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Age- and treatment-related associations with health behavior change among breast cancer survivors

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Abstract

Objective—The aim of this study was to identify demographic and treatment-related factors associated with health-promoting behavior changes after a breast cancer diagnosis. Changes in health behaviors were also evaluated according to weight, exercise, diet and alcohol consumption patterns before breast cancer diagnosis.

Materials and methods—We examined self-reported behavior changes among 1,415 women diagnosed with breast cancer in the NIEHS Sister Study cohort. Women reported changes in exercising, eating healthy foods, maintaining a healthy body weight, drinking alcohol, smoking, getting enough sleep, spending time with family and friends, and participating in breast cancer awareness events. Results: On average, women were 3.7 years from their breast cancer diagnosis. Overall, 20–36% reported positive changes in exercise, eating healthy foods, maintaining a healthy weight, or alcohol consumption. However, 17% exercised less. With each 5-year increase in diagnosis age, women were 11–16% less likely to report positive change in each of these behaviors (OR=0.84–0.89; $p<0.05$), except alcohol consumption (OR=0.97; CI: 0.81, 1.17). Women who underwent chemotherapy were more likely to report eating more healthy foods (OR

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=1.47; 95% CI 1.16–1.86), drinking less alcohol (OR=2.01; 95% CI: 1.01, 4.06), and sleeping enough (OR=1.41; 95% CI: 1.04, 1.91). The majority of women (50–84%) reported no change in exercise, eating healthy foods, efforts to maintain a healthy weight, alcohol consumption, sleep patterns, or time spent with family or friends.

Conclusions—Many women reported no change in cancer survivorship guideline-supported behaviors after diagnosis. Positive changes were more common among younger women or those who underwent chemotherapy.

Keywords

Breast cancer; Cancer survivors; Health behavior; Exercise

Introduction

The number of breast cancer survivors in the United States population has increased, reaching almost 3 million women in 2012 [1]. Health concerns among breast cancer survivors include not only the risk of breast cancer recurrence, but also a potentially increased risk of other cancers and other chronic comorbid conditions [2]. Some evidence suggests that maintaining or adopting a healthy diet and being physically active after diagnosis may improve breast cancer prognosis [3, 4], while also reducing all-cause mortality [5, 6] and improving quality of life [7, 8]. Thus breast cancer survivors represent an important target population for efforts to promote healthy behaviors that contribute to long-term health and survival.

Organizations such as the National Comprehensive Cancer Network (NCCN)[9] and the American Cancer Society (ACS) [10], have published recommendations for cancer survivors regarding maintaining a healthy body weight, engaging in regular physical activity, consuming a healthy diet, minimizing alcohol intake, and avoiding tobacco products. Some have suggested that a cancer diagnosis itself may serve as a stimulus for survivors to make the behavioral changes supported by such guidelines [2], a notion supported by several studies among cancer survivors [11–15]. However, existing studies of health behaviors after a breast cancer diagnosis are most often conducted within samples of women who are recruited and enrolled after diagnosis. Therefore, there has been limited opportunity to address whether lifestyle recommendations were already being met at the time of diagnosis, and whether behavior patterns before diagnosis drive those reported after. Other considerations include proximity to the active treatment period and type(s) of therapy received. Chemotherapy, for example, has been reported to negatively affect cardiorespiratory fitness [16] and weight maintenance [17].

Identifying factors associated with behavior change among breast cancer survivors can help to target interventions toward women who find it more difficult to make positive changes after diagnosis. We assessed behavior change after breast cancer diagnosis in a sample of 1,415 women enrolled in the National Institute of Environmental Health Science (NIEHS) Sister Study cohort who had prospectively-provided information on lifestyle characteristics before diagnosis.

Materials and methods

The Sister Study Survivorship Survey was initiated by the Centers for Disease Control and Prevention (CDC) and the NIEHS in 2012 to examine several priority public health topics among breast cancer survivors, including health behaviors. Survey respondents included in this analysis were women with a prior breast cancer diagnosis (ductal carcinoma *in situ* or invasive breast cancer) who were enrolled in the Sister Study, a cohort of initially breast cancer-free women whose sister had been diagnosed with breast cancer. Sister Study participants were enrolled in 2003–2009 and were eligible to receive the Survivorship Survey if they were diagnosed with breast cancer before October 9, 2012 (Figure 1). After medical record review, 40 women were identified as having a breast cancer diagnosis that preceded completion of Sister study cohort enrollment activities, and were retained in analyses as prevalent breast cancers. Descriptions of the Sister Study design and inclusion criteria, can be found elsewhere [18–20]. This survey was approved by the Institutional Review Board of the NIEHS/NIH as an amendment to the protocol for the Sister Study.

