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Physical activity levels of overweight or obese breast cancer survivors: Correlates at entry into a weight loss intervention study

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Abstract

Purpose—Physical activity is associated with reduced risk and progression of breast cancer, and exercise can improve physical function, quality of life and fatigue in cancer survivors. Evidence on factors associated with cancer survivors' adherence to physical activity guidelines from the American Cancer Society and the U.S. Department of Health and Human Services is mixed. This study seeks to help fill this gap in knowledge by examining correlates with physical activity among breast cancer survivors.

Methods—Overweight or obese breast cancer survivors ($N=692$) were examined at enrollment into a weight loss intervention study. Questionnaires and medical record review ascertained data on education, race, ethnicity, menopausal status, physical activity, and medical history. Measures of anthropometrics and fitness level were conducted. Regression analysis examined associations between physical activity and demographic, clinical, and lifestyle factors.

Results—Overall, 23% of women met current guidelines. Multivariate analysis revealed that body mass index ($p=0.03$), emergency room visits in the past year ($p=0.04$), and number of co-morbidities ($p=0.02$) were associated with less physical activity. Geographic region also was

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Conflict of Interest

Conflict of Interest: Kathleen Wolin has equity in a digital health company whose products include weight management tools. All other authors declare that they have no conflict of interest. Cheryl Rock (corresponding author) and Shirley Flatt have full control of all primary data.

associated with level of physical activity ($p=0.02$), with women in Alabama reporting significantly less activity than those in other participating regions.

Conclusions—The majority of overweight/obese breast cancer survivors did not meet physical activity recommendations. Physical activity levels were associated with degree of adiposity, geographic location, and number of co-morbidities. The majority of overweight breast cancer survivors should be encouraged to increase their level of physical activity. Individualizing exercise prescriptions according to medical co-morbidities may improve adherence.

Keywords

Physical activity; breast cancer; guidelines; obesity; survivors; exercise

Introduction

Cancer is a major public health problem and is the leading cause of death among men and women in the U.S. aged 85 years and younger [1]. Between 1990/1991 and 2007, cancer death rates decreased by 22.2% in men and by 13.9% in women; however, 1 in 4 deaths in the U.S. is currently due to cancer [2]. Due to advances in early detection and treatment, 65% of Americans diagnosed with cancer now live more than 5 years. Breast cancer survivors are the largest group of cancer survivors, followed by prostate cancer survivors and colorectal cancer survivors.

Obesity is an important risk factor for postmenopausal breast cancer incidence and is a major risk factor for breast cancer recurrence and morbidity in both pre- and postmenopausal women [3–6]. Independently, physical activity is also a significant factor related to the risk and recurrence of breast cancer [7]. The Nurses' Health Study found that in nearly 3,000 breast cancer survivors, higher levels of post-treatment physical activity were associated with a 26% to 40% reduction in risk of breast cancer recurrence, breast cancer-specific mortality, and all-cause mortality [8].

Guidelines for physical activity as they relate to various disease states have been published by the U.S. Department of Health and Human Services (US DHHS) [9]. Overall, weekly aerobic activity duration of 150 minutes of moderate-intensity exercise or 75 minutes of vigorous-intensity exercise, or some combination thereof, is currently recommended. These guidelines are endorsed by the American Cancer Society [10]. Further, the American College of Sports Medicine (ACSM) Roundtable on Exercise Guidelines for Cancer Survivors concluded that exercise training is safe during and after cancer treatment and results in improvements in physical function, quality of life and cancer-related fatigue in several cancer survivor groups [11].

Although it is recognized that any amount of physical activity is beneficial to cancer survivors, the evidence describing how much breast cancer survivors exercise and the factors associated with how well they meet the physical activity guidelines is mixed. Potential determinants of physical activity that have been examined include demographic characteristics, cancer-related variables (e.g., stage, type of treatment), degree of obesity, health status, level of aerobic fitness, and various psychosocial factors [12–17]. Level of

physical activity, as well as the factors associated with physical activity, have been observed to change over time following diagnosis, as shown in a longitudinal investigation of a sample of breast cancer survivors who were followed for five years post-diagnosis [15].

