Int.J. Behav. Med. (2010) 17:264–270
DOI 10.1007/s12529-010-9076-y

# Relationships Between Cardiorespiratory Fitness, Physical Activity, and Psychosocial Variables in Overweight and Obese Breast Cancer Survivors

**Deborah L. Taylor · Jeanne F. Nichols · Bilgé Pakiz · Wayne A. Bardwell · Shirley W. Flatt · Cheryl L. Rock**

Published online: 23 February 2010


**Abstract**
*Background* Breast cancer survivors not only experience distressing physical symptoms associated with treatments, but also are faced with psychosocial challenges. Despite growing scientific evidence that physical activity (PA) may mitigate psychosocial distress experienced by women treated for breast cancer, the literature is equivocal.
*Purpose* This study investigated the relationships between cardiorespiratory fitness (CRF), PA, and psychosocial factors in breast cancer survivors.
*Method* Data involving overweight or obese breast cancer survivors ($N$=260) were examined. CRF was determined by a submaximal graded exercise test. PA, depressive symptoms, total fatigue, and global self-esteem were assessed with self-report measures. Pearson's correlations were conducted to determine associations among CRF, PA, depressive symptoms, total fatigue, and global self-esteem. Multiple regression models, with age and body mass index as covariates, were performed using continuous levels for CRF and PA.
*Results* Bivariate correlations suggested that CRF and PA were unrelated to the psychosocial variables. One of the regression models identified a marginally significant ($P$=0.06) inverse association between depressive symptoms and PA.
*Conclusion* CRF and PA were not associated with psychosocial factors in this sample of breast cancer survivors. However, minimal PA was reported by the majority of participants, so low PA variability likely influenced these findings.

**Keywords** Breast cancer survivors · Physical activity · Cardiorespiratory fitness · Psychosocial health

D. L. Taylor (✉) · J. F. Nichols
School of Exercise and Nutritional Sciences,
San Diego State University,
San Diego, CA, USA
e-mail: debbiltaylor@yahoo.com

B. Pakiz · W. A. Bardwell · S. W. Flatt · C. L. Rock
Department of Family and Preventive Medicine,
Moores UCSD Cancer Center, University of California,
La Jolla,
San Diego, CA, USA

## Introduction

Breast cancer is a widespread health problem affecting women across the globe. One in eight women in the USA will develop breast cancer during their lifetime [1]. Internationally, breast cancer is the most commonly diagnosed cancer among women. Over the past two decades, improvements in breast cancer diagnosis, treatment, and care have reduced mortality, and thus have led to a growing population of survivors [2–4].

It is not uncommon for breast cancer survivors to experience distressing physical symptoms from treatment, and face psychosocial challenges [5] that can impede recovery. Treatment-related psychosocial symptoms include reduced quality of life, anxiety, fatigue, depression, poor body image, and negative self-image [4–7]. Fatigue is one of the most common and distressing symptoms reported by survivors with one study reporting significant fatigue in 34% of the subjects at 5–10 years after diagnosis [7]. Similarly, depression has been recognized as one of the most notable psychological effects of mastectomy, with the duration of symptoms lasting months to years following treatment [4]. Self-esteem is another facet of psychosocial health that may be negatively impacted by the breast cancer experience; treatment-related physical consequences may de-value a woman's view of herself [5]. These studies suggest that psychosocial adjustment and health following breast cancer treatment are an essential component of recovery.

While traditional approaches to treating psychosocial distress (e.g., psychotherapy, psychotropic medications) have been used for many years, growing evidence suggests that regular physical activity (PA) may have stress-reducing effects in this population [3–5, 8, 9]. A recent meta-analysis of 14 randomized controlled trials of exercise in breast cancer patients and survivors found PA to be a key component of psychosocial rehabilitation [3]. While these findings demonstrate the utility of PA as a behavioral treatment regimen for breast cancer survivors, it is unclear whether the reported benefits were due to cardiorespiratory adaptations or to increased PA. This has important implications for exercise prescription for this population because if generalized PA performed at low intensity is sufficient to induce positive changes in psychosocial and physical health, it would not be necessary to prescribe higher intensity activities that may increase risk of injury and subsequent set-backs in therapy.