Survey Measures

Survey questions relevant to this analysis pertained to NCCN and ACS guideline-recommended behaviors (exercise, healthy eating, alcohol intake, tobacco use, and maintaining a healthy body weight) [9, 10] and other behaviors related to general health and well-being. Participants were asked “How often do you do each of the following compared to before you were diagnosed with breast cancer?” Listed behaviors used in these analyses included: exercise, eat healthy foods, drink alcoholic beverages, smoke cigarettes or use tobacco products, make efforts to maintain a healthy body weight, participate in run or walk breast cancer awareness events, spend time with family and friends, and get enough sleep. Answer choices included “More often,” “About as often,” “Less often,” “Didn’t do before and don’t do now,” and “Don’t know.” A similar response format has been used in a previous study of behavior changes among cancer survivors [12].

Breast cancer and treatment-related characteristics (stage, chemotherapy, endocrine therapy, trastuzumab, surgery and radiation) were abstracted from medical records. If missing from medical records, these characteristics were ascertained from self-reported measures on the Breast Cancer Follow-Up Questionnaire, a questionnaire completed by Sister Study participants approximately six months after diagnosis of incident breast cancer. Demographic characteristics (age at diagnosis, race/ethnicity) were taken from Sister Study enrollment questionnaires completed prior to breast cancer diagnosis. Information on pre-diagnosis behaviors, including exercise, fruit and vegetable consumption (as an indicator of an overall healthy diet), alcohol consumption, and smoking habits, were also taken from enrollment questionnaires. Exercise was determined based on reported activity during the 12 months prior to Sister Study enrollment. Participants reported the number of hours per week spent engaging in various activities; weekly energy expenditures were then calculated using the assigned metabolic equivalent (MET) values for each activity as listed in established guidelines [21]. Fruit and vegetable consumption was ascertained using the Block 98 food frequency questionnaire (FFQ) [22], and refers to average daily intake in the previous 12 months. Participants also self-reported current smoking and weekly alcohol consumption.

Pre-diagnosis body mass index (BMI) was calculated using height and weight measured by trained personnel during home visits at Sister Study enrollment.

Statistical Analysis

Frequencies and percentages were used to describe demographic and breast cancer/treatment characteristics and responses to the eight survey questions among all participants. For each of the eight behaviors, the proportion who responded “Don’t know” was less than 0.5%. Such women were considered missing and were excluded from all analyses of that behavior. Chi-squared tests were used to compare demographic, diagnosis, and treatment characteristics and post-diagnosis behavior changes between women who did and did not report ever participating in breast cancer awareness run/walks. Women with responses of “more often,” “about the same,” and “less often” were classified as having ever participated in these events; those with a response of “didn’t do before and don’t do now” were classified as never having participated. P-values less than 0.05 were considered statistically significant.

We examined factors associated with positive changes in the following behaviors: exercising, eating healthy foods, making efforts to maintain a healthy body weight, drinking alcohol, smoking, and getting enough sleep. Responses were dichotomized as follows. For questions pertaining to alcohol and smoking, the outcome of interest was a response of “less often” (vs. more often/about as often). Participants who responded “didn’t do before and don’t do now” on these questions were excluded from analyses of that specific behavior, as making a positive change would not be possible for these individuals. For questions pertaining to exercise, eating healthy foods, maintaining a healthy body weight, and sleeping enough, the outcome of interest was a response of “more often” (vs. about as often/less often/didn’t do before and don’t do now). We used logistic regression to estimate odds ratios (OR) and 95% confidence intervals (CI) for the following potential correlates of positive behavior change: demographics (age, race/ethnicity, BMI), diagnosis characteristics (time since diagnosis, disease stage), and treatment history (chemotherapy, trastuzumab, endocrine therapy, surgery and radiation). Women with stage III or stage IV breast cancer were combined into one category for all analyses due to the small number of women with stage IV disease (n=8). Associations were examined among all women and among only those women who were not meeting ACS/NCCN recommendations for that behavior prior to diagnosis. Women were classified as not meeting recommendations if they reported exercising less than 9 MET-hours per week (approximately 150 min/week of moderate-intensity activity [10]), eating less than 5 servings per day of fruits and vegetables [23], being overweight or obese (BMI ≥ 25.0 kg/m² [10]), drinking > 7 alcoholic drinks per week, or currently smoking. Estimates were not calculated for strata in which the number of participants was less than 15. For all behaviors except smoking and drinking alcohol, models were adjusted for age at diagnosis and time since diagnosis. Due to the small number of outcomes, estimates from models of drinking alcohol and smoking are presented without adjustment. All analyses were performed with SAS 9.4 (SAS Institute, Cary, NC).