This study seeks to contribute to knowledge of determinants of physical activity among breast cancer survivors by describing various characteristics associated with physical activity in a large and relatively heterogeneous sample of survivors. The results of this analysis set the stage for the longitudinal evaluation of outcomes of a behavioral intervention to promote weight loss and increase physical activity in this sample. More knowledge of influencing factors may help health care providers to develop interventions and educational programs and to prescribe exercise based on specific patient characteristics.

Methods

Design and study population

A total of 692 overweight or obese breast cancer survivors were enrolled into a randomized controlled trial of a weight loss intervention, the Exercise to Enhance Recovery and Good Health for You (ENERGY) trial, at four U.S. sites (San Diego, CA, USA; Denver, CO; St. Louis, MO; and Birmingham, AL). Inclusion criteria were: age ≥ 21 years; a history of breast cancer (stages I [≥ 1 cm], II, or III) diagnosed within the previous five years; completion of initial therapies not including endocrine therapy; body mass index (BMI) 25–45 kg/m²; and ability to comply with study procedures. Exclusion criteria included: history of malignancies other than initial breast cancer with the exception of non-melanoma skin cancer, serious psychiatric illness, and any medical condition substantially limiting moderate physical activity, such as severe orthopedic conditions. The study was reviewed and approved by the Institutional Review Boards of all sites. Informed consent was obtained from all individual participants included in the study. A detailed description of the study procedures and intervention has been published previously [18].

Measures

At the baseline visit of the ENERGY trial, questionnaires were used to collect self-reported information about education, race, ethnicity, smoking status, menopausal status, and medical history. Staff reviewed all questionnaires for completeness. Medical record review was conducted by trained staff to obtain information on breast cancer diagnosis, treatment including surgery and chemotherapy, and endocrine-modulating therapy, including aromatase inhibitors and selective estrogen-receptor modulators. Before enrollment in the study, all subjects had completed any chemotherapy and/or radiation therapy prescribed by their oncologists, and had not experienced a cancer recurrence or new cancer event.

Measures of height and weight were obtained by trained staff at the baseline clinic visit and used to calculate BMI. Physical activity was measured using the modified Godin Leisure-Time Exercise Questionnaire (GLTEQ) which has been validated previously in cancer research [19]. The modified GLTEQ consists of three questions regarding the frequency and duration of mild, moderate, and strenuous exercise performed during free time in a typical week.

Fitness level was obtained by measuring recovery heart rate after a 3-minute step test in which participants ascended and descended an 8" step for 3 minutes, using a metronome rate of 96 beats per minute. Immediately after the step test, the heart rate was measured for 30 seconds and compared to previously published standards to determine fitness level [20]. "Good to excellent" fitness corresponds to the top tertile (lowest recovery heart rate) among age-matched women in a large community health study [20] and "poor to fair" fitness corresponds to the two lower tertiles (higher recovery heart rates).

The number of co-morbidities was the sum of each of the following conditions for which the participants reported receiving treatment: heart disease, hypertension, lung disease, diabetes, ulcers or stomach disease, kidney disease, liver disease, anemia or other blood disease, depression, osteoarthritis, back pain, rheumatoid arthritis, and other conditions.

Statistical analysis

The mean (standard deviation [SD]) of minutes of reported weekly moderate-to-vigorous physical activity are presented by strata of demographic, geographic, and medical covariates. Regression analysis computed statistical significance for amount of physical activity by continuous or categorical predictors. Women reporting 150 minutes or more of weekly moderate/vigorous physical activity were categorized as "meeting guidelines" [11]. The association between meeting or not meeting physical activity guidelines and demographic, clinical and lifestyle factors was evaluated using chi-square tests (categorical variables) and ANOVA (continuous variables). A multivariate linear model examined the relationship between physical activity level (continuous) with demographic, clinical, and lifestyle variables found to be significant in the bivariate analyses at $p < 0.20$, and contrasts between minutes per week of moderate/vigorous physical activity were compared across categories of variables. The alpha for the multivariate model was set at $p < 0.05$. All analyses were conducted using SAS version 9.3 (SAS Institute, Inc., Cary NC).

