline and declined 4.22 points (27%) across the study. As there was no significant individual variation in the slope to be explained in a Level 2 model, an ANOVA analysis of group mean trajectory adequately represented the data. That analysis showed that the group x time interaction for fatigue was significant, $\Lambda = .78, (F(2,37) = 5.24, p = .010)$. However, inspection of the graph showed this was an artifact of 3-month measures, while values at baseline and 6-months showed no significant differences between groups, leading to the conclusion that the significant effect of the interaction was the result of measurement error.

Discussion

In this sample of long-term cancer survivors, participants in the MI intervention group increased their self-reported regular physical activities by a mean 1556 kcal/week, compared to an mean increase of 397 kcal/week in the control group. On average, the MI group participants were more inactive, with a mean 900 kcal/week less activity than the control group at the beginning of the study, but were more active than the control group at the end of 6 months by

about 230 kcal/week. The mean increased activity of more than 1500 kcal/week in the MI group from beginning to end of the study could represent a clinically important change, as 1000-1500 kcal/week is considered a threshold for achieving health benefits (Schairer, Keteyian, Ehrman, Brawner, & Berkebile, 2003).

Our finding that MI increased physical activity in cancer survivors is similar to that of Pinto et al. (2005), who showed that once-a-week MI telephone calls increased home-based physical activity over 12 weeks in breast cancer survivors less than two years past treatment. The more frequent MI contacts in that study resulted in an $ES=.81$, larger than the $ES=.55$ in this study. Larger effect sizes on physical activity have been reported in studies of MI interventions in persons without cancer, $ES=1.32$ (Di Loreto et al., 2003) and $ES=1.34$ (Kirk, Mutrie, MacIntyre, & Fisher, 2003). Our smaller effect size suggests that cancer survivors may be more difficult to motivate to adopt physical activity habits, requiring a more intense motivational intervention. Some prior studies have shown that survivors undergoing cancer treatment, or shortly past treatment, are willing to engage in home-based exercise programs (Angrist, Imbens, & Rubin, 1996; Schwartz, 1999, 2000b), but whether such motivation endures in long-term survivors is not known. This study shows that MI warrants further investigation as a strategy to motivate long-term cancer survivors to engage in physical activities of their own choosing.

Our results provide evidence for self-efficacy as a key concept in physical activity behavior change, as posited in social cognitive theory (Bandura, 1977), and the transtheoretical model (Prochaska & Velicer, 1997). In the presence of MI counseling, cancer survivors with high self-efficacy for exercise increased their regular physical activities more than did those with low self-efficacy, while participants in the control group increased their physical activity at approximately the same rate, regardless of individual self-efficacy. These findings are

particularly compelling because the mean self-efficacy in the MI group was lower than that of the control group at the beginning of the study. The MI intervention appears to have supported self-efficacy, as theorized. Further, the role of self-efficacy in increasing physical activity depended on MI, self-efficacy alone was not sufficient for behavior change in this sample. The synergy between self-efficacy and MI counseling has been proposed as the main mechanism by which behavior change occurs and the findings of this study provide evidence that this is true in increasing physical activity in cancer survivors and, perhaps, in all persons.

Though participation in regular physical activities increased as a result of an MI intervention in this study, hypothesized effects on aerobic fitness, physical health status, mental health status, and fatigue were not demonstrated. The small sample size may have prevented statistically significant group differences in some, or all, of these outcomes. The non-significant effect on fatigue is particularly surprising, as earlier studies with small sample sizes have decreased fatigue associated with physical activity during cancer treatment (McKenzie & Kalda, 2003; Mock et al., 2005; Schwartz, 2000a; Schwartz et al., 2001). Perhaps a more intense MI intervention, such as more frequent telephone calls or a longer intervention period, would produce significant effects on these outcomes in future studies.