Recent exercise intervention studies [10, 11] have examined changes in cardiorespiratory fitness (CRF) and psychosocial health among cancer patients and survivors and found aerobic training to improve CRF and psychosocial outcomes. Still, the link between CRF and psychosocial health in breast cancer survivors is not well understood. Therefore, more research is needed to improve our understanding of how CRF and PA relate to psychosocial health in this special population and contribute to existing literature on CRF in cancer survivors.

This study was conducted to examine relationships among CRF, PA, and psychosocial variables (depressive symptoms, total fatigue, and global self-esteem) in breast cancer survivors. We hypothesized that both CRF and PA would inversely relate to depressive symptoms and total fatigue and positively relate to global self-esteem.

## Method

The present investigation evaluated baseline associations among CRF, PA, and psychosocial variables in Breast Cancer Survivors Health and Physical Exercise (SHAPE) Study participants. The aims of the SHAPE Study were to examine the effect of an intervention on weight, hormonal, and psychosocial factors. This study was approved by the San Diego State University (SDSU) and University of California, San Diego (UCSD) Institutional Review Boards. All participants gave signed written consent to participate.

### Participants

Participants were 260 breast cancer survivors recruited between April 2005 and March 2007 in San Diego, California, who met the following inclusion criteria: (1) age ≥18 years; (2) diagnosed with breast cancer (Stages 0-IIIB) within the previous 18 years; (3) initial treatments completed; (4) BMI ≥25.0 kg/m²; (5) able and willing to participate in moderate PA; and (6) willingness to be randomized to a treatment or control group. The study was not designed to investigate effects on cancer outcomes, which is why women across a wide range of times since diagnosis were recruited and enrolled. The Physical Activity Readiness Questionnaire [12] was administered to participants during the screening to determine whether the study prospect was capable of engaging in mild and moderate PA. Survivors identified as being unable to participate in PA (at these levels) were excluded from study participation; individuals who were already engaging in regular PA were not excluded. Recruitment of participants was conducted in San Diego and focused on clinical contacts and community outreach.

### Procedure

All participants completed questionnaires regarding personal characteristics, medical history, and psychosocial factors during a baseline clinic visit. Information regarding baseline PA was collected with an individual telephone interview. On another day, participants underwent a submaximal graded exercise test (GXT) to assess CRF.

### Measures

*Demographics and clinical characteristics* Demographic and clinical data collected at baseline were: age, weight, body mass index (BMI), ethnicity, education level, marital status, menopausal status, cancer stage at diagnosis, years since cancer diagnosis, type of initial treatment, and medications post-diagnosis.

*Cardiorespiratory fitness (CRF)* While maximal oxygen uptake, or $VO_{2max,}$ is recognized as the preferred measure of CRF, we chose a submaximal GXT to minimize subject discomfort, and eliminate the need for medical supervision. The GXT was terminated at a pre-determined target heart rate (HR) of either 85% of age predicted maximum heart rate (APMHR; 220-age), or 75% of APMHR if the subject was taking medications known to suppress HR. HR and blood pressure were recorded before, during, and 5 min following the GXT. $VO_{2max}$ was estimated from the final test stage using the known relationship between HR and workload [13]. Room temperature and relative humidity were controlled, and participants were asked to refrain from caffeine and other stimulants on their test day.

*Physical activity (PA)* PA was assessed by telephone interview using the 7-Day Physical Activity Recall [14]. Participants were asked to report PA over the past seven

days; at the end of the interview they were asked whether the past week was typical for them. Data are presented as hours per week (h/week) and metabolic equivalent (MET)-h/week (MET-h/week). MET-h/week were calculated as follows: (1) METs for each activity category (four METs = moderate activity; six METs = hard activity; ten METs = very hard activity) was multiplied by time (min) for the activities; (2) these subtotals were summed to yield total MET minutes; and (3) total MET minutes was divided by 60 [14]. "Light" PA (e.g., stop-and-go walking) was not included in our calculation of PA scores.