Results

Associations between demographic and clinical characteristics and physical activity are presented in Table 1. Among the 692 study participants, the mean (SD) age at enrollment was 56 (9) years and years of education was 16 (2). The majority of the participants identified as non-Hispanic white (79%, $N=547$), college graduates (59%, $N=410$), married or with a partner (67%, $N=463$), and postmenopausal (87%, $N=605$). The majority of participants had received chemotherapy and/or radiation therapy treatments (92%, $N=638$) and did not experience any overnight hospitalization (75%, $N=518$) or emergency room visit (85%, $N=586$) within the year before entering the study. The majority of participants had been diagnosed with stage II breast cancer (52%, $N=358$) within 3 years (58%, $N=401$) before entering the study. Median time since diagnosis was 31 months.

Associations between medical, geographic and lifestyle characteristics and number of minutes of moderate/vigorous exercise also are shown in Table 1. As shown, there was a trend for lower levels of physical activity with higher stages of breast cancer ($p=0.09$). Lower levels of physical activity were reported by those who experienced an emergency room visit within a year of the study compared with those who did not ($p=0.04$). The

number of co-morbidities was also inversely related to the amount of physical activity ($p<0.0001$, continuous ANOVA; $p<0.001$). In this bivariate analysis, there were also differences in level of physical activity across the four clinic sites ($p=0.02$), with survivors living in Alabama reporting far less physical activity than those living in other regions in the U.S.

The results of the bivariate analysis of physical activity within BMI and fitness level categories are shown in Table 2. As expected, the amount (minutes/week) of moderate to vigorous exercise was significantly higher among women with lower BMI ($p=0.002$) and higher cardiovascular fitness levels ($p<0.0001$).

The percentage of participants meeting the physical activity guidelines of 150 minutes/week moderate-intensity exercise across the variables of interest are shown in Table 3. Eighty-five percent of participants from Alabama did not meet the guidelines, whereas California, Colorado, and Missouri had rates of 73%, 74%, and 78%, respectively, who did not meet guidelines ($p=0.07$). As expected, higher BMI levels and lower fitness levels were associated with a higher percentage of participants not meeting guidelines ($p=0.13$ and $p=0.0002$, respectively). Cancer and treatment characteristics were not significantly associated with the percentage of participants meeting physical activity guidelines.

Results of the multivariate model of associations for minutes of physical activity, which controlled for potential influencing factors, are shown in Table 4. Beta coefficients equate to weekly minutes of moderate/vigorous physical activity compared with the reference category for categorical variables, or per unit increase for continuous measures. As in the bivariate analysis, BMI was shown to be significantly associated with the amount of physical activity reported ($p=0.03$). With every increase in 1 kg/m^2 of BMI, there was a mean decrease of 2.5 minutes/week in physical activity. Clinical site also was found to be significant, where participants from California or Colorado showed an average of over 30 minutes/week more physical activity than those from Alabama ($p=0.03$ and $p=0.02$, respectively). The number of co-morbidities was found to be significantly associated with level of physical activity ($p=0.02$), where each additional comorbidity was associated with a mean decrease of 4.9 minutes/week of physical activity.

Discussion

Results of this study indicate that the majority of overweight or obese breast cancer survivors do not meet current physical activity guidelines and recommendations. As expected, fitness level and BMI were strongly associated with amount of physical activity reported, where there were higher levels of physical activity reported among those with higher levels of fitness and lower BMI. The number of co-morbidities was significantly and inversely associated with level of physical activity. Independent of other potentially influencing factors, the clinical site also was strongly associated with level of physical activity, which may reflect general regional differences in the culture and lifestyle in these areas. In this large heterogeneous sample, demographic characteristics, such as age, ethnicity, and education, and whether or not the participant received chemotherapy, were not significantly associated with whether or not participants met physical activity guidelines.

Previous studies that have examined potential determinants of physical activity in breast cancer survivors have involved various samples and time points in the cancer continuum. Determinants of exercise adherence during initial treatment (e.g., chemotherapy) and the immediate post-treatment period have been examined in two studies [16,17], but influencing factors during that time would be expected to be quite different than during survivorship, the time frame of the present study. Results from a 5-year longitudinal study of physical activity in stage II or III breast cancer suggest a natural trajectory following diagnosis and treatment, increasing gradually during the first 18 months (during recovery) and then declining steadily over the subsequent 42 months [15]. Time since diagnosis was not identified as being predictive of level of physical activity in our study, but the majority of the sample were more than 2 years post-diagnosis.

