Racial Differences in Physical Activity among Breast Cancer Survivors: Implications for Breast Cancer Care

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Abstract

Background—Physical activity after breast cancer diagnosis is associated with improved survival. This study examines levels of and changes in physical activity following breast cancer diagnosis, overall and by race.

Methods—The Carolina Breast Cancer Study, Phase III, assessed pre- and post-diagnosis physical activity levels in a cohort of 1,735 women, aged 20–74, diagnosed with invasive breast cancer between 2008 and 2011 in 44 counties of North Carolina. Logistic regression and analysis of variance were used to examine whether demographic, behavioral and clinical characteristics were associated with activity levels.

Results—Only 35% of breast cancer survivors met current physical activity guidelines post-diagnosis. A decrease in activity following diagnosis was reported by 59% of patients, with the average study participant reducing their activity by 15 metabolic equivalent (MET) hours (95% CI: 12, 19). Following adjustment for potential confounders, when compared to white women, African-American women were less likely to meet national physical activity guidelines post-diagnosis (odds ratio: 1.38, 95% CI: 1.01, 1.88) and reported less weekly post-diagnosis physical activity (12 vs. 14 MET-hours; p=0.13). In adjusted, stratified analyses, receipt of treatment was significantly associated with post-diagnosis activity in African-American women (p<0.01).

Conclusion—Despite compelling evidence demonstrating the benefits of physical activity post-breast cancer, it is clear that more work needs to be done to promote physical activity in breast cancer patients, especially among African-American women.

Introduction

Participation in regular physical activity following breast cancer is associated with reduced morbidity and higher quality of life.[1–4] It has also been associated with improved overall and breast-cancer specific survival.[5–8] Findings from a meta-analysis show that the mortality

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rate is reduced by 34% in those with higher levels of reported activity when compared to those with the least amount of physical activity after breast cancer diagnosis.[9] Declines in physical activity following breast cancer diagnosis have also been associated with reduced overall survival.[10]

These compelling findings regarding benefits derived from participation in physical activity following breast cancer diagnosis have been promoted in healthcare and other settings and have led to calls for physical activity to be incorporated into models of breast cancer care.[11–13] However, before a change in clinical practice can be supported, it is first important to understand whether there is capacity for change in the physical activity levels of women with breast cancer.

The US Department of Health and Human Services, as well as the American Cancer Society, recommends that adults engage in at least 150 minutes of moderate-intensity physical activity or 75 minutes of vigorous-intensity physical activity (or an equivalent combination thereof) each week for general health benefits and for chronic disease prevention and management.[14–16] Estimates of the percentage of breast cancer survivors who meet current physical activity guidelines prior to their diagnosis range widely, from 34% [17] to 70%,[18] however, many studies have found that survivors tend to decrease their activity level post-diagnosis, with percentage reductions ranging from 3% to 50%.[18–21] Preliminary studies have suggested that racial disparities may exist in post-diagnosis physical activity, with African-American women less likely to meet physical activity recommendations after a diagnosis[1, 17, 22] and more likely to report higher declines in post-diagnosis physical activity compared with white women.[18] However, many of these studies did not report on change in physical activity by race, included a small sample of African-Americans in their study populations, or were not population-based.[1, 17, 22] Because of the higher rates of morbidity and mortality experienced by African-American women compared with white women,[23, 24] further study of this relationship is warranted.

The purpose of this study was to describe post-diagnosis physical activity and changes between pre- and post-breast cancer diagnosis physical activity levels, overall and by race in a population-based study of breast cancer patients with a large group of African-American women.

Methods

Study Population

Phase III of the Carolina Breast Cancer Study (CBCS) is a prospective, population-based survivorship cohort study based in 44 counties in eastern and central North Carolina.[25] Eligibility for study participation was limited to those who were female, English-speaking, newly diagnosed with invasive breast cancer, and between 20 to 74 years of age. Younger women and African-American women were oversampled to make up 50% of the total population to ensure sufficient power for subgroup analyses. Cases were identified and randomly recruited from the North Carolina Cancer Registry between 2008 and 2011.