Results

Participant characteristics are summarized in Table 1. Most women were diagnosed with invasive breast cancer (75%), and the average age at diagnosis was 59.8 years (SD=8.9). The average time from diagnosis to survey was 3.7 years (SD=1.8). The majority of women were non-Hispanic white, and had at least a Bachelor's degree, a household income of \$50,000, and a BMI of 25.0 kg/m².

Eating healthy foods more often was the most common behavioral change, reported by 36% of participants (Figure 2). Many also reported more frequent efforts to maintain a healthy body weight (25%). Although about one fifth of participants reported exercising more often, 17% reported exercising less often after diagnosis. The majority of women reported no change in getting enough sleep (69%) or spending time with family and friends (84%).

Drinking alcohol less often was reported by 23% of women overall (Figure 2) and 24% of women who drank >7 drinks per week at enrollment. Although most participants did not smoke either before or after diagnosis, a reduction in smoking was reported by 44% of the 91 current smokers at enrollment.

Overall, 49% of women reported ever participating in breast cancer awareness run/walks (Figure 2). Those who participated were more likely to be aged 60 or younger at diagnosis (65% vs. 40%, $p<0.001$), to have received chemotherapy (40% vs. 28%, $p<0.001$), and to have undergone mastectomy (45% vs. 37%, $p=0.009$). They were also more likely to report increasing exercise, efforts to maintain a healthy body weight, and time spent with family and friends since their breast cancer diagnosis (*data not shown*).

Patterns of exercise, eating healthy foods, and maintaining a healthy weight

Prior to their breast cancer diagnosis, 49% of women reported exercising less than 9 MET-hours per week. Overall, correlates of exercising more often included younger age at diagnosis, a longer time since diagnosis, use of endocrine therapy, and increasing body mass index (per 1 kg/m² increase) (Table 3). Associations with age at diagnosis and time since diagnosis were not statistically different, but appeared stronger, for women who exercised <9 MET-hours per week before diagnosis. In this group, associations with endocrine therapy were less apparent.

Overall, 55% of women reported eating <5 servings per day of fruits and vegetables before diagnosis. Efforts to eat healthy foods more often were more commonly reported by younger women (compared to older), non-Hispanic black women (compared to white), and those with BMI >30 kg/m² (compared to <25.0 kg/m²). Women were also more likely report making effort to eat healthy foods when they were further from diagnosis (>4 years), had higher stage breast cancer, or had chemotherapy or biologic therapy with trastuzumab. Patterns were generally similar among women who consumed <5 fruits/vegetables before diagnosis.

Increased efforts to maintain a healthy weight since diagnosis were also more common among younger women, Hispanic women, and those who had a BMI >25 at Sister Study

enrollment. However, diagnosis and treatment characteristics were not strongly related to efforts to maintain a healthy weight overall, or among the 61% of women who had a BMI >25 prior to diagnosis.

Patterns of drinking alcohol, smoking, and getting enough sleep

Prior to diagnosis, 13% of women reported drinking >7 alcoholic drinks per week, and 6% reported current smoking. We observed few patterns in sleep, alcohol or smoking behavior changes according to demographics, diagnosis, or treatment characteristics (Table 4). Women with BMI ≥ 25 at Sister Study enrollment were more likely to report more often getting enough sleep since diagnosis. Higher stage at diagnosis was associated with more frequently sleeping enough and drinking less, but not smoking less. Those who reported having chemotherapy were approximately 1.4 times as likely to report sleeping enough more often and twice as likely to drink less often compared to those who did not have chemotherapy.