A strength of this study was the use of MLM analysis to show significant individual changes in physical activity that would not have been detected using an analysis, such as ANOVA, that compared group means. The MLM analysis was limited to a baseline covariate, months since cancer treatment, because the study variables were measured at only three time points. With additional time points, it would be possible to examine a time-varying covariate—for example, the change in self-efficacy over time—a powerful advantage of MLM analysis that should be considered in the design of future intervention studies.

A limitation of this study was the Physical Activity Counselor's lack of masking to group assignments, which presents the possibility of introducing MI components into the brief telephone calls to control group participants. Future studies would be stronger if telephone calls are conducted by a different interventionist for each group. The 6-minute walk test was conducted using a strict protocol that limited dialogue between participant and Physical Activity Counselor during the test, but it is somewhat possible that conversation prior to the test might have influenced performance.

In summary, this study demonstrated that MI can increase regular choice-based physical activity in long-term cancer survivors and that self-efficacy plays a role in the success of MI. Future research is warranted to determine whether a more intense MI intervention would strengthen the effect on physical activity behavior, and future studies with larger samples may provide evidence that increased physical activity reduces symptoms and improves health in long-term cancer survivors.

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Table 1. Baseline Characteristics of Participants (N=56)

	Intervention Group	Control Group	Intervention
	<i>n</i> = 28	<i>n</i> = 28	vs.
	Mean (<i>SD</i>) or number	Mean (<i>SD</i>) or number	<i>p</i> value
Age	55.5 (8.9)	60.1 (11.0)	.08
(range: 37-85)			
Gender	26 female	24 female	.39
	2 male	4 male	
Married/partnered	19	16	.81
Race/ethnicity	27 White	28 White	not
	1 Latino		calculated
Education	19 associate degree	22 associate degree	.83
	or above	or above	
Employment	13 full time	9 full time	.15
	6 part time	4 part time	
	2 homemaker	15 retired/unemployed	
	7 retired/unemployed		
Body Mass Index	29.6 (6.4)	26.6 (7.2)	.93
Years since cancer	4.8 (3.0)	6.9 (5.9)	.10
diagnosis			
(range: 1-23)			
Type of cancer	20 breast	23 breast	.52

	8 other	6 other	
Months since ending cancer treatment (range: 6-206)	33.7 (30.5)	50.3 (53.8)	.16
Intending to begin exercise in next 30-180 days (contemplation stage of change for exercise)	24	26	.69
Self-efficacy for exercise	20.3 (5.3)	20.7 (5.6)	.87

Note. *SD*=standard deviation; *t*-tests were used to compare means of continuous variables and chi-square tests were used to compare categorical variables.

Table 2. Effects of Motivational Intervention on Outcomes in Exercise Group and Control Group

Outcomes	Effect						
	Baseline		3 Months		6 Months		Size
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N d
Primary Outcomes							
All activities (kcal/wk)							.55
Exercise group	27	1928.97 (1232.58)	23	2571.04 (1872.23)	20	3484.05 (2445.34)	20
Control group	28	2855.66 (2008.92)	24	2651.27 (1590.18)	26	3252.40 (2308.33)	26
Secondary Outcomes							
Aerobic fitness							.09
Exercise group	28	1607.98 (276.12)	23	1686.53 (303.95)	21	1798.68 (313.75)	21
Control group	28	1533.99 (307.98)	24	1654.41 (277.01)	28	1650.85 (345.85)	28
Health status (physical)							.40
Exercise group	28	41.32 (7.97)	23	43.95 (8.71)	20	47.11 (11.08)	20
Control group	28	44.46 (9.79)	24	46.95 (7.72)	26	45.51 (9.80)	26
Health status (mental)							-.24

Exercise group	28	40.92	23	44.13	20	44.42	20	
		(9.84)		(8.78)		(8.24)		
Control group	28	45.58	24	48.92	26	51.68	26	
		(10.26)		(8.79)		(5.98)		
Fatigue							-14	
Exercise group	25	15.56	23	13.43	20	11.00	19	
		(4.64)		(4.23)		(2.90)		
Control group	28	15.52	24	11.29	26	11.46	26	
		(3.65)		(3.71)		(3.64)		