Data Collection

The CBCS Phase III involves data collection by trained personnel at regular intervals for up to 5 years post-diagnosis. The work presented within this paper reflects data collected at the baseline in-person interview by study nurses, conducted at approximately 6 months-post-diagnosis (mean± standard deviation = 5.7± 2.9 months).

Total Physical Activity

At the baseline interview, women were asked to self-report the usual amount of vigorous- and moderate-intensity physical activity they completed in the three months prior to their breast cancer diagnosis and in the seven days prior to the baseline interview. The questions were patterned on those used in the 2001 Behavioral Risk Factor Surveillance System survey[26] and provided examples of moderate-intensity (e.g., brisk walking, vacuuming, and gardening) and vigorous-intensity physical activity (e.g., running and heavy yard work).[26]

Total weekly minutes of physical activity post-diagnosis was evaluated as a continuous (total minutes/week) and categorical variable (sufficiently active, insufficiently active or sedentary). Total minutes of physical activity per week was calculated as 2*vigorous activity + moderate activity.[26] Categories were based on meeting the US Department of Health and Human Services recommendations. Specifically, those reporting 150 minutes total physical activity per week were sufficiently active, those reporting >0 minutes but < 150 minutes per week were insufficiently active, and those reporting no activity were classified as sedentary. Change in physical activity levels between pre- and post-diagnosis was also assessed as a continuous (post-diagnosis levels minus pre-diagnosis levels) and categorical variable (increased: increased activity by 30 minutes compared to pre-diagnosis amount; decreased: decreased activity by 30 minutes; no change: reported activity levels at post-diagnosis were within 30 minutes of pre-diagnosis levels). Physical activity levels were also used to calculate total weekly metabolic equivalent task (MET)-hours per week. MET values of 4.0 and 8.0 were assigned to moderate- and vigorous-intensity activity, respectively (based on the International Physical Activity Questionnaire Guidelines),[27] were multiplied by reported number of hours per week for each activity type and then summed across these amounts. To determine if high levels of reported physical activity affected data interpretation, a sensitivity analysis was conducted by truncating reported weekly physical activity at 21 hours/week. Because no differences in data interpretation were found, the non-truncated physical activity data was used for all analyses.

Covariates

Information collected at baseline also included demographic data (race, household income, education, marital status, age at diagnosis) and physical and behavioral characteristics (body mass index one year before diagnosis, alcohol consumption, smoking status). Treatment and diagnostic characteristics including surgery type, lymph node dissection, receipt of chemotherapy and/or radiation therapy, receipt of hormone therapy, and tumor stage, as well as presence of comorbidities, were abstracted from medical records. The receipt of chemotherapy and/or radiation therapy was coded as chemotherapy only, radiation therapy only, both chemotherapy and radiation therapy, and neither chemotherapy nor radiation

therapy. Those who received chemotherapy and hormonal therapy or radiation therapy and hormonal therapy were coded as having received hormonal therapy.

Statistical Analyses

Physical activity levels were described using means (with 95% confidence intervals) and proportions, for the continuous and categorical outcomes, respectively. Covariates were described with proportions. Stratified analyses were restricted to African-American and white women; analysis of the total population included all races. Logistic regression was performed to calculate the odds of insufficient or sedentary versus sufficient post-diagnosis activity by race. Analysis of variance (ANOVA) models were fit to compare post-diagnosis physical activity and mean change in physical activity after diagnosis by study variables. All analyses were weighted by or adjusted for age and race, to account for sampling design as appropriate. The sampling weights were based on four age-race strata: African-American women less than 50 years of age, African-American women aged 50 years or higher, non-African-American women less than 50 years of age, and non-African-American women aged 50 years or higher. Fully adjusted models for both the logistic regression and ANOVA analyses included adjustment for personal characteristics (age at diagnosis, income, education level, marital status, body mass index, alcohol consumption, smoking status, and comorbidities) and treatment- and diagnostic-related variables (stage, receipt of chemotherapy and/or radiation therapy, receipt of hormonal therapy, surgery type, and lymph node removal). Total MET-hours of pre-diagnosis activity were adjusted for in models of post-diagnosis activity. A p-value <.05 was considered statistically significant. SAS version 9.2 (Cary, NC) was used to conduct all analyses.