Discussion

While many cancer survivors may be motivated to make behavioral changes following diagnosis, few studies have reported the prevalence of such changes specifically among women with a history of breast cancer. In this study, eating more healthy foods was the most commonly reported behavior change among breast cancer survivors, though decreases in alcohol consumption and increases in exercise and efforts to maintain a healthy body weight were also frequently reported. However, for each of these ACS/NCCN guideline-recommended behaviors, the majority of women reported no change since their diagnosis, demonstrating a continued need for targeted interventions and recommendations from clinicians. Our results also suggest that younger women and those who receive chemotherapy may be most likely to make positive behavior changes after diagnosis.

Though one fifth of breast cancer survivors in our sample reported an increase in exercise frequency following diagnosis, it is notable that nearly as many reported a decrease. Similarly, among survivors of invasive breast cancer in the Women's Health Initiative, 25% reported decreases in physical activity from pre-diagnosis to post-diagnosis [5]. In the current study, almost half of women were below ACS/NCCN recommended activity levels prior to diagnosis, and less than one-quarter of these reported exercising more after diagnosis, demonstrating the importance of exercise promotion within the survivor population. We identified several predictors of exercising more often, including younger age and a longer time since diagnosis. These findings suggest a need to target exercise interventions toward breast cancer survivors who are older and more recently diagnosed, as these women may find it more difficult to initiate and maintain change on their own.

A substantial proportion of women reported eating more healthy foods and making more efforts to maintain a healthy body weight after diagnosis. However, for each of these behaviors, a greater percentage reported no change since their diagnosis. It seems unlikely that the lack of change could be explained by a high prevalence of healthy behaviors prior to diagnosis, given that less than half of women in this study reported eating at least 5 servings per day of fruits and vegetables at enrollment, and over 60% were either overweight or

obese. Furthermore, only 35% of those whose consumption of fruit and vegetables was below recommendations reported eating more healthy foods after diagnosis, while less than a third of overweight or obese women reported increased efforts to maintain a healthy body weight. Previous reports have also suggested that many breast cancer survivors gain weight following treatment [17], and that survivors may experience greater weight gain than cancer-free women of the same age [24]. These findings, along with ours, demonstrate that although many women are motivated to make healthy changes following a breast cancer diagnosis, there is still room for improvement through dietary interventions and increased health promotion efforts.

Our results suggest that specific treatments may be associated with post-diagnosis changes in health behaviors. Relative to before diagnosis, women who received chemotherapy were more likely to report eating more healthy foods, drinking less alcohol, and getting enough sleep more often. Similar patterns were observed for disease stage, suggesting that women with more aggressive or more advanced disease may be more motivated to make healthy changes after diagnosis. Predictors of change in post-diagnosis behavior may be an important consideration for future studies investigating associations between pre-diagnosis behaviors and breast cancer outcomes.

The breast cancer advocacy community is one of the most mobilized of any disease or health condition, with support and awareness events highly publicized and attended. There is a continued need to identify new survivor populations to better understand long-term health after diagnosis. In the past, some studies have identified participants through their participation in breast cancer run/walk awareness events. If this recruitment strategy is extended to future research, it will be important to understand how behavior and lifestyle characteristics among participants compare to the broader breast cancer community. In our study, those who participated in awareness events tended to be younger at diagnosis, and they were more likely to report positive changes in exercise and weight maintenance behavior after diagnosis. These findings may inform future efforts to recruit women for survivorship-focused research.

Our study has some limitations. Due to the self-reported nature of the Survivorship Survey, data on behavior changes relied on participants' recall, which may be inaccurate and/or subject to social desirability bias. We also did not have information on breast cancer recurrences that may have occurred prior to survey completion, though women with a recurrence may be less able to make positive health behavior changes. Few women in our sample were current smokers; thus we had limited power to identify factors associated with positive change in this behavior. Many women may have already changed some of their behaviors when their sister was diagnosed with breast cancer, even before they enrolled in the Sister Study, which may limit generalizability of these findings. Additionally, 90% of women in our sample were non-Hispanic white, well-educated, and older than 50 at diagnosis; future studies are warranted to address patterns among more diverse samples of breast cancer survivors.