*Depressive symptoms* Depressive symptoms were measured with the 20-item Center for Epidemiologic Studies Depression Scale (CES-D). As defined by Radloff [15], the major psychological components of depressive symptoms include: "depressed mood, feelings of guilt and worthlessness, feelings of helplessness and hopelessness, psychomotor retardation, loss of appetite, and sleep disturbance" (p. 386). While a score of ≥16 on the CES-D suggests clinically significant levels of psychological distress, the scale was designed based on symptoms of depression, but not for the clinical diagnosis of depression. Items on the CES-D are scored with a 4-point Likert scale (0 to 3). The possible range of scores is 0 to 60, with higher scores indicative of greater depressive symptoms and risk for depression. The CES-D has demonstrated adequate scale reliability and validity [15].

*Total fatigue* The Multidimensional Fatigue Symptom Inventory—Short Form (MFSI-SF) was administered to assess fatigue. The MFSI-SF is comprised of 30 items that correspond to one of five subscales (general fatigue, physical fatigue, emotional fatigue, mental fatigue, and vigor) [16]. Total fatigue score was calculated by adding the scores for the first four subscales and then subtracting the vigor subscale score from the subtotal. Higher scores on the MFSI-SF are indicative of greater total fatigue, and its range of scores is −24 to 96. Internal reliability for the five subscales and construct validity have been reported previously [16].

*Global self-esteem* The 10-item, 4-point response version of the Rosenberg Self-Esteem Scale (RSE) was used to evaluate global self-esteem, which refers to an overall sense of personal worth [17]. Scores range from 0 and 30, with higher scores corresponding to higher self-esteem. Construct and convergent validity have been reported high, with alpha reliabilities ranging between 0.88 and 0.90 [18].

## Statistical Analysis

Frequency and descriptive statistics were calculated to check all relevant demographic and clinical characteristics of the sample. Pearson's correlations were performed to examine associations among CRF, PA, psychosocial outcomes, and participant characteristics. Multiple regression models with age and BMI as covariates examined the relative contributions of the predictors (CRF, PA, PA levels) to depressive symptoms, fatigue, and self-esteem, respectively. Regression models were performed using continuous levels for CRF and PA. PA levels were classified as those who met ($n$=49) and did not meet ($n$=203) established American College of Sports Medicine (ACSM) and American Heart Association (AHA) physical activity recommendations [19]. Specifically, participants were categorized as either meeting or not meeting the weekly recommendation of 150 min of moderate to vigorous PA. No subjects reported very hard PA, and only three women reported hard PA; therefore, only total PA (primarily moderate PA) was analyzed. All statistical analyses were executed using SAS Version 9.2 (Cary, NC). Data are presented as means and standard deviations (SD), and an $\alpha$-level of 0.05 was used to determine statistical significance.

## Results

Demographic and clinical characteristics of the participants are reported in Table 1. Of the 260 participants, the majority was white non-Hispanic (83%), well-educated (86% had ≥13 years of education), married (68%), and postmenopausal (95%). Table 2 shows the mean scores for CRF, PA, depressive symptoms, fatigue, and self-esteem. Of the 252 participants with PA data, 81% did not meet the ACSM/AHA PA recommendation. Mean ± SD PA values for those who did not meet and those who met the ACSM/AHA recommendation are also shown in Table 2. The mean difference between CRF in the current sample (Table 2) and age- and gender-matched normative data for $VO_{2max}$ [13] was −4.5 ml·kg·min$^{-1}$.

Associations among participant characteristics, CRF, PA, and the psychosocial variables are presented in Table 3. While CRF and PA were positively correlated ($P$<0.01), these two variables were unrelated to any of the psychosocial outcomes. Depressive symptoms, fatigue, and self-esteem were all moderately correlated: greater depressive symptoms were associated with greater fatigue ($r$=0.64), and lower self-esteem was associated with greater depressive symptoms ($r$=−0.55) and greater fatigue ($r$=−0.52). Age and BMI were both inversely related to CRF and PA. Education was also correlated to depressive symptoms ($r$=-0.18), fatigue ($r$=−0.19), and self-esteem ($r$=0.27).