This study was approved by the Office of Human Research Ethics at the University of North Carolina at Chapel Hill; all patients gave informed consent.

Results

Of the 2,843 breast cancer patients screened for study eligibility and with data available at the time of study analysis, 1,108 were excluded for failure to meet inclusion criteria (n=364), refusal to participate (n=535), non-response (n=178), or for being deceased at the time of contact (n=31); the overall response rate was 71%. The final study population consisted of 1,735 participants, with a weighted mean age at diagnosis of 55.9. Approximately 48% of the participants were African-American. After taking into account weighting, African-American women were more likely to report low incomes, to be diagnosed at less than 50 years of age, and to be diagnosed with stage 3 or 4 breast cancer than white women, but were less likely to receive hormonal therapy (Table 1).

Table 2 shows level of reported physical activity overall and stratified by race. The average pre- to post-diagnosis reduction in weekly physical activity for the total study population was 15 MET-hours per week (95% CI: 12, 19), with the majority of participants reporting declines in physical activity. There were racial differences in reported levels of activity. African-American women reported lower levels of pre-diagnosis physical activity compared with white women and a larger decline between pre- and post-diagnosis activity. However, a similar percentage of African-American and white women reported a decrease in physical

activity levels (60% vs. 59%). In fully adjusted models (adjusting for age at diagnosis, race, income, education level, marital status, body mass index, alcohol consumption, smoking status, comorbidities, stage, receipt of chemotherapy and/or radiation, receipt of hormonal therapy, surgery type, removal of lymph nodes, and pre-diagnosis activity [for the post-diagnosis analysis]), racial differences in post-diagnosis activity and change in activity were not significant (data not shown). African-American women reported 12 MET-hours of post-diagnosis activity versus 14 MET-hours reported by white women (p-value=0.13), and African-American patients reduced their pre-diagnosis activity by 17 MET-hours, while white patients reported an average 16 MET-hour reduction (p-value=0.33).

In a logistic regression model that was used to examine post-diagnosis physical activity level by race, African-American women had elevated odds of reporting insufficient or sedentary behavior compared to white women, after full adjustment for all of the covariates listed above [odds ratio (OR): 1.38; 95% confidence interval (CI): 1.01, 1.88].

Table 3 shows means for post-diagnosis physical activity levels and for change in activity levels adjusted for all of the listed covariates and stratified by race. Among African-American women, receipt of chemotherapy and/or radiation was significantly associated with post-diagnosis physical activity (p-value <0.01), with those receiving chemotherapy only and those receiving neither chemotherapy nor radiation therapy exercising the least. African-American women who reported no prior comorbidities reduced their post-diagnosis activity to a greater extent than those with comorbidities (p-value=0.04), and though not statistically significant, higher income African-American women reduced their post-diagnosis activity to a lesser extent than those with lower income (p-value=0.06). Among white women, no variable was significantly associated with post-diagnosis physical activity; however, women who were normal or overweight reported higher activity levels than obese women (p-value=0.06). Income (p-value=0.02) and receipt of treatment (p-value=0.02) were significantly associated with change in activity levels, with low income women and women who received neither chemotherapy nor radiation therapy reporting the greatest average reductions in activity.

Discussion

Our study found that physical activity declined on average by 15 MET-hours/week between pre- and post-breast cancer diagnosis. Further, approximately 65% of the women failed to meet national recommendations for physical activity levels following a breast cancer diagnosis, compared to 39% pre-diagnosis. Compared with white women, we found that African-American women were less likely to meet national physical activity guidelines, reported lower amounts of pre- and post-diagnosis activity, and reported larger declines in physical activity between pre- and post-breast cancer diagnosis, though differences in post-diagnosis activity and change in activity levels were not statistically significant in multivariate analyses.

