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Association between race and physical functioning limitations among breast cancer survivors

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Abstract
Purpose The goal of this study was to examine differences in physical functioning limitations among African-American and white breast cancer survivors.
Methods Data were analyzed from 115 African-American and 712 white breast cancer survivors who responded to a hospital registry-based survey. Physical functioning limitations were assessed using a series of eight questions in which individuals were asked about their ability to perform a physical task such as walking a quarter of a mile. A four-category summary score, representing overall severity of limitation, was created using participant responses to the eight questions. Ordinal logistic regression was used to estimate the odds ratio (OR) and 95 % confidence interval (CI) for the association between race and physical functioning limitation adjusted for potential confounders.
Results In the unadjusted model, the African-American breast cancer survivors were more than twice as likely to have a greater degree of physical functioning limitation compared to their white counterparts (OR 2.31; 95 % CI 1.59, 3.38). After adjustment for covariates, including body mass index (BMI), the race OR was attenuated and no longer statistically significant (OR 1.44; 95 % CI 0.92, 2.27).
Conclusions Findings from this study showed that African-American breast cancer survivors were more likely to have worse physical functioning limitations than their white counterparts; however, much of this disparity was due to racial differences in other variables such as BMI. Future research should focus on effective interventions targeting modifiable risk factors of physical functioning limitations among breast cancer survivors with the goal of improving quality of life.

Keywords Body mass index · Breast cancer · Health status disparities · Mobility · Physical limitations

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Introduction

Advances in early detection and treatments have contributed to better survival after a breast cancer diagnosis [1]. Although more women are surviving their breast cancer, a major area of concern for breast cancer survivors is the long-term adverse effects of cancer treatments on physical functioning. Physical functioning limitations documented among breast cancer survivors include restrictions in mobility, decreases in strength, limited range of motion in limbs, poor vision, and reduced hearing [2, 3]. Functional limitations can impact the survivor's ability to work, her ability to perform daily activities, cognitive functioning, intimacy with a partner, and interactions with family and friends [2–7]. Such effects can decrease the survivor's quality of life and, ultimately, may lead to an increased risk of death [8].

While a number of studies have shown a higher prevalence of physical functioning limitations among breast cancer patients compared to women of the same age without a history of cancer [9–11], few studies have examined differences in physical functioning limitations by race [9, 12, 13], and the results of these studies have been conflicting. For example, in an analysis of data from the Women's Health Initiative Observational Study (WHI-OS), Paskett et al. [9] showed that African-American breast cancer survivors (n =465) had significantly worse physical functioning, as measured using the RAND 36

physical functioning subscale, than their white counterparts (n=4,446). In contrast, in a study conducted in a military health care system, Morehead-Gee et al. [12] found no statistically significant difference in mean Medical Outcome Survey Short Form-36 (SF-36) physical functioning score among 28 African-American and 130 white breast cancer patients at 12–24 months after breast cancer surgery [12]. Limitations of the literature pertaining to race and physical functioning among breast cancer survivors include the lack of consideration of other potential confounding variables, such as body mass index (BMI) [9, 13], the lack of generalizability to all breast cancer patients, such as long-term survivors [9, 13], and small numbers of African-Americans included in the analyses [12].

Thus, the purpose of this study was to examine whether there were any differences in physical functioning limitations, assessed using a series of eight questions in which individuals were asked about their ability to perform a physical task [14], among 827 African-American and white breast cancer survivors using data from a hospital registry-based survey study.

Methods

Study sample

In June 2008, a self-administered questionnaire was sent to all cancer survivors (those diagnosed with cancer thought to still be alive) listed in the Mercy Medical Center Cancer Registry between January 1996 (inception of the registry) and July 2007. The Mercy Medical Center Cancer Registry includes all individuals diagnosed or treated at Mercy Medical Center with invasive forms of cancer as well as patients with ductal carcinoma in situ. A second mailing to nonrespondents was conducted in November 2009. Consent was implied with the return of the questionnaire. A total of 2,513 breast cancer survivors were sent the questionnaire (57.1 % of all cancer survivors in the registry dataset); of these, 868 (34.5 %) returned the questionnaire. Respondents were significantly more likely to be of white race compared to nonrespondents (83.7 versus 67.4 %); however, the two groups did not differ in terms of sex, time since diagnosis, or tumor behavior (malignant versus in situ). The study was approved by the Institutional Review Board at Mercy Medical Center in Baltimore, MD, USA.

