



Published in final edited form as:

Psychooncology. 2016 September ; 25(9): 1064–1070. doi:10.1002/pon.4175.

Great Expectations: Racial Differences in Outcome Expectations for a Weight Lifting Intervention among Black and White Breast Cancer Survivors with or without Lymphedema

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Abstract

Background—Black breast cancer survivors are less likely to engage in physical activity than White survivors. This is unfortunate because physical activity may be especially beneficial given Black breast cancer survivors' higher rates of obesity and adverse treatment effects related to obesity, such as breast cancer-related lymphedema (BCRL). The analysis explored outcome expectations for a weight lifting intervention by sedentary Black or White female breast cancer survivors, and assessed the role of breast cancer-related lymphedema (BCRL) on outcome expectations for exercise.

Methods—Chi-square tests compared mean outcome expectation values for Black and White breast cancer survivors who completed baseline surveys for the Physical Activity and Lymphedema (PAL) trial (N=281). With race as the independent variable, multivariable analysis compared results for women without BCRL to those with BCRL, separately.

Results—Across the entire sample, Black survivors (n=90) had significantly higher ($p<0.05$) outcome expectations than White survivors (n=191) for improvements in: sleep, appearance, mental health, affect, energy, and eating habits, with small to moderate effect sizes. When stratified by BCRL status, differences by race were robust only among those with BCRL.

Conclusions—Black cancer survivors had greater expectations than White cancer survivors for how a weight lifting intervention would improve their physical and mental states; these differences were most apparent among women with BCRL. Improving outcomes in Black breast cancer survivors rests on the development of interventions that are appropriately tailored to address the expectations of this population, and account for differences in persistent adverse effects of cancer such as BCRL.

Keywords

breast cancer survivorship disparities; physical activity; outcome expectations; lymphedema; oncology

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Conflict of Interest: The authors have no conflicts of interest to declare.

Background

Post-treatment physical activity has many benefits for cancer survivors [1], yet over 60% of breast cancer survivors do not meet recommended guidelines for physical activity [2, 3]. Black breast cancer survivors are 62% less likely than non-Hispanic White cancer survivors to meet recommended daily physical activity guidelines [4]. Physical activity may especially be beneficial to Black breast cancer survivors, for a variety of reasons. First, Black breast cancer survivors are more likely than Whites to die after a breast cancer diagnosis [5], and physical activity has been shown to reduce breast cancer mortality risk [1]. Further, studies have shown that Black breast cancer survivors face poorer physical health [6], greater fatigue, pain, cognitive and affective dysfunction, sleep disturbance, mobility challenges [7], worse physical functioning [8] and functional impairment [9, 10], all of which can be improved upon by physical activity [11]. Physical activity interventions have demonstrated safety and efficacy among women with adverse treatment effects including breast cancer-related lymphedema (BCRL) [13] for which Black breast cancer survivors have an over two-fold higher risk of onset than Whites [12]. Black breast cancer survivors face unique multi-level barriers to physical activity, including: limited accessible facilities; lack of interest; time and personal constraints; lack of social support; pain; and safety concerns [14, 15]; however, few quantitative studies have explored what Black women might expect to gain from physical activity to motivate them to become more physically active. Understanding expectations can assist with developing physical activity interventions that will be most effective in motivating Black breast cancer survivors.

Several studies have demonstrated the usefulness of Social Cognitive Theory (SCT) for assessing motivations to engage in physical activity [16] and to design structured physical activity interventions for breast cancer survivors [17]. SCT posits that behavior is driven by the dynamic interplay of external influences and internal beliefs, such as the results of the expected actions (outcome expectations) and one's belief in the ability to achieve the results by self-directed action (self-efficacy). *Outcome expectations* have been shown to be positive predictors of physical activity for cancer patients [18–20], and bolster self-efficacy for physical activity [21]. They may be influenced by one's physical health, mental health, self-esteem [20], attitude toward life, and may be higher among those who express more optimistic life orientation [22]. Positive outcome expectations of physical activity identified in prior studies of breast cancer survivors include improving mood [23], attitude, energy, muscle strength, physical appearance, physical fitness, self-efficacy, and self-esteem while reducing stress, fatigue, and weight [18, 19]. SCT-based physical activity studies suggest that SCT constructs may operate differently for Black and White [24] individuals, warranting explorations of differences in outcome expectations by race. For example, Black research participants experience somewhat higher levels of self-efficacy and physical outcome expectations than Whites, despite less engagement in physical activity [24]. The increased presence of a morphologically disfiguring adverse effect of cancer treatment like BCRL may further influence why breast cancer survivors enroll in an exercise intervention and what they expect to gain from it, thus higher BCRL among Black women may lead to differences in expectations for exercise. These differences in expectations prior to the intervention could explain, in part, why Black women tend to lose less weight than women