### Regression Models for Psychosocial Outcomes as a Function of CRF, PA, and PA Levels

We employed separate multiple regression models with age and BMI as covariates to further examine the relationships

**Table 1** Demographic and clinical characteristics of study participants ($N$=260)

| Characteristic | $N$ (%)[a] | Mean (SD) | Range |
|---|---|---|---|
| Age (year) | | 55 (9.4) | 28–81 |
| Weight (kg) | | 84.6 (15.2) | 56.8–130.9 |
| BMI (kg/m²) | | 31.3 (4.9) | 24.8–48.8 |
| Time post-diagnosis (year) | | 5 (3.2) | 0–18 |
| Ethnicity | | | |
| Caucasian | 217 (83) | | |
| Hispanic | 13 (5) | | |
| African American | 10 (4) | | |
| Asian American | 5 (2) | | |
| Pacific Islander | 3 (1) | | |
| American Indian | 1 (0) | | |
| Other | 11 (4) | | |
| Education level | | | |
| 12 years | 36 (14) | | |
| 13–16 years | 150 (58) | | |
| 17+ years | 72 (28) | | |
| Marital status | | | |
| Married | 177 (68) | | |
| Single | 22 (8) | | |
| Widowed | 16 (6) | | |
| Divorced | 43 (17) | | |
| Separated | 2 (1) | | |
| Menopausal status[b] | | | |
| Pre-menopausal | 13 (5) | | |
| Post-menopausal | 247 (95) | | |
| Cancer stage at diagnosis | | | |
| Stage 1A | 110 (42) | | |
| Stage IB | 8 (3) | | |
| Stage IIA | 52 (20) | | |
| Stage IIB | 5 (2) | | |
| Stage IIIA | 59 (23) | | |
| Stage IIIB | 1 (0) | | |
| Ductal carcinoma in situ, Stage 0 | 15 (6) | | |
| Type of initial treatment | | | |
| Surgery only | 26 (10) | | |
| Surgery, chemotherapy | 35 (13) | | |
| Surgery, radiation | 68 (26) | | |
| Surgery, chemotherapy, and radiation | 128 (49) | | |
| Medications post-diagnosis | | | |
| No medications reported | 129 (50) | | |
| Tamoxifen (nolvadex) | 33 (13) | | |
| Letrozole (femara) | 23 (9) | | |
| Anastrozole (arimidex) | 49 (19) | | |
| Exemestane (aromasin) | 24 (9) | | |
| Combination | 2 (1) | | |

[a] Percentages may not equal 100% because of rounding

[b] Menopausal status was determined by self-report; those who reported at least one menstrual period in the past year were classified as pre-menopausal. There were missing data as follows: education (two people), cancer stage (ten people), initial treatment (three people)

between the predictors (CRF, PA, and PA levels) and psychosocial variables. Table 4 depicts the regression models with depressive symptoms, fatigue, and self-esteem as dependent variables. A marginally significant inverse association between PA and depressive symptoms ($P$=0.06) was detected. Neither CRF, PA, or PA levels were significant predictors of the psychosocial variables in the other regression models (Table 4).

**Table 2** Psychosocial, physical activity, and fitness measures for total sample and by physical activity levels

| | Total sample | | | ACSM/AHA recommendation not met[a] | | ACSM/AHA recommendation met[a] | |
|---|---|---|---|---|---|---|---|
| Variable | *N* | Mean (SD) | Range | *N* | Mean (SD) | *N* | Mean (SD) |
| CRF (ml·kg·min$^{-1}$) | 257 | 25.5 (6.5) | 9.5–52.6 | 200 | 24.1 (6.1)* | 49 | 29.4 (7.0)* |
| PA (hr/wk)[b] | 252 | 1.3 (1.4) | 0–6.8 | 203 | 0.7 (0.8)* | 49 | 3.7 (5.3)* |
| PA (MET-hr/wk)[c] | 252 | 6.1 (6.5) | 0–33 | 203 | 3.7 (4.0)* | 49 | 6.2 (5.3)* |
| Depressive symptoms | 260 | 8.7 (7.0) | 0–36 | 203 | 9.1 (7.4) | 49 | 7.7 (5.1) |
| Total fatigue | 260 | 6.6 (16.9) | −21–58 | 203 | 6.3 (16.3) | 49 | 8.6 (19.2) |
| Global self-esteem | 260 | 23.6 (4.5) | 10–30 | 203 | 23.4 (4.4) | 49 | 24.1 (4.5) |

*ACSM* American College of Sports Medicine, *AHA* American Heart Association, *CRF* cardiorespiratory fitness, *PA* physical activity