Measures

Self-reported information was obtained for race as well as other demographic, health habit, and cancer treatment characteristics. Respondents reported their date of birth, education, marital status, menopausal status, smoking status, and self-rated health. BMI was calculated based on self-reported weight and height. Further, respondents were queried as to whether they had "ever been told by a doctor or other health professional" that they had any of 49 medical conditions, including diabetes, high cholesterol, depression, and osteoporosis. Participants were also given the option of listing "other" medical conditions not present among the 49 conditions on the survey. Conditions were then grouped into the following 12 overarching categories: diabetes, heart, bone, thyroid, lung, autoimmune, gastrointestinal, kidney/bladder, neurological, gynecological, eye, and emotional. A variable was created that reflected the total number of comorbid condition types. For analyses, the number of comorbid condition types was categorized into quartiles.

Respondents reported their history of all cancer diagnoses, including their breast cancer diagnosis, as well as the age at which each cancer was diagnosed. Self-reported information was supplemented with data from the cancer registry. Time since diagnosis of first breast cancer was calculated. The median time since breast cancer diagnosis for the breast cancer survivors who responded to the survey was 7 years (range 1–43 years).

Physical functioning limitations were assessed using a series of eight questions in which individuals were asked about their ability to perform a physical task [14], as follows: "By yourself, and without special equipment, how difficult is it for you to…" "walk a quarter of a mile (about 3 city blocks)", "stand for about 2 h", "sit for about 2 h", "stoop, bend or kneel", "reach up over your head", "use your fingers to grasp or handle small objects", "lift or carry something as heavy as 10 pounds such as a full bag of groceries", and "push or pull large objects like a living room chair." This series of questions has been used on the National Health Interview Survey [15], most recently in 2011. Respondent choices for each question were: not at all difficult, only a little difficult, somewhat difficult, very difficult, I can't do at all, I do not do this activity, and I don't know. For each individual physical task, a dichotomous "yes/no" physical functioning limitation variable was created by combining responses reflecting any difficulty for comparison to a response of no difficulty in that specific task. A physical functioning limitation summary score was also created by assigning a number value to the original response to each of the eight questions (not at all difficult=0, only a little difficult=1, somewhat difficult=2, very difficult=3, I can't do at all=4) and adding the responses for all eight questions together. If a respondent answered either "I don't know" or "I do not do this activity" or had a missing value for any of the eight questions, a summary score could not be calculated, and, therefore, the respondent was missing a physical functioning limitation summary score value. For analyses, because data for the summary score were not normally distributed, the summary score values were categorized into four groups: for those with a summary score of 0 (no limitation), the categorized summary score value was 0; for those with some

limitation (summary score >0), summary score category values were assigned by tertile (group 1 was a score of 1–3, group 2 was a score of 4–7, and group 3 was a score of 8 or greater). A similar method in categorizing and analyzing this variable was published in Ryerson et al. [16].

Data analysis

Male breast cancer survivors ($n=5$), individuals self-identifying as a race other than white or African-American ($n=26$), and respondents missing data on all eight physical functioning limitation questions ($n=10$) were excluded from the analytic dataset. Thus, the final analytic was comprised of 712 white and 115 African-American breast cancer survivors.

Differences in the demographic and health characteristics between the white and African-American breast cancer survivors were tested using Student's t tests for continuous variables (age) and chi-square tests for categorical variables. Similarly, the unadjusted associations between the physical functioning limitation summary score and the demographic and health characteristics were examined using generalized linear models for continuous variables (age) and chi-square tests for categorical variables.