from other races during behavioral interventions [25], and why culturally tailored interventions have improved weight loss outcomes only modestly [25, 26]. Black women may carry these different expectations into the increasing number of physical activity interventions designed to mitigate BCRL, warranting exploration of racial differences in expectation within the BCRL subgroup.

This analysis explored outcome expectations for a physical activity intervention (weight lifting) by sedentary Black or White female breast cancer survivors. The domains examined specifically address areas that have generally received less attention [27] in explorations of racial/ethnic differences in expectations of physical activity for cancer survivors, including fatigue, sleep, attention, and affect. As a secondary aim, this study explored the role of a persistent adverse effect of breast cancer treatment on racial differences in outcome expectations for physical activity, by examining racial differences within the study subpopulation who had BCRL and who did not.

Methods

Study Design and Participants

This study is a secondary analysis of data from the Physical Activity and Lymphedema (PAL) trial, a randomized controlled trial that included breast cancer survivors at-risk for or with stable breast cancer-related lymphedema (BCRL) [13]. The PAL Trial was approved by the Institutional Review Board (IRB) at the University of Pennsylvania. Informed consent was obtained from all individual participants included in the study; however, consent was not required for analysis of the de-identified data set, which met the qualifications of being IRB exempt.

Eligibility criteria for participation in PAL included: 1) female breast cancer survivor 1–15 years post-cancer diagnosis; 2) cancer-free at study entry; 3) 1 lymph node removed; 4) no medical conditions or medications that would prohibit participation in a physical activity program. Additional eligibility criteria included: 5) body mass index ≤ 50 kg/m²; 6) no plans for surgery during the intervention period; 7) no history of bilateral lymph node dissection; 8) no weight lifting activities in the prior one-year, and; 9) weight stable and not attempting to lose weight [13].

Outcome Expectations – Primary Dependent Variable

The outcome expectations questionnaire is a 15-item scale that was developed to assess biobehavioral variables that are influenced by physical activity [28]. It has been used in middle-aged adults [29] and older women [28] for both aerobic and strength training forms of physical activity. Prior to randomization, participants were asked to indicate how they expected each of the following items to improve over the study period: 1) quality of sleep; 2) satisfaction with physical shape and appearance; 3) dysphoric or depressed mood; 4) tension or anxiety; 5) ability to concentrate; 6) alertness; 7) sense of confidence and well-being; 8) energy; 9) appetite; 10) perceived physical fitness level; 11) amount of stress experienced; 12) ability to cope with stress; 13) general mood; 14) satisfaction with weight; and 15) eating habits. The amount of improvement expected was rated on an 11-point Likert scale

where 0 indicated an expectation of worsening, 1 indicated an expectation of no change, and 2–11 indicated increasing expectations of improvement, where 4–6 and 11 indicated expectations of moderate and extreme improvement, respectively. The instrument has demonstrated adequate 3-day test-retest reliability coefficient ($\rho > 0.70$) for each item [29] and internal consistency ($\alpha > 0.81$) across all items [28] for assessing expectations for physical activity.

Race – Primary Independent Variable

Non-Hispanic Black or White race was self-reported by study participants. Those who did not report as Black or White were excluded from this secondary analysis ($n=15$; 4.7%).