*$P<0.0001$ between meeting and not meeting ACSM/AHA recommendation

[a] The ACSM/AHA joint physical activity recommendation is 150 min of moderate to vigorous activity per week

[b] Hours per week includes strength exercise

[c] MET-h/week includes strength training weighted as moderate activity

## Discussion

The main findings of our study were that both CRF and PA were unrelated to depressive symptoms, fatigue, and self-esteem, although we did note a marginally significant inverse relationship between depressive symptoms and PA. Overall, our results were not consistent with recent research [8, 9, 20] and reviews of studies [1, 3] that reported inverse associations between PA and psychosocial symptoms, and mixed findings between physical fitness and psychosocial outcomes [20, 21]. Low PA variability among our participants likely influenced our findings. Even with gardening and housework counted as moderate PA, the majority (80%) of the total sample did not meet PA recommendations of either ACSM/AHA or the American Cancer Society (≥30 min of moderate to vigorous PA, *on* 5 or more days per week) [22].

PA reported in this study was considerably lower than that reported in other breast cancer survivor studies, where 67–73% of participants met the recommendation of 150 min/week of moderate to vigorous PA [23, 24]. Hong et al. [8] reported a mean of over 13 MET-h/week in a large sample of breast cancer survivors; this is more than twice the mean MET hours reported by our participants. However, Hong et al. used a threshold of three METS, whereas we did not include activity less than four METS. This discrepancy likely explains some of the difference between our study and others.

**Table 3** Pearson correlation matrix: participant characteristics, cardiorespiratory fitness, physical activity, and psychosocial variables

| Variable | Age, year | BMI, kg/m$^2$ | Education, year | Time post-diagnosis, year | CRF, ml·kg·min$^{-1}$ | PA, h/week | PA (MET-h/week) | Depressive symptoms | Total fatigue | Global self-esteem |
|---|---|---|---|---|---|---|---|---|---|---|
| Age | 1.00 | 0.04 | 0.05 | 0.19** | −0.39** | −0.15* | −0.13* | −0.17** | −0.24** | 0.10 |
| BMI | | 1.00 | −0.01 | −0.03 | −0.36** | −0.19** | −0.21** | 0.05 | 0.06 | −0.02 |
| Education | | | 1.00 | 0.11 | −0.01 | 0.06 | 0.06 | −0.18** | −0.19** | 0.27** |
| Time post-diagnosis | | | | 1.00 | 0.03 | 0.07 | 0.07 | −0.05 | −0.14* | −0.06 |
| CRF | | | | | 1.00 | 0.35** | 0.33** | −0.01 | 0.03 | −0.01 |
| PA, h/week | | | | | | 1.00 | 0.95** | −0.10 | −0.02 | 0.07 |
| PA (MET-h/week) | | | | | | | 1.00 | −0.11 | −0.04 | 0.07 |
| Depressive symptoms | | | | | | | | 1.00 | 0.64** | −0.55** |
| Total fatigue | | | | | | | | | 1.00 | −0.52** |
| Global self-esteem | | | | | | | | | | 1.00 |

*BMI* body mass index, *CRF* cardiorespiratory fitness, *PA* physical activity

*$P<0.05$; **$P<0.01$

**Table 4** Regression models for psychosocial outcomes as a function of cardiorespiratory fitness[a], physical activity[a], and compliance with ACSM and AHA physical activity recommendation[b]

| Classification | *N* | *F* | *P* | $\beta$ | $R^2$ |
|---|---|---|---|---|---|
| Depressive symptoms | | | | | |
| CRF | 257 | 1.04 | 0.31 | −0.079 | 0.03 |
| PA | 251 | 3.69 | 0.06 | −0.131 | 0.05 |
| PA levels (did not meet vs. met ACSM/AHA PA recommendation) | 251 | 2.18 | 0.14 | −1.649 | 0.05 |
| Total fatigue | | | | | |
| CRF | 257 | 0.44 | 0.51 | −0.122 | 0.06 |
| PA | 251 | 0.72 | 0.40 | −0.138 | 0.07 |
| PA levels (did not meet vs. met ACSM/AHA PA recommendation) | 251 | 0.31 | 0.58 | 1.482 | 0.07 |
| Global self-esteem | | | | | |
| CRF | 257 | 0.20 | 0.66 | 0.022 | 0.01 |
| PA | 251 | 1.68 | 0.20 | 0.057 | 0.02 |
| PA levels (did not meet vs. met ACSM/AHA PA recommendation) | 251 | 1.45 | 0.23 | 0.863 | 0.02 |