Ordinal logistic regression was used to estimate the unadjusted and adjusted odds ratios (ORs) and 95 % confidence intervals (CI) for the association between race and the four-category physical functioning limitation summary score. The proportional odds assumption for each model was tested using the score test; for both the unadjusted and adjusted models, this assumption was met. Covariates included in the adjusted model were identified as: (1) variables significantly associated ($p<0.05$) with both race and the physical functioning limitation summary score in the bivariate analyses (marital status, education, BMI, smoking status); and (2) variables shown to be confounders of the association between race and physical functioning in studies of the general population (age, number of comorbid conditions) [17]. In addition, stratified analyses were conducted by age (<60 and ≥60 years), BMI (<25, 25 to <30, and ≥30 kg/m^2), and years since first breast cancer diagnosis (<5 and ≥5 years); however, no evidence of effect modification was found, either in comparing the ORs across strata or by examining the statistical significance of an interaction term in the regression model. Thus, the results of these stratified analyses are not reported. All analyses were performed using SAS version 9.2. A two-sided p value <0.05 was considered statistically significant.

Results

The white breast cancer survivors were significantly more likely than their African-American counterparts to be married or living with a partner, to have some college education, to report that their health was excellent or very good, and to indicate a history of multiple cancers (Table 1). In contrast, the African-American breast cancer survivors were more likely to be obese (BMI ≥30 kg/m^2) and to be current smokers compared to the white breast cancer survivors. There were no statistically significant differences by race in terms of the other characteristics examined.

Overall, the proportion of breast cancer survivors reporting any physical functioning limitation for each of the eight tasks was higher among African-American than white women (Fig. 1) [all differences $p<0.05$ with the exception of "use your fingers to grasp or handle small objects" ($p=0.2$)]. Factors associated with the physical functioning limitation summary score, including race, are shown in Table 2. Overall, the African-Americans breast cancer survivors had more severe physical functioning limitations than their white counterparts ($p=0.0002$). Specifically, among the white breast cancer survivors, 23.4 % had a score of 0, indicating no difficulties with the eight tasks listed on the survey, compared to 18.0 % of the African-American breast cancer survivors. In contrast, 46.1 % of the African-American breast cancer survivors had a summary score in the highest category, indicating severe physical functioning limitation, compared to 23.9 % of white survivors. In addition to race, a higher physical functioning limitation summary score was significantly associated with older age, being single or widowed, less years of education, a higher BMI, being postmenopausal, current smoking, having poorer self-rated health, a greater number of comorbid conditions, and radiation treatment (Table 2).

The unadjusted and multivariable-adjusted ORs and 95 % CI for the association between race and severity of physical functioning limitation are shown in Table 3. In the unadjusted model, the African-American breast cancer survivors were more than twice as likely to have a greater degree of physical functioning limitation compared to the white breast cancer survivors (OR 2.31; 95 % CI 1.59, 3.38). After adjustment for potential confounders, the race OR was attenuated and no longer statistically significant (OR 1.44; 95 % CI 0.92, 2.27). All other variables included in the model were significantly associated with severity of physical functioning limitation. Specifically, older age, higher BMI, being a current smoker, and reporting a higher number of comorbid conditions were associated with greater severity of physical functioning limitation. Conversely, higher educational attainment or being married/living with partner was associated with a lower degree of severity of physical functioning limitation.

Discussion

While the number of cancer survivors in the USA is increasing rapidly, research related to racial disparities in health outcomes

Table 1 Demographics and covariates by race

Characteristic	White (n=712)	African-American (n=115)	p value[a]
Age, years, mean (SD)	62.1 (11.1)	63.6 (11.6)	0.2
Marital status, %			
Single	26.0	40.9	<0.0001
Married/living with partner	59.4	29.6	
Widowed	14.6	27.8	
Educational level, %			
High school or less	30.6	41.7	0.04
Some college/college graduate	44.1	36.5	
Graduate school	25.0	19.1	
Body mass index, kg/m^2, %			
<25.0	43.0	16.5	<0.0001
25.0 to 29.9	32.0	26.1	
≥30.0	24.9	56.5	
Postmenopausal, %			
Yes	91.4	90.4	1.0
No	7.2	7.0	
Smoking status, %			
Current	6.3	12.2	0.02
Former	42.0	46.0	
Never	51.1	39.1	
Self-rated health, %			
Excellent	16.6	5.2	<0.0001
Very good	38.9	19.1	
Good	32.3	42.6	
Fair/poor	12.1	33.0	
Number of comorbid conditions, %			
0 or 1	13.6	16.5	0.7
2 or 3	31.5	29.6	
4 or 5	33.1	29.6	
≥6	21.5	24.3	
History of multiple cancers, %			
Yes	18.3	10.4	0.04
No	81.7	89.6	
Years since breast cancer diagnosis, %			
<2 years	2.0	3.5	0.4
2 to 5 years	25.5	28.7	
>5 years	72.5	67.8	
Chemotherapy, %			
Yes	42.4	47.8	0.3
No	57.6	52.2	
Radiation, %			
Yes	61.2	61.7	0.9
No	38.8	38.3	
Aromatase inhibitor, %			
Yes	38.9	28.6	0.1
No	61.0	68.7	
Tamoxifen, %			
Yes	39.6	39.1	1.0
No	60.2	59.1	