Demographic, Clinical, and Biobehavioral Covariates

Demographic characteristics including age, marital status, persons living in household, and education were obtained by self-report. Clinical information, including time since cancer diagnosis and type of cancer treatment, were taken from the state cancer registry, surgical pathology reports, or self-report. For the purposes of study eligibility, breast cancer-related lymphedema (BCRL) was defined as 10% interlimb difference of the arms, or meeting any of the Common Toxicity Criteria Adverse Events version 3.0 (swelling, obscuration, pitting), or a prior clinical diagnosis of lymphedema. A variety of biobehavioral variables were included to account for characteristics that may systematically differ by race and influence outcome expectations. Depressive symptoms were quantified using The Center for Epidemiologic Studies Depression Scale (CES-D), scored from 0 to 60 with higher numbers indicating increased depression risk; scores above 16 represent clinically significant depression risk. Self-esteem was quantified using the Coopersmith Self-Esteem Inventory, with greater numbers indicating greater self-esteem. Self-rated overall health was quantified using the first question of the Short Form (SF-36) Health Survey that asked participants to rate their current health on a 5-point Likert scale from excellent to poor. Overall quality of life and life satisfaction was quantified using a 100-mm visual analog scale, with worst possible quality of life at 0 and best possible quality of life at 100. Optimism was quantified using the revised adult short-form version of the Life Orientation Test (LOT-R), scored from 0–40 with higher numbers representing greater optimism.

Analysis

Comparisons between Black and White study samples were performed using Chi-square and t-tests. Mean values for each outcome expectation were calculated, and then compared by racial group using t-tests. Mean values of outcome expectations are reported because those results are directly interpretable. Effect sizes were assessed using the Cohen's d coefficient, calculated as the difference between the mean outcome expectation values for Black and White women, divided by the standard deviation, s , of either group, and interpreted as "small, $0.2 < d < 0.5$," "medium, $0.5 < d < 0.8$," and "large, $d > 0.8$ ". Multivariable regression results controlled for all other demographic, clinical, and biobehavioral covariates. To avoid endogeneity, depression score was removed for the models predicting the depression expectancy, and self-esteem score was removed for models predicting self-esteem expectancy. Race was used as an independent predictor of each outcome expectation,

comparing those who did or did not have BCRL, respectively. R^2 values assessed the variance in each model.

Results

The study population consisted of 281 non-metastatic breast cancer survivors from the Physical Activity and Lymphedema (PAL) study, self-identifying as Non-Hispanic Black/African-American (n=90) or White (n=191).

The mean age of breast cancer survivors was 56 (SD=9), the majority had at least a high school diploma, and were on average 62 months post-surgery at the time of completing the baseline survey for the study (Table 1). Black women were significantly more likely to have undergone chemotherapy (83%) compared with Whites (72%) in the sample ($p=0.04$), were more likely to have lymphedema (60%) compared to Whites (43%; $p=0.04$) and reported significantly better self-rated health ($p<0.001$) and optimism based on the life orientation scores ($p=0.03$). Otherwise, there were no significant differences in type of cancer treatments, months since surgery at study entry, depression, or self-esteem by race/ethnicity. White women were more likely to be partnered (70%) than Black women (41%; $p<0.001$).

Black breast cancer survivors had higher outcome expectations for physical activity than White breast cancer survivors in nearly all domains except for confidence & well-being and physical fitness (Table 2). For expectancies that were significantly higher among Blacks, effect sizes were small to moderate, ranging from Cohen's d of 0.27 to 0.56.

Black women were more likely to have BCRL in this sample ($p=0.008$). Among the no BCRL group, 25% were Black (n=36) and 75% were White (n=109), while among the BCRL group, 40% were Black (n=54) and 60% were White (n=82). When examining racial differences within the sample of survivors without BCRL (Table 3), the racial differences were significantly attenuated in all domains except for appetite. For survivors with BCRL, Black women continued to report significantly higher expectations for physical activity, except for alleviation of depression, increasing confidence & well-being, increasing physical fitness, and improving mood. For those with no BCRL, regression models explained 12% to 32% of the variance for each expectation modeled (model R^2 values ranged from 0.12 to 0.32), and for those with BCRL, from 10% to 24% of the variance in the model (model R^2 values ranged from 0.10 to 0.24).

Conclusions

The findings herein suggest that Black women had overall higher expectations than White women for physical activity across many physical and psychological domains, which has been found in other explorations of outcome expectations for both male and female cancer survivors across tumor sites [24]. The expectations gap between Black and White women all but disappeared when looking within the sample of women who did not have BCRL, except for appetite. As BCRL status is unlikely to affect appetite through direct physiological pathways, this result is not surprising. These results highlight the importance of accounting for persistent adverse effects of cancer treatment that may be differentially distributed by

race, and considering addressing them explicitly in physical activity interventions involving Black breast cancer survivors.