Overall, our findings are consistent with those reported in previous studies,[18–20] though the magnitude of decline in physical activity reported here are greater than in previous findings. The inclusion of physical activity reported soon after breast cancer diagnosis for some

participants, where larger reductions in physical activity occurred (in our study, the average time was 6 months post-diagnosis), may partially explain the difference in magnitude between our results and previous studies. Our findings of potential racial differences among breast cancer survivors are also consistent with results from previous studies.[1, 22] In a racially diverse study of breast cancer survivors, African-American women (n=118) had the lowest value of reported median MET-minutes/week at 225.0 (whites [n=2,634] reported a median value of 607.5) and were less likely than other racial groups to meet physical activity guidelines post-diagnosis.[1] Specifically, 32% of African-Americans reported meeting physical activity guidelines, which is higher than the 24% who reported meeting the guidelines in our study.[1] The multi-ethnic HEAL study, also reported that African-Americans were less likely to meet the physical activity recommendations compared to whites and Hispanics, with 23% of African-Americans (n= 259) meeting the guidelines when reporting on sports and/or recreational physical activity, though the percentage increased to 63% when all types of physical activity were included.[22]

Findings from focus groups conducted with African-American breast cancer survivors may provide clues for the inadequate physical activity levels specifically reported by this subgroup.[28, 29] African-American women in one study indicated that while they were aware of the benefits of exercise, those who reported a higher income were more knowledgeable of the potential benefits and more likely to engage in regular physical activity.[29] Though not statistically significant, our results showing that low income African-American women were more likely to report higher declines in physical post-diagnosis support these findings. Another focus group of African-American breast cancer survivors found that only 21% mentioned physical activity as a strategy to reduce risk of recurrence and that many participants did not receive physical activity guidelines from healthcare providers.[28]

Type of treatment received also seems to impact activity levels in breast cancer patients. Our fully-adjusted stratified results suggested that the administration of adjuvant therapy, and the type of therapy received, may be associated with post-diagnosis physical activity levels in African-American women and with change in activity levels in white women. Interestingly, both receipt of chemotherapy alone and no receipt of chemotherapy or radiation therapy were associated with lower physical activity levels and higher declines in physical activity post-diagnosis. It seems plausible that side effects associated with receipt of chemotherapy, such as pain, fatigue or neuropathy, may present as barriers to engaging in physical activity.[29] In contrast, lack of receipt of adjuvant therapy may reduce contact with health professionals who may promote and encourage participation in physical activity during and beyond breast cancer treatment. Additional work is needed to more precisely sort out potential determinants.

Of note, our findings also suggested that approximately one in five women increased their activity levels by at least 30 minutes a week after being diagnosed with breast cancer. Understanding motivations for positive change in physical activity would prove useful in designing interventions to promote exercise among breast cancer patients. Current research indicates that both the distribution of pedometers [30] and the sense of accomplishment that comes with being physically activity during cancer treatment [31] have been motivating factors for increasing post-diagnosis activity levels. One report suggested that among

African-American women, home-based exercise programs have also led to increased post-diagnosis physical activity levels. [32] In our dataset, women who increased versus decreased post-diagnosis activity were more likely to report high income, receipt of radiation therapy only versus chemotherapy only, and receipt of hormonal therapy (data not shown), suggesting that income level and type of therapy received should also be considered in the design of interventions. More research is warranted to determine what other characteristics are associated with increased post-diagnosis physical activity.

Our findings were derived from a population-based study and our sampling design was successful at recruiting a large proportion of African-American women with breast cancer, allowing for adequately powered subgroup analysis. Nonetheless, this work may be limited by non-response. Our response rates were moderate (71% overall, 67% for African-American women, and 74% for white women) and, within the racial groups, there was no difference in mean age for those who did and did not participate in the study. However, it is possible that breast cancer patients who participate in the study are highly motivated individuals who may be more likely to exercise than non-participants. Women in our study were more likely to meet physical activity guidelines pre-diagnosis than women in the 2011 US population (61% vs. 46%),[33] suggesting potential overestimation of physical activity levels in our data when compared to the general population.