Percentages for each characteristic may not equal 100 due to missing data

[a] Derived using Student's t tests for continuous variables and χ^2 for categorical variables

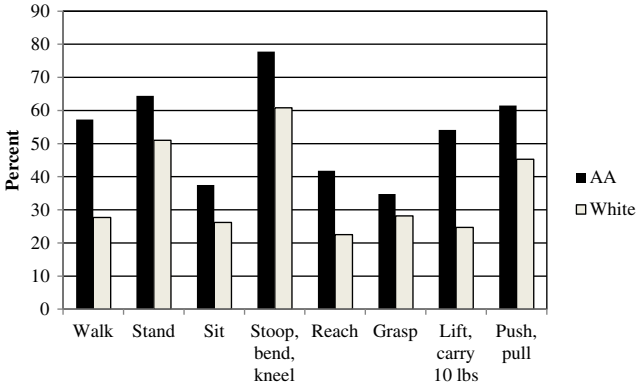

Fig. 1 Percentage of African-American (*AA*) and white breast cancer survivors with any physical limitation for each of eight tasks; questions derived from National Health Interview Survey questionnaires; all race differences with the exception of grasping objects are statistically significant at $p<0.05$

among this population is limited. Results from this large registry-based study showed that African-American breast cancer survivors were more likely to have worse physical functioning limitations than white breast cancer survivors of a similar age and time since diagnosis. However, much of this disparity was due to variation by race in other factors that were also associated with physical functioning limitations, such as BMI.

Few studies have examined the association between race and physical functioning among breast cancer survivors and, among those that have, results have been conflicting. Consistent with our study, Morehead-Gee et al. [12] found no statistically significant difference in physical functioning, measured using the physical function subscale of the SF-36, among 130 white and 28 African-American breast cancer survivors assessed 1 year after diagnosis. Breast cancer survivors in the Morehead-Gee et al. [12] study were identified in a military healthcare system, and the group was comprised of active duty women as well as spouses of active duty military and retirees, all of whom have access to health care. At baseline, unlike the present study, there were no statistically significant race differences in terms of BMI, marital status, or certain comorbid conditions. In contrast, Paskett et al. [9], analyzing data from 4,911 breast cancer survivors in the WHI-OS, reported that African-American breast cancer survivors had significantly lower physical functioning as reported using the RAND 36-item Health Survey compared to their white counterparts after adjustment for general health, pain, age, education, and comorbid conditions. Similar results were found by Bowen et al. [13], where race/ethnicity and socioeconomic status were found to be significantly related to the SF-36 physical component score among 804 long-term (23–63 months since diagnosis) breast cancer survivors enrolled in the Health, Eating, Activity and Lifestyle study. Specifically, African-American women and women of lower socioeconomic status had poorer physical functioning

Table 2 Bivariate associations between demographics and health characteristics with physical limitation summary score among breast cancer survivors