Results from the present study are consistent with prior examination of racial/ethnic differences in outcome expectations for physical activity among breast cancer survivors [30]. Among those with BCRL, Black women had significantly higher expectations that physical activity would improve sleep, physical appearance, tension or anxiety, concentration, alertness, energy, appetite, stress, coping with stress, weight, and eating habits. Similar to what has been found in a previous study [30], there were no race-based differences in expectations for depression, self-confidence, and physical fitness. Confidence, and physical and mental well-being may be implicit prerequisites for motivation to enroll into a weight training study [30]. Expectations for physical activity to reduce depression were higher among Black women than White women, but race was not a factor when looking within the BCRL samples. Taken together, results from this study and prior studies suggest that improvements in sleep, physical appearance, tension or anxiety, concentration, alertness, energy, appetite, stress, coping with stress, weight, and eating habits may be of greater importance to Black breast cancer survivors than White breast cancer survivors. The presence of a physically visible condition like BCRL may somewhat alter the types of expectations, such that expectations for changes in physical attributes gain importance over expectations for psychological characteristics. Clinical researchers should showcase improvements in these domains to better attract Black breast cancer survivors to physical activity interventions, alongside adopting best practices for serving underrepresented minorities in physical activity trials, which include randomized controlled trial study design, objective assessment of physical activity, goal-setting, and a structured curriculum [26].

Black women hold similar expectations for physical activity as breast cancer survivors broadly, but have stronger endorsements of these expectations when compared to other racial/ethnic groups. Across all racial groups, breast cancer survivors cite expectations of improvements in energy, weight management, physical appearance [31], less depression, improved well-being [18], better coping with stress and weight control [32] as motivating factors for exercising. Several studies support the findings of Black women reporting greater improvements in life outlook after cancer than White women, and additionally report that Black women find more meaning in life after cancer [30, 33]. At the same time, other studies suggest that Black breast cancer survivors report lower quality of life than women of other race groups [27]. Age, income, and use of chemotherapy have been found as important contributing factors [10] to quality of life for Black breast cancer survivors, and the present study results highlight less explored quality of life indicators for cancer survivors, including fatigue, sleep, attention, and affect [13].

Although Black women also had overall consistently higher expectations in the present study, given the lack of difference in self-reported quality of life, it is difficult to ascertain the degree to which their expectations were too high or whether or not White women's expectations were too low. Since the results were robust when levels of self-esteem, quality of life, depression, and optimism are equal, it is unlikely that higher expectations are due to differences in general affect or life outlook among Black compared with White women. But having positive subjective perceptions of greater improvement may predispose Black women

to have even higher expectations for future improvements when active interventions, like physical activity, are in place in their lives. High expectations may put Black women at risk of establishing “false hope” for the effects of physical activity on their well-being, which could lead to frustration when expectations are not met and ultimately result in lower adherence to physical activity guidelines. Unmet expectations could lead to a lack of adherence to recommended physical activity regimens, and may in part explain Black breast cancer survivors’ low rates of physical activity [4]. The results of physical activity may feed back into outcome expectations and change expectations for future physical activity [34]. This is a critical issue since Black women may be more likely to need and benefit from physical activity after cancer survivorship due to a greater likelihood of developing adverse treatment effects like BCRL, or other obesity-associated co-morbidities. Although this analysis suggests that race-based differences in expectations are largely driven by BCRL status for this sample, the lived experience of a Black woman with a history of breast cancer is of having both high expectations for physical activity and BCRL concurrently. Establishing achievable expectations in a group of sedentary women who are likely to be inexperienced with physical activity could help increase rates of success, and adherence [35], as well as prevent potential negative effects of failure to fully attend and complete physical activity regimens [36].