Conclusions

Overall, our findings support the theory that a breast cancer diagnosis can be a motivating factor for behavioral change among some groups of breast cancer survivors. However, for many health-related behaviors, including those recommended by ACS/NCCN guidelines, the majority of women in our sample reported no change, and decreases in physical activity were also relatively common. Research is needed to better understand the barriers and facilitators to specific health behaviors among different groups of breast cancer survivors.

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Highlights

- Most women did not report guideline-supported behavior changes after breast cancer.
- Younger age and chemotherapy were associated with some positive behavior changes.
- Decreases in exercise were also commonly reported after breast cancer diagnosis.

Figure 1.
Flow diagram of Sister Study participants who completed the Survivorship Survey

Figure 2.
Frequency of behaviors as compared to before diagnosis of breast cancer.

Table 1

Characteristics of Survivorship Survey participants

	N^a	%
Total	1,415	
Age at Diagnosis		
Mean (SD)	59.8	(8.9)
35–50	253	17%
51–60	478	34%
61–70	506	36%
71–80	175	12%
Race/ethnicity		
Non-Hispanic White	1,274	90%
Non-Hispanic Black	68	5%
Hispanic	38	3%
Other	34	2%
BMI before diagnosis (kg/m²)		
Mean (SD)	27.8	(6.1)
<25.0	545	39%
25.0–29.9	458	32%
30.0+	412	29%
Time between diagnosis and survey (years)		
Mean (SD)	3.7	(1.8)
<2	293	21%
2–3.9	532	38%
4.0–5.9	425	30%
6.0+	162	11%
Stage		
0	346	25%
I	714	51%
II	260	19%
III/IV	76	5%
Chemotherapy	463	34%
Trastuzumab	104	7%
Endocrine therapy	994	71%
Surgery and radiation		
No surgery	23	2%
Mastectomy	564	40%
Breast conserving surgery (BCS) with radiation	752	54%
BCS without radiation	56	4%

^aNumbers may not sum to total due to missing

Table 3

Characteristics associated with positive behavior change in exercise, eating healthy foods, and making efforts to maintain a healthy body weight

	Exercise more often			Eat healthy foods more often			Make efforts to maintain a healthy body weight more often		
	All women		Among women who reported <9 MET-hrs/ week before diagnosis- N=695	All women		Among women with <5 fruit/veg servings/day before diagnosis- N=776	All women		Among women with BMI 25.0 kg/m ² before diagnosis- N=870
	OR (95% CI) ^a	OR (95% CI) ^a	OR (95% CI) ^a	OR (95% CI) ^a	OR (95% CI) ^a	OR (95% CI) ^a	OR (95% CI) ^a	OR (95% CI) ^a	OR (95% CI) ^a
Demographics									
Age at Diagnosis									
35–50	1		1	1		1	1		1
51–60	1.07 (0.74–1.55)		0.97 (0.58–1.60)	1.16 (0.84–1.58)		0.86 (0.57–1.30)	0.86 (0.61–1.21)		0.96 (0.61–1.50)
61–70	0.94 (0.65–1.37)		0.94 (0.56–1.56)	0.83 (0.60–1.14)		0.59 (0.38–0.90)	0.78 (0.55–1.10)		0.86 (0.55–1.34)
71–80	0.49 (0.28–0.86)		0.37 (0.16–0.86)	0.50 (0.32–0.78)		0.36 (0.20–0.66)	0.51 (0.31–0.83)		0.52 (0.28–0.95)
Per 5 year increase	0.89 (0.83–0.96)		0.89 (0.80–0.98)	0.89 (0.84–0.95)		0.84 (0.77–0.92)	0.89 (0.83–0.96)		0.89 (0.82–0.97)
Race/ethnicity									
Non-Hispanic White	1		1	1		1	1		1
Non-Hispanic Black	0.77 (0.40–2.51)		0.61 (0.26–1.40)	2.30 (1.39–3.79)		1.94 (1.00–3.75)	1.30 (0.75–2.24)		1.15 (0.63–2.11)
Hispanic	1.85 (0.91–3.75)		1.20 (0.37–3.90)	1.53 (0.79–2.95)		1.91 (0.86–4.26)	1.98 (1.02–3.88)		2.43 (1.07–5.50)
BMI (kg/m ²) before diagnosis									
<25.0	1		1	1		1	1		Not included
25.0–29.9	1.11 (0.81–1.52)		0.82 (0.51–1.30)	1.27 (0.97–1.66)		1.05 (0.73–1.52)	1.80 (1.34–2.42)		1
30.0+	1.25 (0.91–1.73)		0.94 (0.61–1.46)	1.61 (1.22–2.12)		1.33 (0.91–1.94)	1.63 (1.20–2.22)		0.90 (0.66–1.21)
Per 1 kg/m ² increase	1.03 (1.01–1.05)		1.01 (0.99–1.04)	1.04 (1.02–1.06)		1.03 (1.00–1.06)	1.04 (1.02–1.06)		1.00 (0.98–1.03)
Diagnosis characteristics									
Time since diagnosis (years)									
<2	1		1	1		1	1		1
2–3.9	0.98 (0.68–1.43)		1.08 (0.64–1.81)	1.13 (0.83–1.54)		1.31 (0.86–1.99)	0.73 (0.53–1.02)		0.67 (0.45–0.99)
4.0–5.9	1.38 (0.94–2.01)		1.63 (0.97–2.75)	1.38 (1.00–1.89)		1.49 (0.96–2.30)	0.91 (0.65–1.28)		0.87 (0.58–1.32)
6.0+	1.33 (0.83–2.16)		1.66 (0.85–3.25)	1.50 (1.00–2.26)		1.61 (0.92–2.83)	1.06 (0.69–1.63)		1.29 (0.76–2.20)
Per 1 year increase	1.11 (1.03–1.19)		1.14 (1.03–1.26)	1.15 (0.84–1.58)		1.07 (0.99–1.17)	1.02 (0.96–1.10)		1.04 (0.96–1.14)