Note. Effect sizes were computed using means and standard deviations of participants with data for both baseline and 6 month surveys using the following formula: $((M_{3E} - M_{1E}) - (M_{3C} - M_{1C})) / \text{Pooled } SD_{3E,3C}$

Table 3
Multilevel Model Random-Effect Results for Level 1 Model Using Full Maximum Likelihood Estimation (N = 56)

	<i>Variance Component</i>	<i>df</i>	χ^2
Regular Physical Activities (kcal/wk)			
Intercept	893792.96	51	81.55**
Linear Slope	590192.29	51	81.99**
Aerobic Fitness			
Intercept	78144.59	50	925.51***
Linear Slope	1068.86	50	68.85*
Physical Health Status			
Intercept	53.13	51	195.36***
Linear Slope	0.36	51	40.92
Mental Health Status			
Intercept	73.55	51	189.33***
Linear Slope	6.07	51	68.55*
Fatigue			
Intercept	10.70	50	125.66***
Linear Slope	0.87	50	59.66

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4

Multilevel Model Fixed-Effect Results for Level 2 Models Using Full Maximum Likelihood Estimation (N = 56)

	Regular Physical Activities		Aerobic Fitness		Mental Health Status	
	<i>Coefficient</i>	<i>SE</i>	<i>Coefficient</i>	<i>SE</i>	<i>Coefficient</i>	<i>SE</i>
Intercept	2776.25***	286.07	1542.97***	54.62	45.65***	1.84
Intervention group	-907.41*	411.61	59.73	77.97	-4.10	2.62
Linear Slope	79.16	220.12	59.24***	11.77	3.12**	0.89
Intervention group	732.93*	330.11	12.62	17.99	-1.16	1.32

Note: Unstandardized coefficients shown. Model controlled for months since cancer treatment.

* $p < .05$. ** $p < .01$. *** $p < .001$.

FIGURE LEGENDS

Figure 1. Flow of participants through the trial

Figure 2. Average physical activity trajectory for the overall sample (N=56) and individual trajectories for 12 participants. High scores indicate greater physical activity.

Figure 3. Physical activity trajectories for participants in the intervention and control groups, controlling for months since end of cancer treatment.

Figure 4. Interaction of self-efficacy on physical activity trajectories for participants in the intervention and control groups, controlling for months since end of cancer treatment.