Results of two previous studies of physical activity in breast cancer survivors involved samples similar to that of the present study. One study analyzed the exercise habits of 806 women in the third year after their diagnosis enrolled in the Health, Eating, Activity, and Lifestyle (HEAL) Study [12,13]. In that cohort, BMI was significantly and inversely associated with level of physical activity. They found a significant inverse relationship between age and exercise where women 60 years old spent 44% less time in physical activity compared to women under 50 years of age. Disease stage was also significantly associated, where those with higher disease stages tended to exercise more than those with lower disease stages. That study also found that non-Hispanic white and Hispanic cancer survivors exercised more than black cancer survivors.

Another study involving 2819 breast cancer survivors enrolled in the Women's Healthy Eating and Living (WHEL) study had similar results [14]. As in the HEAL study, the WHEL study found that black cancer survivors were likely to exercise less than non-Hispanic whites. However, age was not found to be significantly associated with physical activity level. Also, they found an inverse relationship between exercise and disease stage. Further, survivors who received only radiation treatment reported significantly higher amounts of exercise as compared to the survivors who received chemotherapy or a combination of radiation and chemotherapy. Time since diagnosis was not found to be significantly associated with level of physical activity, as in the present study. In the WHEL Study, education and diet composition were found to be significantly related to the amount of physical activity.

In the present study, we found a significant relationship between the number of co-morbidities and level of physical activity, and this was not examined in the WHEL and HEAL studies. In another WHEL study analysis, the presence of co-morbidities was found to affect outcomes, with type 2 diabetes mellitus significantly associated with reduced overall survival regardless of treatment group assignment [21]. The association between reduced physical activity and co-morbidities may be one factor that contributes to poorer outcome with co-morbidities. The ACSM guidelines for cancer survivors recommend that exercise prescriptions be individualized according to a cancer survivor's medical co-morbidities, as well as pretreatment fitness and treatment-related side effects [11].

Also, the geographic location of the clinic site was found to be independently associated with level of physical activity. According to the Centers for Disease Control and Prevention (CDC) [22], Alabama has the highest prevalence of obesity, followed by Missouri, California and Colorado, among the regions of the clinical sites in this study. Although it may be expected that women in the regions with higher obesity rates would have lower amounts of physical activity, the clinical site remained significantly associated with physical activity level even after adjusting for BMI in the multivariate analysis. Notably, the order of lowest to highest level of physical activity by state in our multivariate model exactly matches the order in the CDC's State Indicator Report on Physical Activity [23]. One hypothesis to explain this observation is that the general culture of the region may play a role such that, regardless of an individual's degree of adiposity, the attitudes and general lifestyle of the region may not encourage physical activity among cancer survivors. This suggests that promotion of physical activity in the general population may benefit survivors across various geographic regions. Regional barriers associated with climate and walkability (hot, humid environments and roads that lack shoulders or sidewalks) may also explain this observation. Courneya et al. [17] found differential adherence to a supervised exercise intervention during breast cancer chemotherapy across site locations, although there were differences in the exercise facilities at these sites as well as climate and other regional factors.

In the general population, 48% of all adults living in the U.S. currently meet the physical activity guidelines set by the US DHHS. Further, 42.6% of all women living in the U.S. meet US DHHS guidelines [24]. Among the participants in the ENERGY study, less than 30% met these guidelines at enrollment. In the HEAL study, 32% of women met the recommendation of 150 min/week of any type of moderate- to vigorous-intensity physical activity when physical activity was defined as sports/recreational physical activity excluding household and yard work. Notably, however, when the HEAL study included activities such as household work and yard work, the percent of participants meeting the guidelines rose to 73% [13]. Across these previous studies and the present study, the evidence suggests that breast cancer survivors may benefit by more purposeful encouragement from their physicians with regard to physical activity.

There were several limitations in this study. In a cross-sectional analysis, it is recognized that the associated factors could be both the cause and effect of low level of physical activity. The participants were predominantly non-Hispanic white, and other racial and ethnic groups were not highly represented in our sample. Also, income levels, occupation, history of depression, access to health care, and dietary habits were not analyzed in this study. The self-reported nature of much of the physical activity data is also a limitation, because it is known that study participants often over-report their levels of physical activity [25].