	Exercise more often		Eat healthy foods more often		Make efforts to maintain a healthy body weight more often	
	All women	Among women who reported <9 MET-hrs/ week before diagnosis- N=695	All women	Among women with <5 fruit/veg servings/day before diagnosis- N=776	All women	Among women with BMI 25.0 kg/m ² before diagnosis- N=870
Stage	OR (95% CI) ^a	OR (95% CI) ^a	OR (95% CI) ^a	OR (95% CI) ^a	OR (95% CI) ^a	OR (95% CI) ^a
0	1	1	1	1	1	1
I	0.99 (0.71–1.37)	0.87 (0.56–1.37)	1.15 (0.87–1.52)	1.26 (0.86–1.85)	1.11 (0.82–1.50)	0.99 (0.67–1.44)
II	1.18 (0.79–1.75)	0.99 (0.58–1.69)	1.59 (1.13–2.22)	1.48 (0.92–2.38)	0.87 (0.59–1.28)	0.78 (0.49–1.24)
III/IV	1.31 (0.73–2.35)	1.08 (0.50–2.32)	1.60 (0.96–2.68)	2.26 (1.13–4.51)	1.60 (0.93–2.76)	1.65 (0.88–3.11)
<i>Treatment history</i>						
Chemotherapy						
No	1	1	1	1	1	1
Yes	1.09 (0.82–1.45)	1.10 (0.75–1.62)	1.47 (1.16–1.86)	1.56 (1.13–2.17)	1.04 (0.80–1.35)	1.00 (0.73–1.39)
Trastuzumab						
No	1	1	1	1	1	1
Yes	0.88 (0.53–1.47)	1.37 (0.72–2.61)	1.51 (1.00–2.27)	1.56 (0.89–2.75)	0.91 (0.57–1.47)	0.70 (0.38–1.28)
Endocrine therapy						
No	1	1	1	1	1	1
Yes	1.47 (1.08–1.99)	1.30 (0.86–1.98)	1.17 (0.92–1.50)	1.09 (0.78–1.53)	1.20 (0.91–1.58)	1.12 (0.80–1.58)
Surgery and Radiation						
Mastectomy	1	1	1	1	1	1
BCS with radiation	1.14 (0.86–1.50)	1.33 (0.91–1.93)	1.03 (0.82–1.31)	1.12 (0.81–1.54)	0.82 (0.63–1.06)	0.91 (0.66–1.26)
BCS without radiation	0.86 (0.40–1.81)	1.33 (0.45–3.91)	1.01 (0.56–1.83)	1.06 (0.49–2.32)	1.16 (0.63–2.16)	0.89 (0.38–2.11)