Figure 1 is a separate document

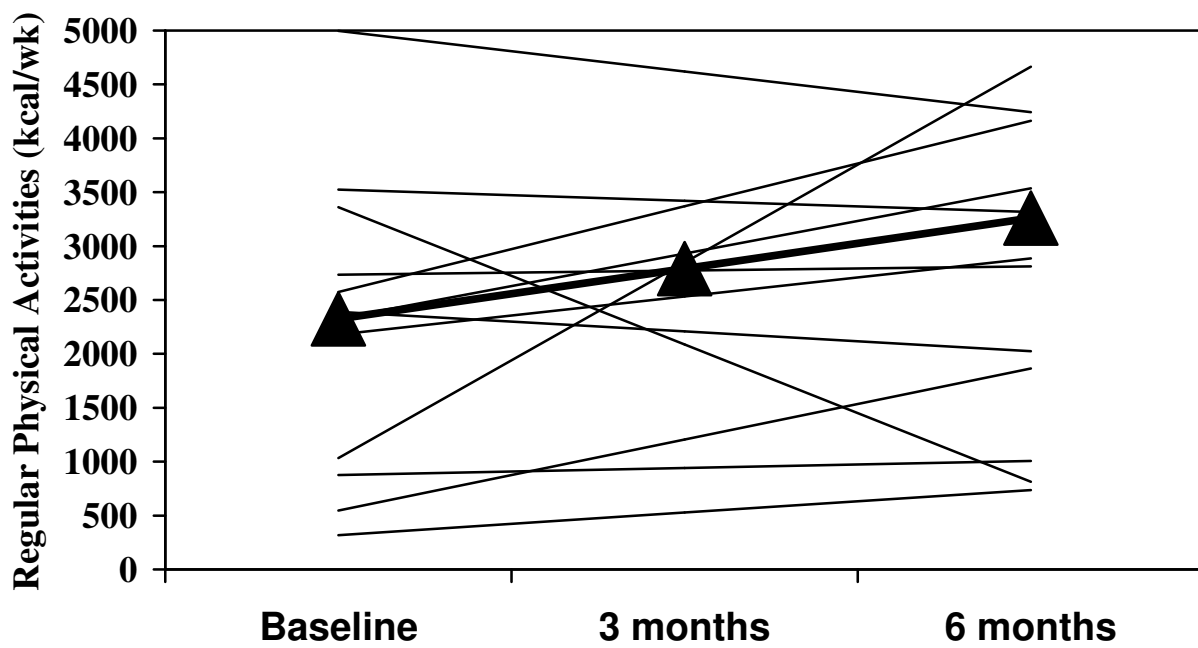


Figure 2