Attendance and adherence are keys to effectiveness in physical activity trials, and may be influenced by expectations [35, 37]. Low adherence is of detriment to the research community, its knowledge of the role of physical activity for Black breast cancer survivors, and to the women themselves, who are likely to be in high need of physical activity interventions that they perceive as effective. While one review [37] suggests that there is insufficient evidence to support the notion that realistic outcome expectations could increase adherence, the single study reviewed [35] conceded that the lack of association between outcome expectations and physical activity adherence may have been due to a “ceiling effect” of very high scores in baseline outcome expectations [35], and that outcome expectations may still play a role. There is stronger evidence in non-cancer samples that physical activity initiation and adherence are driven by outcome expectations [38], which also may support that outcome expectations could still be important for cancer survivors’ physical activity motivations. Managing outcome expectations while employing other best practices may increase the effectiveness of physical activity trials to serve Black breast cancer survivors. For example, Black breast cancer survivors may be most responsive to physical activity interventions which promote walking and resistance training and that are delivered via the email or web [39]. Setting expectations could be done through the use of mobile technologies by offering messages of what to expect from physical activity sessions [39]. Outcome expectations can be tethered to specific goal-setting for physical activity [20], as goal-setting is a best practice for physical activity trials for underrepresented minorities [26]. Given the effect sizes found in the present study, messages around energy, alertness and appetite may be a strong place to start.

Despite many strengths, this study had limitations. Study data were based on a sample of women who had chosen to participate in a weight lifting training intervention. This may have increased the likelihood of reporting high expectations given participants may have been physiologically more able to participate in weight training than others who were not

eligible to enroll; however, this would not influence cross-race comparisons. No further data were available to assess the degree of value placed on outcome expectations (outcome expectancies). The intervention was focused on weight training, and it is unknown whether or not these findings can be extended to interventions that focus on aerobic activity, which is a potential future area of study. A recent study suggests that Black women define exercise and physical activity broadly, which can include movement beyond aerobic exercise [40], so it is possible that Black participant expectations applied to both aerobic and weight training. There were no end data to ascertain how outcome expectations may have changed due to physical activity; however, this study adds value by reporting on specific outcome expectations that may be salient for getting women into physical activity trials.

The results of this study contribute to the growing body of literature on racial differences in cancer survivorship outcomes. Black breast cancer survivors have greater expectations regarding how physical activity will benefit them compared with White breast cancer survivors, regardless of age, education, treatment type, length of survivorship, and overall health. This research points to a greater need to learn what motivates Black or White breast cancer survivors to engage in physical activity. Future analysis should include the role of changes in outcome expectations and self-efficacy on physical activity adoption, maintenance, and adherence, while accounting for outside external factors that might influence one's ability to adhere to an intervention. Improving outcomes in Black breast cancer survivors rests on the development of interventions that are appropriately tailored to address the physical activity expectations of this population, and account for differences in persistent adverse effects of cancer such as breast cancer-related lymphedema.

Acknowledgments

Funding: This work was supported by NIH NCI R01CA-106851-01, 1K01CA184288, 1U54CA155850-01 and by the Institute for Translational Medicine and Therapeutics (ITMAT) Clinical and Translational Research Center (CTRC) at the University of Pennsylvania.

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Table 1

Demographic Characteristics of the Sample (Mean±SD, n(%))

	All N=281	Black n=90 (% yes of Black)	White n=191 (% yes of White)	p
Age in Years	56 ± 9	56 ± 10	56 ± 8	0.97
Partnered	179	36 (41%)	133 (70%)	<0.001
Number in Household	3 ± 1	3 ± 1	3 ± 1	0.62
Education				0.10
High School Diploma	139	38 (42%)	101 (53%)	
> High School Diploma	142	52 (58%)	90 (47%)	
Radiation	219	73 (81%)	146 (76%)	0.38
Chemotherapy	213	75 (83%)	138 (72%)	0.04
Months since Surgery	62 ± 40	65 ± 43	60 ± 38	0.22
Lymphedema Present	136	54 (60%)	82 (43%)	0.008
CES-D Score, n=247 [range 0–44] ¹	7.3 ± 8.3	7.8 ± 7.7	7.0 ± 8.5	0.47
Coopersmith Self-Esteem Score [range 0–84] ²	19.7 ± 17.9	19.3 ± 15.8	19.8 ± 18.8	0.82
Self-Rated Health, n=277				
Fair/Poor	128	26 (29%)	102 (54%)	<0.001
Good/Excellent	149	63 (71%)	86 (46%)	
Overall Quality of Life, n=277 [range 15–100] ²	82.3 ± 14.8	81.7 ± 16.9	82.6 ± 13.7	0.65
Life Orientation Test (LOT-R), n=276 [range 18–37]²	28.9 ± 2.9	29.4 ± 3.2	28.6 ± 2.7	0.03