In conclusion, the majority of overweight or obese breast cancer survivors entering a weight loss study do not meet current guidelines for physical activity. Degree of obesity, as well as regional differences and medical characteristics, appear to independently contribute to the likelihood of meeting current guidelines. The majority of overweight breast cancer survivors should be encouraged to increase their level of physical activity. Results from this study may

help oncologists and primary care physicians develop educational and intervention programs and to prescribe exercise based on specific patient characteristics. Individualizing exercise prescriptions according to medical co-morbidities may improve adherence.

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References

1. National Cancer Institute National Cancer Institute at the National Institute of Health. <http://www.cancer.gov/>.
2. American Cancer Society. Cancer Treatment and Survivorship Facts and Figures 2014–2015. Atlanta: American Cancer Society; 2014.
3. Chlebowski RT, Aiello E, McTiernan A. Weight loss in breast cancer patient management. *J Clin Oncol*. 2002; 20(4):1128–1143. [PubMed: 11844838]
4. Kroenke CH, Chen WY, Rosner B, Holmes MD. Weight, weight gain, and survival after breast cancer diagnosis. *J Clin Oncol*. 2005; 23(7):1370–1378. doi:JCO.2005.01.079 [pii] 10.1200/JCO.2005.01.079. [PubMed: 15684320]
5. Majed B, Moreau T, Senouci K, Salmon RJ, Fourquet A, Asselain B. Is obesity an independent prognosis factor in woman breast cancer? *Breast Cancer Res Treat*. 2008; 111(2):329–342. [PubMed: 17939036]
6. Patterson RE, Cadmus LA, Emond JA, Pierce JP. Physical activity, diet, adiposity and female breast cancer prognosis: a review of the epidemiologic literature. *Maturitas*. 2010; 66(1):5–15. doi:S0378-5122(10)00005-8 [pii] 10.1016/j.maturitas.2010.01.004. [PubMed: 20097494]
7. Courneya KS, Mackey JR, McKenzie DC. Exercise for breast cancer survivors: research evidence and clinical guidelines. *The Physician and Sportsmedicine*. 2002; 30(8):33–42. [PubMed: 20086538]
8. Holmes MD, Chen WY, Feskanich D, Kroenke CH, Colditz GA. Physical activity and survival after breast cancer diagnosis. *JAMA*. 2005; 293(20):2479–2486. doi:293/20/2479 [pii] 10.1001/jama.293.20.2479. [PubMed: 15914748]
9. Department of Health and Human Services. 2008 Physical Activity Guidelines for Americans. 2008. <http://www.health.gov/paguidelines/guidelines/>
10. American Cancer Society. ACS Guidelines on Nutrition and Physical Activity for Cancer Prevention. 2014 <http://www.cancer.org/healthy/eathealthygetactive/acsguidelinesonnutritionphysicalactivityforcancerprevention/acs-guidelines-on-nutrition-and-physical-activity-for-cancer-prevention-guidelines>.
11. Schmitz KH, Courneya KS, Matthews C, Demark-Wahnefried W, Galvao DA, Pinto BM, Irwin ML, Wolin KY, Segal RJ, Lucia A, Schneider CM, von Gruenigen VE, Schwartz AL. American College of Sports Medicine roundtable on exercise guidelines for cancer survivors. *Med Sci Sports Exerc*. 2010; 42(7):1409–1426. [pii]. [PubMed: 20559064]
12. Irwin ML, Crumley D, McTiernan A, Bernstein L, Baumgartner R, Gilliland FD, Kriska A, Ballard-Barbash R. Physical activity levels before and after a diagnosis of breast carcinoma: the Health, Eating, Activity, and Lifestyle (HEAL) study. *Cancer*. 2003; 97(7):1746–1757. [PubMed: 12655532]