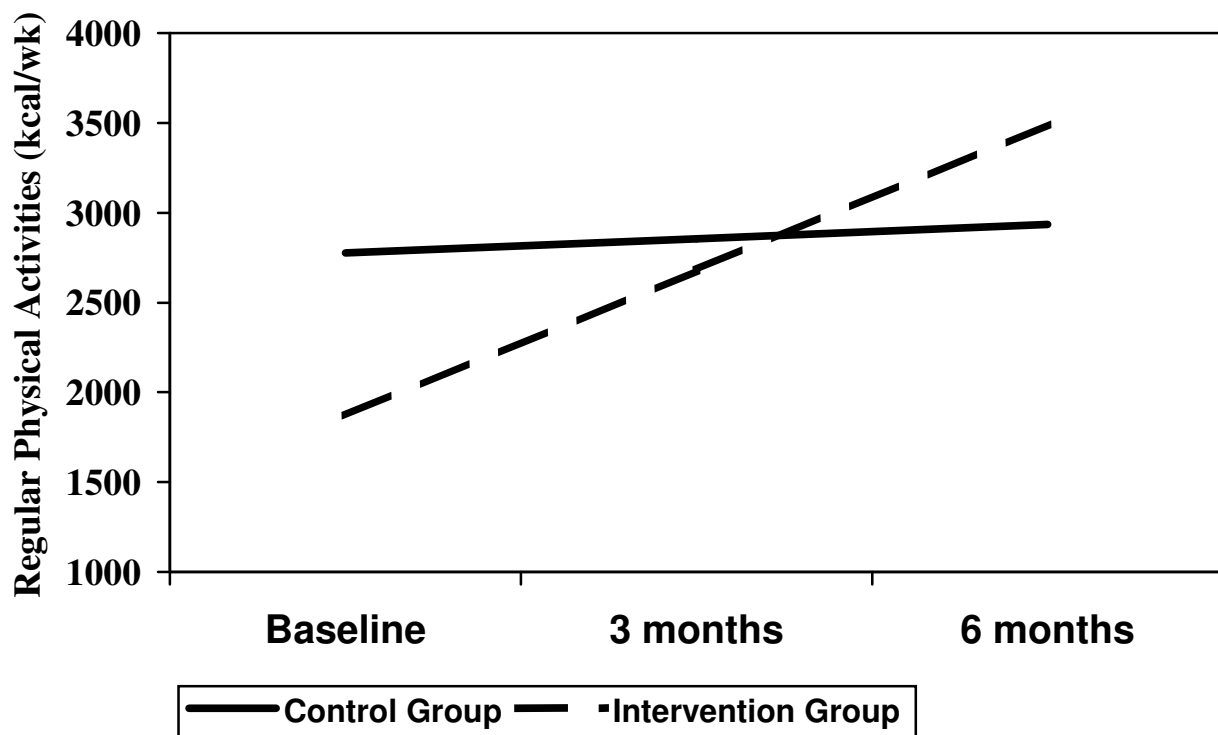


Figure 3

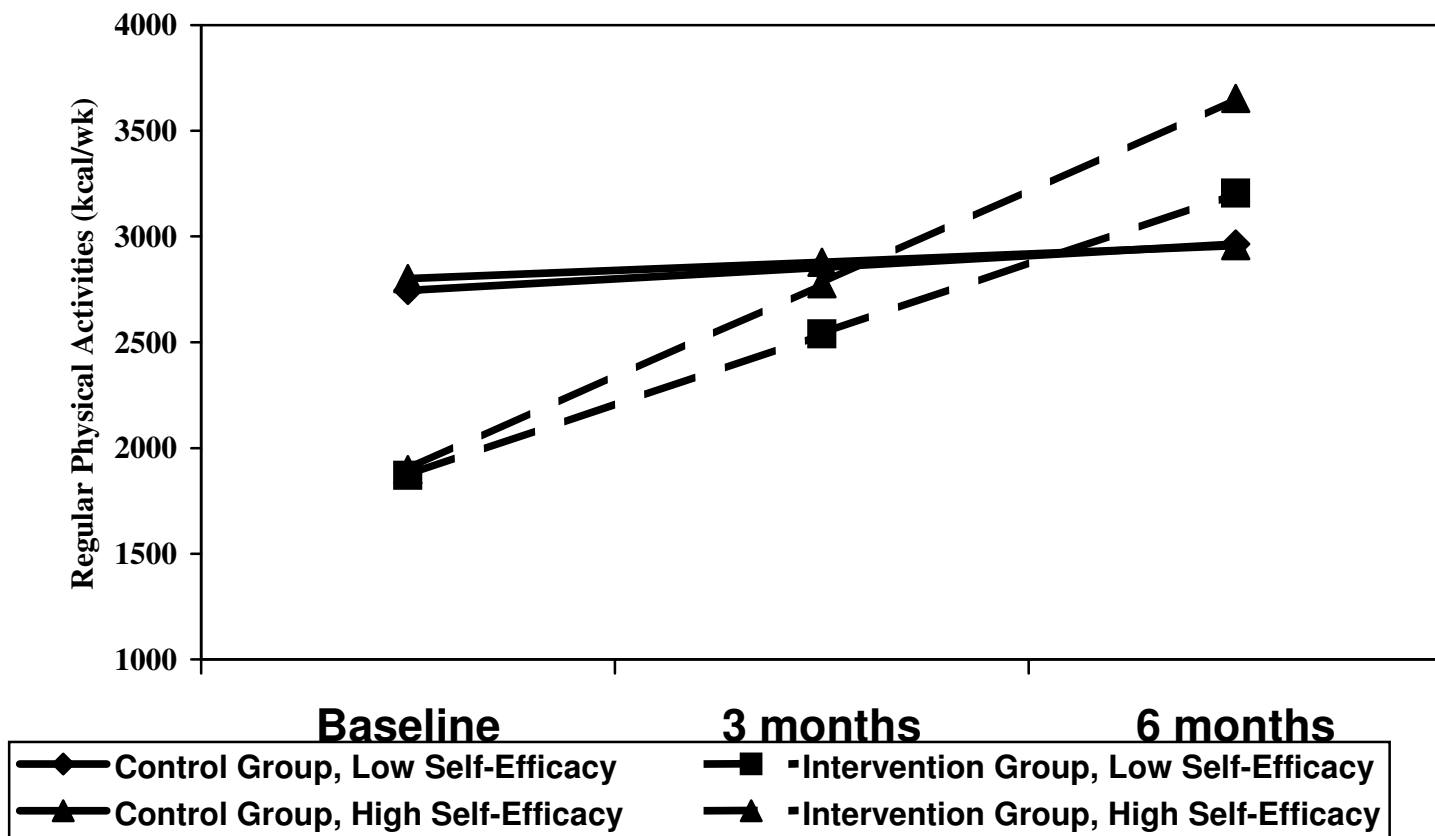


Figure 4