¹Higher values represent greater risk of depression²Higher values represent greater self-esteem, quality of life, and optimism, respectively

Table 2

Values for Outcome Expectations [Range=0–11] (Mean±SD)

	All (N=295)	Black (n=90)	White (n=191)	P	Cohen's <i>d</i> *
Quality of sleep	4.2 ± 2.9	4.9 ± 3.0	3.9 ± 2.7	0.004	0.35
Physical Shape & Appearance	6.4 ± 2.4	7.0 ± 2.4	6.1 ± 2.4	0.004	0.38
Depression	3.3 ± 2.9	3.9 ± 3.3	3.1 ± 2.6	0.03	0.27
Tension or Anxiety	4.0 ± 2.9	4.8 ± 3.2	3.7 ± 2.6	0.005	0.38
Concentration	4.1 ± 2.9	4.9 ± 3.1	3.7 ± 2.7	<0.001	0.41
Alertness	4.3 ± 2.9	5.4 ± 3.0	3.8 ± 2.7	<0.001	0.56
Confidence & Well-being	4.4 ± 2.8	4.8 ± 3.0	4.2 ± 2.7	0.06	0.21
Energy	6.0 ± 2.6	6.9 ± 2.7	5.6 ± 2.5	<0.001	0.50
Appetite	2.7 ± 2.5	3.7 ± 3.2	2.2 ± 2.0	<0.001	0.56
Physical Fitness	6.9 ± 2.4	7.2 ± 2.5	6.7 ± 2.4	0.28	0.20
Stress	4.0 ± 2.9	4.8 ± 3.2	3.6 ± 2.7	0.002	0.41
Coping with Stress	4.3 ± 2.9	5.1 ± 3.2	4.0 ± 2.6	0.002	0.38
Mood	4.1 ± 2.8	4.7 ± 3.2	3.8 ± 2.6	0.02	0.31
Weight	6.1 ± 2.8	6.7 ± 2.9	5.8 ± 2.8	0.01	0.32
Eating Habits	5.0 ± 2.9	5.9 ± 3.0	4.6 ± 2.8	<0.001	0.45

* Effect sizes represented as: 0.2 *d* < 0.5=small; 0.5 *d* < 0.8=medium; *d*>0.8=large

Table 3

Regression Results for Race for Each Outcome Expectation by BCRL Status

	No BCRL (n=124)			With BCRL (n=119)		
	β	95% CI	p	β	95% CI	p
Quality of sleep	0.60	-0.73 – 1.93	0.37	1.35	0.13 – 2.57	0.03
Physical Shape & Appearance	0.11	-1.10 – 1.32	0.86	1.19	0.19 – 2.18	0.02
Depression*	0.55	-0.76 – 1.86	0.41	0.62	-0.10 – 0.02	0.28
Tension or Anxiety	0.87	-0.45 – 2.20	0.19	1.34	0.16 – 2.52	0.03
Concentration	0.69	-0.58 – 1.97	0.283	1.42	0.20 – 2.64	0.02
Alertness	1.06	-0.19 – 2.32	0.096	1.81	0.59 – 3.03	0.004
Confidence & Well-being*	0.76	-0.39 – 1.91	0.194	0.29	-0.81 – 1.39	0.60
Energy	0.98	-0.24 – 2.21	0.114	1.41	0.31 – 2.50	0.01
Appetite	1.10	0.08 – 2.15	0.04	1.70	0.61 – 2.79	0.003
Physical Fitness	-0.32	-1.49 – 0.85	0.59	0.82	-0.23 – 1.86	0.12
Stress	0.39	-0.91 – 1.68	0.55	1.43	0.21 – 2.66	0.023
Coping with Stress	0.54	-0.77 – 1.86	0.413	1.26	0.06 – 2.45	0.04
Mood	0.60	-0.55 – 1.75	0.31	1.17	-0.04 – 2.38	0.06
Weight	0.70	-0.66 – 2.06	0.31	1.52	0.41 – 2.64	0.008
Eating Habits	0.89	-0.41 – 2.19	0.18	1.59	0.41 – 2.75	0.009

* Controlled for respondent age, level of education, months since surgery, chemotherapy, radiation, depression, self-esteem, self-rated health, quality of life on that day, and life orientation except for depression expectancy, for which depression score was removed, and self-esteem, for which self-esteem score was removed.