13. Irwin ML, McTiernan A, Bernstein L, Gilliland FD, Baumgartner R, Baumgartner K, Ballard-Barbash R. Physical activity levels among breast cancer survivors. *Med Sci Sports Exerc.* 2004; 36(9):1484–1491. [PubMed: 15354027]
14. Hong S, Bardwell WA, Natarajan L, Flatt SW, Rock CL, Newman VA, Madlensky L, Mills PJ, Dimsdale JE, Thomson CA, Hajek RA, Chilton JA, Pierce JP. 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(2):225–232. [PubMed: 17028988]
15. Emery CF, Yang HC, Frierson GM, Peterson LJ, Suh S. Determinants of physical activity among women treated for breast cancer in a 5-year longitudinal follow-up investigation. *Psycho-Oncology.* 2009; 18(4):377–386. [PubMed: 19241490]
16. Charlier C, Van Hoof E, Pauwels E, Lechner L, Spittaels H, De Bourdeaudhuij I. The contribution of general and cancer-related variables in explaining physical activity in a breast cancer population 3 weeks to 6 months post-treatment. *Psycho-Oncology.* 2013; 22(1):203–211. [PubMed: 22052746]
17. Courneya KS, Segal RJ, Gelmon K, Mackey JR, Friedenreich CM, Yasui Y, Reid RD, Proulx C, Trinh L, Dolan LB, Wooding E, Vallerand JR, McKenzie DC. Predictors of adherence to different types and doses of supervised exercise during breast cancer chemotherapy. *Int J Behav Nutr Phys Act.* 2014; 11:85. [PubMed: 24997476]
18. Rock CL, Byers TE, Colditz GA, Demark-Wahnefried W, Ganz PA, Wolin KY, Elias A, Krontiras H, Liu J, Naughton M, Pakiz B, Parker BA, Sedjo RL, Wyatt H. Reducing breast cancer recurrence with weight loss, a vanguard trial: the Exercise and Nutrition to Enhance Recovery and Good Health for You (ENERGY) Trial. *Contemp Clin Trials.* 2013; 34(2):282–295. doi:S1551-7144(12)00262-5 [pii] 10.1016/j.cct.2012.12.003. [PubMed: 23266440]
19. Milne HM, Wallman KE, Gordon S, Courneya KS. Effects of a combined aerobic and resistance exercise program in breast cancer survivors: a randomized controlled trial. *Breast Cancer Res Treat.* 2008; 108(2):279–288. [PubMed: 17530428]
20. Montoye, H. *Physical Activity and Health: An Epidemiologic Study of an Entire Community.* Englewood Cliffs, N.J: Prentice-Hall; 1975.
21. Erickson K, Patterson RE, Flatt SW, Natarajan L, Parker BA, Heath DD, Laughlin GA, Saquib N, Rock CL, Pierce JP. Clinically defined type 2 diabetes mellitus and prognosis in early-stage breast cancer. *J Clin Oncol.* 2011; 29(1):54–60. [PubMed: 21115861]
22. Centers for Disease Control and Prevention. Overweight and Obesity, Adult Obesity Facts. 2012. <http://www.cdc.gov/obesity/data/adult.html>.
23. Centers for Disease Control and Prevention. State Indicator Report on Physical Activity, 2010. Atlanta, GA: U.S. Department of Health and Human Services; 2010.
24. Centers for Disease Control and Prevention Physical Activity: Facts about Physical Activity. <http://www.cdc.gov/physicalactivity/data/facts.html>.
25. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc.* 2008; 40(1):181–188. [PubMed: 18091006]

Table 1

Physical activity by demographic and cancer characteristics

	<i>N</i>	Minutes of moderate/vigorous physical activity mean (SD)	<i>p</i> value
Age, years			0.81
<50	173	102 (137)	
50–64	372	92 (129)	
65	147	101 (136)	
Education			0.30
Not a college graduate	282	89 (136)	
College graduate	410	102 (130)	
Race/ethnicity			0.22
White non-Hispanic	547	93 (122)	
African-American	71	128 (189)	
Hispanic	46	81 (105)	
Asian	11	122 (90)	
Mixed/other	15	114 (233)	
Menopause status at study entry			0.16
Premenopausal/ peri-menopausal	87	115 (155)	
Postmenopausal	605	94 (129)	
Years between diagnosis and study entry			0.61
<1	76	102 (167)	
1–2.9	325	93 (121)	
3	291	100 (134)	
Breast cancer stage			0.09
I	210	113 (134)	
II	358	92 (138)	
III	124	83 (109)	
Cancer treatment			0.32
Radiation only	111	99 (137)	
Chemotherapy only	136	97 (160)	
Both radiation and chemotherapy	391	91 (117)	
Adjuvant hormone therapy			0.31
Aromatase Inhibitor	366	98 (130)	
Selective estrogen receptor modulator	147	108 (138)	
None	179	85 (133)	
Clinical site			0.02
Alabama	116	66 (99)	
California	215	109 (126)	
Colorado	187	109 (148)	
Missouri	174	89 (139)	