This work may also be limited by the retrospective data collection of pre-diagnosis physical activity levels. It is unclear what impact distant recall of physical activity has on the validity of reported levels, with some studies finding only modest correlations between activity reported in the past and later recall of that same activity,[34, 35] and other research reporting higher correlations.[36] There is evidence that the accuracy of the recall of past activity levels differs by the activity type,[35, 36] with one study finding that individuals tend to overestimate prior vigorous activity and underestimate prior light and moderate activity.[35] Therefore, it is difficult to predict whether the levels of activity reported in our analyses over- or underestimate the true levels of physical activity in our study population. Similarly, it is difficult to predict how recall might differ between the reporting of pre-diagnosis physical activity (in which participants were asked to recall weekly activity 3 months prior to diagnosis) and the reporting of post-diagnosis activity (in which participants were asked to report activity in the week prior to their baseline interview). It is possible that the post-diagnosis physical activity variable is less prone to measurement error than the change in activity variable because the latter required more distant recall.

Additionally, there is evidence that survivors' level of activity changes dependent on the amount of time that has passed since the diagnosis, with one study finding that those further out from diagnosis have higher activity levels than those closer to diagnosis[20] and another study reporting the opposite.[17] In our study, though study participants reported their physical activity, on average, 6 months post-diagnosis, the range was from 1.8 to 32.8 months post-diagnosis, with 95% of all interviews occurring within 12 months of diagnosis. We conducted a sensitivity analysis restricted to those whose physical activity was assessed within the first year after diagnosis, and found no meaningful changes in our overall study estimates or interpretation, though the p-value for the odds ratio comparing post-diagnosis activity between African-Americans and whites increased from .05 to .07.

It has been suggested that exercise needs to be formally incorporated into the care of women with breast cancer. A recently proposed breast cancer care model recommended that patients be educated about physical activity at the point of breast cancer diagnosis, and be provided with the necessary support and advice to become and stay active along the breast cancer diagnosis-treatment continuum and beyond.[11] Our findings, which clearly demonstrate that the majority of breast cancer survivors remain insufficiently active or sedentary post-diagnosis and are likely to reduce physical activity between pre- and post-diagnosis, further highlight the potential for change and the value that implementation of such a model could bring. Though breast cancer advocates are actively promoting the message that physical activity post-diagnosis improves quality of life and survival, and the evidence supporting participation in physical activity following breast cancer continues to mount, it is clear that more work needs to be done to translate evidence into practice, especially among African-American women.

Acknowledgments

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Table 1

Demographic and clinical characteristics of study participants in the Carolina Breast Cancer Study (CBCS), overall and by race

	CBCS Total[a]		White		African-American	
	N	Weighted %	N	Weighted %	N	Weighted %
Total	1,735		859		830	
Age at Diagnosis						
<50	851	29.1	424	26.8	397	35.5
50	884	70.9	435	73.2	433	64.5
Missing	-		-			
Income						
<$30,000	560	28.7	161	22.3	384	50.7
$30,000	1,076	71.3	652	77.7	396	49.3
Missing	99		46		50	
Education[b]						
< High School	146	7.6	43	5.9	96	12.4
HS Graduate	560	33.7	243	33.1	304	37.5
Some College	1,028	58.6	573	61.0	429	50.1
Missing	1		-		1	
AJCC Stage						
1 or 2	1339	84.5	693	85.9	610	78.8
3 or 4	296	15.5	124	14.1	165	21.2
Missing	100		42		55	
CT/RT[c, d]						
CT and RT	211	14.2	88	13.2	119	18.3
CT only	741	50.8	350	49.8	374	56.7
RT only	126	12.1	70	12.4	49	8.5
No CT or RT	261	22.9	152	24.6	102	16.5
Missing	132		50		79	
Hormonal Therapy[d]						
Yes	459	34.2	269	37.0	178	24.5
No	1,143	65.8	537	63.0	576	75.5

	CBCS Total[a]		White		African-American	
	N	Weighted %	N	Weighted %	N	Weighted %
Missing	133		53		76	
Surgery[d]						
Biopsy Only	148	6.2	57	5.2	90	10.8
Lumpectomy	525	35.5	259	35.6	246	33.1
Mastectomy	946	58.3	495	59.2	428	56.1
Missing	116		48		66	
Lymph Nodes[d]						
1 LN Removed	739	49.5	364	45.0	357	47.8
No LNs Removed	850	50.5	435	55.0	392	52.2
Missing	146		60		81	

Abbreviatons: CBCS = Carolina Breast Cancer Study; HS = High School; AJCC = American Joint Commission on Cancer; CT = Chemotherapy; RT= Radiation Therapy; LN = Lymph Nodes

[a] Total includes all races

[b] The high school graduate category includes those who went to technical school.