Characteristic	Overall n[a]	Physical limitation summary score				p value[b]
		No limitation %	1–3 %	4–7 %	8–30 %	
Race						
White	651	23.4	30.3	22.4	23.9	0.0002
African-American	89	18.0	20.2	15.7	46.1	
Age, years, mean (SD)	793	58.0 (9.8)	60.2 (10.5)	62.8 (10.6)	66.5 (11.8)	<0.0001
Marital status						
Single	209	18.2	31.6	23.4	26.8	<0.0001
Married/living with partner	422	27.0	31.3	20.4	21.3	
Widowed	108	14.8	15.7	22.2	47.2	
Educational level						
High school or less	221	16.7	22.2	23.1	38.0	<0.0001
Some college/college graduate	323	23.2	28.8	22.9	25.1	
Graduate school	193	28.5	37.8	17.6	16.1	
Body mass index, kg/m^2						
<25.0	301	32.9	33.2	18.6	15.3	<0.0001
25.0–29.9	237	16.5	28.3	27.4	27.8	
>30.0	201	14.9	23.4	19.4	42.3	
Postmenopausal						
Yes	670	21.3	28.2	22.1	28.4	0.004
No	57	35.1	38.6	15.8	10.5	
Smoking status						
Current	50	10.0	24.0	30.0	36.0	0.0005
Former	321	18.7	28.7	19.9	32.7	
Never	365	27.7	30.1	21.9	20.3	
Self-rated health						
Excellent	120	44.2	45.0	7.5	3.3	<0.0001
Very good	275	30.9	34.9	21.8	12.4	
Good	251	11.5	21.9	29.1	37.5	
Fair/poor	93	0.0	10.8	19.4	69.8	
Number of comorbid conditions						
0 or 1	110	47.3	31.8	12.7	8.2	<0.0001
2 or 3	241	24.5	36.9	22.4	16.2	
4 or 5	239	19.3	27.6	24.7	28.4	
≥6	149	7.4	16.8	21.5	54.4	
History of multiple cancers						
Yes	127	18.1	22.8	25.2	33.9	0.1
No	613	23.7	30.3	20.9	25.1	
Years since breast cancer diagnosis						
<2 years	17	17.7	23.5	23.5	35.3	0.5
2–5 years	191	26.7	27.2	24.1	22.0	
>5 years	532	21.4	29.9	20.7	28.0	
Chemotherapy						
Yes	325	21.2	30.8	19.1	28.9	0.3
No	415	23.9	27.7	23.6	24.8	
Radiation						
Yes	456	19.5	28.7	23.5	28.3	0.04
No	284	27.8	29.6	18.7	23.9	
Aromatase inhibitor						
Yes	277	18.8	27.8	25.6	27.8	0.1
No	460	25.0	29.8	19.4	25.8	

Table 2 (continued)

Characteristic	Overall n[a]	Physical limitation summary score				p value[b]
		No limitation %	1–3 %	4–7 %	8–30 %	
Tamoxifen						
Yes	299	23.1	27.8	22.4	26.7	0.9
No	438	22.4	29.9	21.2	26.5	

[a] Excludes those missing physical limitation summary score

[b] Derived using one-way ANOVAs for continuous variables and χ^2 for categorical variables

compared to non-Hispanic white women and women of higher socioeconomic status, respectively, controlling for age, education, breast cancer treatment, stage at diagnosis, and other factors. Inconsistencies of the results of the few published studies examining racial differences in physical functioning among breast cancer survivors are likely due to differences in study population, instruments used to measure physical functioning, covariates included in the analyses, as well as other factors.

Table 3 Unadjusted and adjusted odds ratios (ORs) and 95 % confidence intervals (CI) for the association between race and physical limitation among breast cancer survivors

Characteristics	Unadjusted OR (95 % CI)	Multivariable-adjusted OR (95 % CI)[a]
Race		
White	1.00 (reference)	1.00 (reference)
African-American	2.31 (1.59, 3.38)	1.44 (0.92, 2.27)
Age, years (continuous)		1.02 (1.01, 1.04)
Body mass index, kg/m^2		
<25.0		1.00 (reference)
25.0 to 29.9		1.98 (1.43, 2.73)
≥30.0		2.44 (1.71, 3.47)
Marital status		
Single/widowed		1.00 (reference)
Married/living with partner		0.72 (0.54, 0.96)
Educational level		
High school or less		1.00 (reference)
Some college/college graduate		0.73 (0.53, 1.02)
Graduate school		0.44 (0.30, 0.64)
Smoking status		
Never		1.00 (reference)
Former		1.45 (1.09, 1.92)
Current		1.91 (1.07, 3.39)
Number of comorbid conditions		
0 or 1		1.00 (reference)
2 or 3		1.87 (1.21, 2.89)
4 or 5		2.96 (1.89, 4.62)
≥6		8.52 (5.13, 14.16)