	<i>N</i>	Minutes of moderate/vigorous physical activity mean (SD)	<i>p</i> value
Marital status			0.61
Married or partnered	463	99 (131)	
Divorced	99	75 (93)	
Single	74	107 (170)	
Widowed	41	101 (144)	
Other	15	113 (139)	
Hospitalizations in last year			0.17
Any	174	85 (131)	
None	518	101 (133)	
Emergency room visits in the last year			0.04
Any	106	72 (90)	
None	586	101 (138)	
Number of prescription medications			<0.0001
0	135	133 (170)	
1–2	292	100 (128)	
3–4	181	79 (111)	
5 or more	84	67 (106)	
Number of co-morbidities			0.001
0	253	118 (152)	
1	240	93 (123)	
2	119	81 (119)	
3 or more	82	65 (98)	
Smoking status			0.60
Current	24	70 (145)	
Former	219	96 (135)	
Never	448	98 (130)	

Table 2

Physical activity by body measurements and fitness level

	<i>N</i>	Minutes of moderate/vigorous physical activity mean (SD)	<i>P</i> value
Body mass index, kg/m ²			0.002
Overweight, 25–29.99	321	118 (145)	
Obese I, 30–34.99	219	80 (106)	
Obese II, 35–39.99	105	80 (143)	
Obese III, 40	47	68 (102)	
Fitness level			<0.0001
Good to excellent	162	140 (163)	
Poor to fair	499	83 (118)	

Table 3

Percentage of participants not meeting physical activity guidelines

Variable	% Not Meeting Guidelines	p value
Age, years		0.64
<50	75	
50–64	78	
65	74	
Race/ethnicity		0.56
White non-Hispanic	78	
African-American	70	
Hispanic	78	
Asian	64	
Mixed/other	80	
Education		0.27
Not college graduate	79	
College graduate	75	
Body mass index, kg/m ²		0.13
Overweight, 25–29.999	73	
Obese I, 30–34.999	79	
Obese II, 35–39.999	82	
Obese III, 40	81	
Fitness level		0.0002
Good to excellent	66	
Poor to fair	80	
Menopause status at study entry		0.33
Premenopausal/peri-menopausal	72	
Postmenopausal	77	
Years between diagnosis and study entry		0.94
<1	78	
1–2.9	77	
3	76	
Breast cancer stage		0.25
I	73	
II	77	
III	81	
Chemotherapy		0.26
Yes	78	
No	73	
Radiation		0.36
Yes	77	
No	74	
Adjuvant hormone therapy		0.36

Variable	% Not Meeting Guidelines	<i>p</i> value
Aromatase Inhibitor	75	0.07
Selective estrogen receptor modulator	75	
None	80	
Clinical site		
Alabama	85	0.73
California	73	
Colorado	74	
Missouri	78	
Smoking status		0.06
Current	83	
Former	76	
Never	76	
Number of co-morbidities		0.06
0	72	
1	76	
2	82	
3 or more	84	

Table 4

Multivariate model of variables associated with minutes of moderate/vigorous physical activity

Variable	Beta Coefficient*	Standard Error	p value
Body mass index	−2.4	1.1	0.03
Menopause status			
Postmenopausal vs Pre or perimenopausal	−18.0	15.5	0.25
Breast cancer stage			
Stage II vs Stage I	−19.4	12.6	0.12
Stage III vs Stage I	−29.4	16.5	0.08
Cancer treatment			
Both chemo and radiation vs neither	−21.1	19.7	0.28
Chemo only vs neither	−21.2	21.3	0.32
Radiation only vs neither	−30.9	21.9	0.16
Clinical site			
California versus Alabama	34.3	15.3	0.03
Colorado versus Alabama	37.8	15.5	0.02
Missouri versus Alabama	19.5	15.7	0.22
Hospitalizations	2.8	7.9	0.73
Emergency room visits vs none	−29.4	14.0	0.04
Co-morbidities	−11.2	4.9	0.02

* Beta coefficients are equivalent to weekly minutes of moderate/vigorous physical activity compared with the reference category for categorical variables, or per unit increase for continuous measures.