Abbreviations: BMI=body mass index; BCS=breast conserving surgery

^a Adjusted for age at diagnosis and time since diagnosis

Table 4

Characteristics associated with positive behavior change in drinking alcohol, smoking, and sleeping enough

	Drink alcohol less often <i>Among women who reported >7 drinks per week before diagnosis- N=190</i>	Smoke less often <i>Among women who were smokers before diagnosis- N=91</i>	Sleep enough more often <i>All women- N=1,415</i>
	OR (95% CI) ^a	OR (95% CI) ^a	OR (95% CI) ^b
Demographics			
Age at Diagnosis			
35–50	1	NC	1
51–60	0.64 (0.26–1.61)	1.00 (ref)	1.20 (0.79–1.82)
61–70	0.68 (0.28–1.70)	1.10 (0.39–3.12)	1.08 (0.70–1.64)
71–80	0.36 (0.08–1.50)	NC	0.89 (0.51–1.57)
<i>Per 5 year increase</i>	0.97 (0.81–1.17)	0.87 (0.54–1.39)	0.95 (0.88–1.04)
Race/ethnicity			
Non-Hispanic White	NC	NC	1
Non-Hispanic Black	NC	NC	1.61 (0.90–2.88)
Hispanic	NC	NC	1.64 (0.76–3.54)
BMI (kg/m ²) before diagnosis			
<25.0	1	1	1
25.0–29.9	1.60 (0.75–3.43)	0.65 (0.21–2.03)	1.51 (1.07–2.14)
30.0+	1.29 (0.53–3.14)	0.94 (0.30–2.96)	1.48 (1.03–2.12)
<i>Per 1 kg/m² increase</i>	1.02 (0.95–1.09)	0.99 (0.92–1.06)	1.03 (1.01–1.05)
Diagnosis characteristics			
Time since diagnosis- years			
<2.0	1	NC	1
2.0–3.9	0.85 (0.33–2.21)	1.00 (ref)	1.13 (0.77–1.68)
4.0–5.9	1.03 (0.37–2.86)	0.97 (0.33–2.84)	1.10 (0.73–1.66)
6.0+	1.73 (0.54–5.57)	NC	0.86 (0.49–1.49)
<i>Per 1 year increase</i>	1.10 (0.92–1.31)	1.27 (0.74–2.17)	0.98 (0.90–1.06)
Stage			
0	1	1	1
I	1.29 (0.50–3.33)	0.63 (0.20–2.00)	1.13 (0.79–1.62)
II	4.17 (1.45–11.97)	0.96 (0.26–3.63)	1.27 (0.82–1.97)
III/IV	NC	NC	1.77 (0.95–3.29)
Treatment history			
Chemotherapy			
No	1	1	1
Yes	2.02 (1.01–4.06)	1.03 (0.37–2.93)	1.41 (1.04–1.91)
Trastuzumab			
No	1	1	1

	Drink alcohol less often <i>Among women who reported >7 drinks per week before diagnosis- N=190</i>	Smoke less often <i>Among women who were smokers before diagnosis- N=91</i>	Sleep enough more often <i>All women- N=1,415</i>
	OR (95% CI)^a	OR (95% CI)^a	OR (95% CI)^b
Yes	0.88 (0.31–2.51)	NC	1.42 (0.86–2.34)
Endocrine therapy			
No	1	1	1
Yes	0.71 (0.33–1.54)	0.83 (0.32–2.14)	1.04 (0.76–1.42)
Surgery and Radiation			
Mastectomy	1	1	1
BCS with radiation	0.87 (0.43–1.76)	1.82 (0.71–4.62)	0.88 (0.65–1.18)
BCS without radiation	NC	NC	1.11 (0.54–2.28)

Abbreviations: BMI=body mass index; NC=not calculated (sample size <15); BCS=breast conserving surgery

^a Unadjusted model

^b Adjusted for age at diagnosis and time since diagnosis