[c] For the CT/RT variable: N = 1,474 for total CBCS population, 710 for whites, and 723 for African-Americans

[d] Those who received treatments after post-diagnosis physical activity was assessed were coded as not having received treatment

Table 2

Physical activity levels pre- and post-diagnosis[a] and change in physical activity, overall and by race[b]

Total CBCS Population[c]

	Pre-diagnosis		Post-diagnosis		Change between pre- and post-diagnosis		
	N	Mean (95% CI)	N	Mean (95% CI)		N	Mean (95% CI)
Total minutes	1,728	473.9 (434.0, 513.7)	1,731	245.0 (214.9, 275.2)		1,726	−230.3 (−270.4, −190.1)
Total METs[d]	1,728	31.6 (28.9, 34.2)	1,731	16.3 (14.3, 18.3)		1,726	−15.4 (−18.0, −12.7)
	N	(%)	N	(%)		N	(%)
Sedentary[f]	299	16.4	786	42.2	Increased[e]	284	17.5
Insufficiently active[f]	403	22.9	415	23.2	Decreased[e]	1,045	59.1
Sufficiently active[f]	1,025	60.6	530	34.6	No change[e]	397	23.4

White

	Pre-diagnosis		Post-diagnosis		Change between pre- and post-diagnosis		
	N	Mean (95% CI)	N	Mean (95% CI)		N	Mean (95% CI)
Total minutes	856	491.0 (446.5, 535.6)	859	263.8 (235.7, 291.8)		856	−229.1 (−271.7, −186.5)
Total METs	856	32.7 (29.8, 35.7)	859	17.6 (15.7, 19.5)		856	−15.3 (−18.1, −12.4)
	N	(%)	N	(%)		N	(%)
Sedentary	133	15.2	327	39.2	Increased	157	18.1
Insufficiently active	186	22.6	209	23.2	Decreased	518	59.1
Sufficiently active	536	62.1	323	37.6	No change	181	22.8

African-American

	Pre-diagnosis		Post-diagnosis		Change between pre- and post-diagnosis		
	N	Mean (95% CI)	N	Mean (95% CI)		N	Mean (95% CI)
Total minutes	826	420.1 (374.8, 465.4)	827	144.7 (116.2, 173.3)		825	−275.0 (−318.4, −231.6)
Total METs	826	28.0 (25.0, 31.0)	827	9.6 (7.7, 11.6)		825	−18.3 (−21.2, −15.4)
	N	(%)	N	(%)		N	(%)
Sedentary	154	19.2	437	52.7	Increased	121	15.1
Insufficiently active	208	25.1	195	23.3	Decreased	503	60.3
Sufficiently active	464	55.7	195	24.0	No change	201	24.6

[a] Post-diagnosis physical activity was reported, on average, 6 months after diagnosis

[b] All analyses in Table 2 are weighted or adjusted to take into account sampling

[c] Total includes all races

[d] To calculate total METs, MET values of 4.0 and 8.0 were assigned to moderate- and vigorous-intensity activity, were multiplied by reported number of hours per week for each activity type and then were summed

[e] To evaluate change between pre- and post-diagnosis activity, the categorical variable was defined as follows: Increased: increased activity by ≥30 minutes compared to pre-diagnosis amount; Decreased: decreased activity by ≥30 minutes; No change: reported activity levels at post-diagnosis were within 30 minutes of pre-diagnosis levels

[f] Sedentary = No activity reported; Insufficiently active >0 minutes but < 150 minutes of activity per week; Sufficiently active ≥150 minutes of activity per week

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Table 3

Characteristics associated with post-diagnosis[a] physical activity and change in physical activity between pre- and post-diagnosis