[a] Adjusted for all other covariates displayed on table

While there is a paucity of studies examining race and physical functioning among breast cancer survivors, there is a larger literature on racial disparities and functionality in the general cancer survivor population. Some, but not all, of these studies report that race plays a role in physical functioning among cancer survivors [3, 18, 19]; however, in most analyses, the role of race is diminished after considering other demographic characteristics, health-related behaviors, or comorbid conditions. For example, a study analyzing data from the 2005 to 2007 National Health Interview Survey showed that, while African-American cancer survivors had a higher prevalence of lower-body functional limitations than white cancer survivors, this difference was primarily due to the fact that African-Americans were more likely to have certain chronic conditions such as diabetes and asthma [19]. Similarly, Deimling et al. [18] reported that, among 321 long-term adult cancer survivors aged 60 years or older, being African-American was a statistically significant predictor of poorer functioning; however, number of comorbidities and symptoms were more strongly correlated to physical functioning among the cancer survivors. Deimling et al. [18] concluded that while being an African-American is a statistically significant predictor of poorer physical functioning, it is in conjunction with other variables where the most vulnerability is seen. It should be noted that no data on BMI were analyzed in relation to physical functioning in the Deimling et al. [18] study.

Although race was not significantly associated with physical functioning limitations in the multivariable-adjusted model in the present study, several other variables were found to be associated with poorer physical functioning among the breast cancer survivors in the adjusted model, including higher BMI and a greater number of comorbid conditions. Importantly, introduction of the BMI variable caused the greatest attenuation in the race risk estimate (2.31–1.68), indicating that race differences in BMI explained more of the association between race and poorer physical functioning

than the other variables (data not shown). It has been shown in several studies that BMI has a detrimental impact on the health of cancer survivors [20–22]; for example, Blanchard et al. [20] found that, among 1,013 breast cancer survivors in the American Cancer Society's Study of Cancer Survivors II, BMI was inversely and significantly associated with the physical component composite score of the RAND survey after adjustment for age, education, number of comorbidities, and physical activity. Further, while the number of comorbid conditions did not differ between the African-American and white breast cancer survivors in our study, this variable was also strongly and inversely associated with physical functioning. Results reported in other studies that have examined this relationship are consistent with those reported in the present study [23–25]. Both high BMI and a greater number of chronic conditions are factors that can help identify breast cancer survivors at risk for poorer physical functioning.

While the present study provides insight on the association between race and physical functioning among breast cancer survivors, several limitations of the study should be noted. First, the overall response rate was relatively low (34.3 %), and, as with any survey study, breast cancer survivors who completed the questionnaire may differ from those who did not complete the questionnaire, limiting the generalizability of the results and, perhaps, introducing selection bias. For example, a comparison of respondents and nonrespondents showed that the African-American breast cancer survivors in the cancer registry were less likely to return the survey than their white counterparts. The African-American nonrespondents may have been at a more advanced stage of cancer and, further, have had more physical limitations than both the respondents and the white nonrespondents; thus, we may have underestimated the extent of poor physical functioning among breast cancer survivors and, further, the strength of the association between African-American race and worse physical functioning (in both the unadjusted and multivariable analyses). A second limitation of this study is that the study sample included breast cancer survivors primarily from single institution, and the population that seeks services at this institution may not reflect the population in other parts of the country.

Findings from this study indicate that, while African-American breast cancer survivors report poorer physical functioning compared to white breast cancer survivors, much of the difference in physical functioning may be attributed to differences in other variables. This finding underscores the need for behavioral factors to be addressed just as vigorously in the breast cancer survivor population as they are in the general population. Because physical functioning limitations can lead to premature disability and, potentially, earlier death, it is imperative that factors that lead to a decrease in physical functioning be dealt with—preferably prior to the decline in physical functioning.

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