Regression models were conducted with age and BMI as covariates

*ACSM* American College of Sports Medicine, *AHA* American Heart Association, *CRF* cardiorespiratory fitness, *PA* physical activity

[a] Cardiorespiratory fitness and physical activity were modeled as continuous variables

[b] Physical activity levels were classified as those who did not meet vs. those who met the ACSM/AHA joint physical activity recommendation of 150 min of moderate to vigorous activity per week

Moderate correlations emerged among the psychosocial variables. Previous studies have reported strong correlations between fatigue and depression or depressive symptoms in breast cancer patients and survivors [7, 21]. Although no association was identified between time since diagnosis and psychosocial factors, we may have seen stronger relationships among depressive symptoms, fatigue, and self-esteem had participants been diagnosed more recently, as the mean time since diagnosis in our study was 5.0 years.

We did not observe CRF, PA, or PA levels to be significant predictors of depressive symptoms, fatigue, or self-esteem. However, other cross-sectional studies have provided evidence of CRF or PA group differences on these psychosocial variables [21, 24, 25]. The findings pertaining to CRF and psychosocial outcomes in breast cancer survivors appear to be limited and inconsistent, and it is plausible that CRF does not influence depressive symptoms, fatigue, and self-esteem.

The present study has several limitations. First, low variability in PA may have contributed to the lack of associations among the primary variables of interest. Second, while we did not aim to investigate effects on cancer outcomes, the large heterogeneity in time since diagnosis may limit our ability to understand the breast cancer experience as it relates to CRF, PA, and psychosocial health. Third, method variance or bias is a potential problem in behavioral research and should be considered when interpreting these findings. For example, lower correlations are expected between objective and self-report measures than correlations between self-report measures only. Lastly, we must be careful not to infer causality (or lack thereof) due to the study's cross-sectional design.

The current study provides support for interrelationships among depressive symptoms, fatigue, and self-esteem that should be considered when designing programs for psychosocial health and recovery in breast cancer survivors. As such, psychotherapy and educational approaches to general health and well-being may be critical to facilitating psychosocial recovery among this population. While we did not demonstrate significant relationships between CRF or PA and psychosocial variables in overweight breast cancer survivors, our findings underscore the need for further investigation. Of greatest importance is to examine *changes* in PA, fitness, and psychosocial variables and their interrelatedness following behavioral interventions that include PA for breast cancer survivors. Such research will enhance our understanding of how PA and fitness influence psychosocial factors, and also provide needed information regarding exercise prescription for this population.

**Acknowledgements** This research was supported in part by Research Scholar Grant RSGPB-04-258 from the American Cancer Society, the Susan G. Komen Foundation, and the Lance Armstrong Foundation. The authors would like to acknowledge all of the breast cancer survivors who graciously participated in this study.