			Total MET-Hours of Weekly Physical Activity											
			Post-Diagnosis						Mean Change in Activity					
			White			African-American			White			African-American		
	White N	African-American N	Mean	Fully Adjusted[b] 95% CI	P	Mean	Fully Adjusted[b] 95% CI	P	Mean	Fully Adjusted[b] 95% CI	P	Mean	Fully Adjusted[b] 95% CI	P
Age at Diagnosis					0.64			0.85			0.47			0.83
50	435	433	17.5	(11.7, 23.3)		11.5	(6.9, 16.1)		−11.9	(−22.6, −1.2)		−19.0	(−28.9, −9.1)	
<50	424	394	16.5	(10.4, 22.6)		11.2	(6.6, 15.8)		−9.2	(−20.3, 2)		−19.8	(−29.8, −9.9)	
Income					0.44			0.25			0.02			0.06
<$30,000	161	383	15.9	(9.7, 22)		10.2	(5.9, 14.5)		−16.5	(−27.7, −5.2)		−23.3	(−32.6, −13.9)	
$30,000	652	395	18.1	(11.7, 24.5)		12.4	(7.5, 17.4)		−4.6	(−16.3, 7.1)		−15.6	(−26.3, −4.9)	
Education					0.73			0.35			0.91			0.21
< High School	43	95	14.9	(5.1, 24.7)		14.0	(7.5, 20.5)		−9.0	(−27.1, 9.1)		−12.0	(−26, 2)	
HS Graduate	243	304	17.5	(11.7, 23.2)		9.5	(4.9, 14.2)		−12.1	(−22.6, −1.6)		−23.2	(−33.3, −13.1)	
Some College	573	428	18.6	(12.9, 24.2)		10.5	(6.1, 14.8)		−10.6	(−21, −0.2)		−23.0	(−32.4, −13.7)	
Marital Status					0.53			0.12			0.32			0.57
Single	42	159	16.3	(6.3, 26.4)		10.0	(4.7, 15.4)		−11.6	(−30, 6.8)		−18.8	(−30.4, −7.3)	
Widowed	59	72	16.5	(7.9, 25)		10.1	(3.4, 16.8)		−8.1	(−23.7, 7.6)		−22.7	(−37.3, −8.2)	
Divorced/Separated	153	250	19.5	(13, 25.9)		10.5	(5.7, 15.4)		−7.0	(−18.8, 4.8)		−20.8	(−31.3, −10.3)	
Married	605	346	15.6	(10.1, 21.1)		14.6	(10.1, 19.2)		−15.5	(−25.7, −5.4)		−15.3	(−25.2, −5.4)	
Body Mass Index					0.06			0.60			0.05			0.48
Obese	272	473	13.6	(7.4, 19.9)		10.9	(6.5, 15.4)		−4.5	(−15.9, 6.9)		−16.7	(−26.4, −7.1)	
Overweight	260	224	18.3	(12.1, 24.5)		12.6	(7.7, 17.5)		−12.8	(−24.2, −1.5)		−21.6	(−32.2, −11)	
Normal	319	129	19.0	(12.9, 25.2)		10.4	(4.9, 15.9)		−14.3	(−25.6, −3)		−19.9	(−31.8, −8)	
Alcohol Consumption					0.59			0.39			0.14			0.28
Ever Use	734	597	16.1	(10.7, 21.6)		12.2	(8, 16.4)		−14.7	(−24.7, −4.6)		−17.2	(−26.3, −8.1)	
Never Use	125	230	17.8	(10.7, 24.9)		10.5	(5.4, 15.6)		−6.4	(−19.5, 6.6)		−21.6	(−32.5, −10.7)	
Smoking Status					0.98			0.82			0.41			0.27
Ever Smoked	411	344	17.0	(10.9, 23)		11.5	(6.9, 16.2)		−9.0	(−20.1, 2.1)		−21.6	(−31.6, −11.5)	

Total MET-Hours of Weekly Physical Activity

			Post-Diagnosis						Mean Change in Activity					
			White			African-American			White			African-American		
	White N	African-American N	Mean	Fully Adjusted[b] 95% CI	P	Mean	Fully Adjusted[b] 95% CI	P	Mean	Fully Adjusted[b] 95% CI	P	Mean	Fully Adjusted[b] 95% CI	P
Never Smoked	448	483	17.0	(11.2, 22.7)		11.1	(6.6, 15.7)		−12.1	(−22.7, −1.4)		−17.3	(−27.1, −5.6)	
Comorbidities					0.12			0.86			0.24			0.04
Yes	629	645	15.2	(9.8, 20.6)		11.5	(7.4, 15.6)		−13.0	(−23, −3.1)		−14.4	(−23.3, −5.6)	
No	192	132	18.8	(12.2, 25.3)		11.1	(5.7, 16.5)		−8.1	(−20.1, 4)		−24.4	(−36.1, −12.8)	
AJCC Stage					0.75			0.73			0.39			0.22
1 or 2	693	609	16.5	(11.1, 22)		11.7	(7.5, 15.9)		−8.3	(−18.3, 1.6)		−16.5	(−25.6, −7.5)	
3 or 4	124	163	17.4	(10.5, 24.3)		11.0	(5.7, 16.2)		−12.8	(−25.5, −0.1)		−22.3	(−33.7, −10.9)	
CT/RT[c]					0.13			<0.01			0.02			0.38
CT and RT	88	119	19.3	(12.2, 26.4)		10.2	(5.3, 15.1)		−2.4	(−15.4, 10.6)		−16.1	(−26.7, −5.6)	
CT only	350	173	14.9	(8.9, 20.9)		7.2	(2.5, 11.8)		−15.0	(−26, −4)		−16.3	(−26.4, −6.2)	
RT only	70	49	20.4	(12.2, 28.6)		19.4	(12, 26.8)		−5.0	(−20.1, 10)		−19.0	(−35, −3.1)	
No CT or RT	152	101	13.2	(6.4, 20.1)		8.5	(2.8, 14.2)		−19.8	(−32.4, −7.2)		−26.2	(−38.4, −13.9)	
Hormonal Therapy[c]					0.21			0.48			0.69			0.06
Yes	269	177	19.0	(11.9, 26.1)		12.4	(6.2, 18.5)		−9.4	(−22.5, 3.7)		−13.5	(−26.8, −0.2)	
No	537	574	14.9	(9.3, 20.6)		10.3	(6.4, 14.2)		−11.7	(−22.2, −1.3)		−25.3	(−33.8, −16.9)	
Surgery[c]					0.85			0.69			0.70			0.11
Biopsy	57	90	17.2	(8.8, 25.7)		12.5	(6.1, 18.9)		−9.6	(−25.1, 5.9)		−10.8	(−24.7, 3.1)	
Lumpectomy	259	246	16.2	(9.7, 22.7)		10.1	(5.1, 15)		−9.4	(−21.2, 2.5)		−24.9	(−35.5, −14.2)	
Mastectomy	495	425	17.5	(11.9, 23.1)		11.4	(7.2, 15.6)		−12.7	(−22.9, −2.5)		−22.6	(−31.6, −13.6)	
Lymph Nodes[c]					0.58			0.60			0.25			0.17
1 LN Removed	364	354	16.4	(10.3, 22.5)		11.9	(6.9, 16.8)		−8.3	(−19.5, 2.9)		−16.4	(−27.1, −5.8)	
No LNs Removed	435	392	17.6	(11.7, 23.4)		10.8	(6.4, 15.2)		−12.8	(−23.4, −2.1)		−22.4	(−31.9, −12.8)	

Abbreviatons: CI= Confidence Interval; HS = High School; AJCC = American Joint Commission on Cancer; CT = Chemotherapy; RT= Radiation Therapy; LN = Lymph Nodes

[a] Post-diagnosis physical activity was reported, on average, 6 months after diagnosis

[b] Fully adjusted models include adjustment for total minutes of pre-diagnosis physical activity, in addition to all of the listed covariates

[c]Treatment-related variables includes only those who treatment regimens began before post-diagnosis physical activity was assessed