## References


1. Courneya KS, Mackey JR, McKenzie DC. Exercise for breast cancer survivors: research evidence and clinical guidelines. Phys SportsMed. 2002;30(8):33–42.
2. Parkin MD, Fernández LMG. Use of statistics to assess the global burden of breast cancer. Breast J. 2006;12:S70–80.
3. McNeely ML, Campbell KL, Rowe BH, Klassen TP, Mackey JR, Courneya KS. Effects of exercise on breast cancer patients and survivors: a systematic review and meta-analysis. Can Med Assoc J. 2006;175(1):34–41.
4. Segar ML, Katch VL, Roth RS, Weinstein Garcia A, Portner TI, Glickman SG, et al. The effect of aerobic exercise on self-esteem and depressive and anxiety symptoms among breast cancer survivors. Oncol Nurs Forum. 1998;25(1):107–13.
5. Berterö C, Chamberlain Wilmoth M. Breast cancer diagnosis and its treatment affecting the self. Cancer Nurs. 2007;30(3):194–202.
6. Pinto BM, Trunzo JJ. Body esteem and mood among sedentary and active breast cancer survivors. Mayo Clin Proc. 2004;79:181–6.
7. Bower JE, Ganz PA, Desmond KA, Bernaards C, Rowland JH, Meyerowitz BE, et al. Fatigue in long-term breast carcinoma survivors: a longitudinal investigation. Cancer. 2006;106(4):751–8.
8. Hong S, Bardwell WA, Natarajan L, Flatt SW, Rock CL, Newman VA, et al. Correlates of physical activity level in breast cancer survivors participating in the Women's Healthy Eating and Living (WHEL) Study. Breast Cancer Res Treat. 2007;101:225–32.
9. Yeter K, Rock CL, Pakiz B, Bardwell WA, Nichols JF, Wilfley DE. Depressive symptoms, eating psychopathology, and physical activity in obese breast cancer survivors. Psycho-Oncol. 2006;15:453–62.
10. Adamsen L, Quist M, Midtgaard J, Anderson C, Møller T, Knutsen L, et al. The effect of a multidimensional exercise intervention on physical capacity, well-being, and quality of life in cancer patients undergoing chemotherapy. Support Care Cancer. 2006;14(2):116–27.
11. Courneya KS, Friedenreich CM, Quinney HA, Fields AL, Jones LW, Fairey AS. A randomized trial of exercise and quality of life in colorectal cancer survivors. Eur J Cancer Care. 2003;12(4):347–57.
12. Canadian Society for Exercise Physiology (CSEP) Resources [Online]. Available: http://www.csep.ca/forms.asp.
13. American College of Sports Medicine. Guidelines for exercise testing and prescription. 7th ed. Philadelphia: Lippincott Williams & Wilkins; 2006.
14. Blair SN, Haskell WL, Ho P, Paffenbarger Jr RS, Vranizan KM, Farquhar JW, et al. Assessment of habitual physical activity by a seven-day recall in a community survey and controlled experiments. Am J Epidemiol. 1985;122(5):794–804.
15. Radloff LS. The CES-D Scale: a self-report depression scale for research in the general population. Appl Psychol Meas. 1977;1:385–401.
16. Stein KD, Jacobsen PB, Blanchard CM, Thors C. Further validation of the Multidimensional Fatigue Symptom Inventory—Short Form. J Pain Symptom Manage. 2004;27(1):14–23.
17. Rosenberg M. Society and the adolescent self-image. Princeton: Princeton University Press; 1965.
18. Robins RW, Hendin HM, Trzesniewski KH. Measuring global self-esteem: construction validation of a single-item measure and the Rosenberg Self-Esteem Scale. Pers Soc Psychol Bull. 2001;27:151–60.
19. Haskell WL, Lee I, Pate RR, Powell KE, Blair SN, Franklin BA, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Med Sci Sports Exerc. 2007;39(8):1423–34.
20. Winters-Stone KM, Bennett JA, Nail L, Schwartz A. Strength, physical activity, and age predict fatigue in older breast cancer survivors. Oncol Nurs Forum. 2008;35(5):815–21.
21. Dimeo F, Stieglitz RD, Novelli-Fischer U, Fetscher S, Mertelsmann R, Keul J. Correlation between physical performance and fatigue in cancer patients. Ann Oncol. 1997;8:1251–5.
22. Doyle C, Kushi LH, Byers T, Courneya KS, Demark-Wahnefried W, Grant B, et al. Nutrition and physical activity during and after cancer treatment: an American Cancer Society guide for informed choices. CA Cancer J Clin. 2006;56:323–53.
23. Irwin ML, McTiernan A, Bernstein L, Gilliland FD, Baumgartner R, Baumgartner K, et al. Physical activity levels among breast cancer survivors. Med Sci Sports Exerc. 2004;36(9):1484–91.
24. Pinto BM, Maruyama NC, Clark MM, Cruess DG, Park E, Roberts M. Motivation to modify lifestyle risk behaviors in women treated for breast cancer. Mayo Clin Proc. 2002;77(2):109–13.
25. Mustian KM, Katula J, Gabriele J, Gaukstern J, Karnitz A, Campbell S, et al. Physical activity influences multidimensional self-esteem in breast cancer survivors [abstract]. J Sport Exerc Psychol. 2002;24:S99.