Journal of
Women's Health and Gynecology

JScholar

Research Open Access

Perceived Recurrence Risk and Health Behavior Change among Breast Cancer Survivors

Iacolo EK[1], Makari-Judson G[2], Mertens WC[2], Katz D[2], Sturgeon SR[1], Bigelow C[1] and Reeves KW[1,*]

[1]Division of Biostatistics and Epidemiology, University of Massachusetts Amherst, Amherst, MA 01003-9304
[2]Baystate Regional Cancer Program, Baystate Medical Center, Springfield, MA 01199

[*]**Corresponding author:** Reeves KW, Division of Biostatistics and Epidemiology, Arnold House, University of Massachusetts Amherst, 715 North Pleasant Street, Amherst, MA 01003-9304; Tel: (413) 577-4298; Fax: (413) 545-1645; Email: kwreeves@schoolph.umass.edu

Received Date: October 17, 2014 **Accepted Date:** November 12, 2014 **Published Date:** November 20, 2014

Citation: Iacolo EK(2014) Perceived Recurrence Risk and Health Behavior Change among Breast Cancer Survivors. J Womens Health Gyn 1: 1-8

Abstract

Fear of recurrence is a primary concern for breast cancer survivors. While behavior changes may reduce recurrence risk, how perceived recurrence risk affects behavior change is unknown. We assessed perceived recurrence risk (local and distant) and change in nutrition, physical activity, and weight following diagnosis by questionnaire in a population of 267 breast cancer survivors. We used multinomial logistic regression to evaluate associations between perceived recurrence risk and health behavior change. The average participant was age 60 at diagnosis and had Stage I cancer (47.2%). Local or distant recurrence risk was perceived to be >30% by 20.2% and 30.3% of the population, respectively. Women most frequently reported increased physical activity (33.7%), improved nutrition (43.5%), and weight gain (33.0%). Higher local and distant perceived recurrence risk was associated with positive change in physical activity (OR 1.9, p=0.10; OR 1.7, p=0.12, respectively) and nutrition (OR 4.0, p<0.01; OR 2.0, p=0.05), while weight change was unrelated to perceived recurrence risk. Understanding women's perceived recurrence risk may be useful in counseling them regarding behavior change following breast cancer.

Keywords: Breast cancer; Perceived risk; Recurrence; Behavior change

Introduction

Approximately one in eight women will be diagnosed with breast cancer in their lifetime, and an estimated 232,670 U.S. cases are predicted in 2014 [1]. While women fear a diagnosis of breast cancer, women who are breast cancer survivors fear recurrence. One study showed that 39% of breast cancer survivors named "fear of recurrence" as their primary concern [2], while another found that approximately 40% of women rated their risk of local or distant recurrence as "likely" [3]. With best clinical practices, risk of local recurrence following breast conserving therapy (i.e. "in breast" recurrence), is estimated to be only 3.5% in node negative women and 6.6% in node positive women [4-6]. Distant relapse, the more significant event, is influenced by tumor stage, biology and other risk factors. With consideration of stage only, five year survival rates for Stage I, IIA, IIB, IIIA and IIIB are estimated to be 95, 85, 70, 52 and 48% [7]. At 5-12 years following diagnosis, the risk for recurrence is estimated to be 4.3% per year, with higher risks based on lymph node status and tumor size [8]. Thus, for the 2.9 million breast cancer survivors, perceived risk may differ in important ways from actual risk.

Making lifestyle behavior changes following cancer diagnosis and treatment may reduce the likelihood of recurrence. In particular, behavior changes such as maintaining a healthy weight [9], being physically active [9], and increasing fruit and vegetable consumption [9], following diagnosis and treatment have been linked to a reduction in breast cancer recurrence risk. The American Cancer Society recommends that breast cancer patients focus on maintaining a healthy weight through physical activity and a diet high in fruits and vegetables and low in saturated fat [10].

Behavior change is common following a cancer diagnosis. One study reported that 86% of cancer survivors made at least one behavior change following diagnosis [11]. Among them, 75% reported at least one positive (that is, health enhancing) behavior change and 38.5% reported making a negative (or potentially deleterious) change following diagnosis [11]. Other studies report that 40-50% of cancer survivors made positive changes in their diet [12,13] and 15-26% increased physical activity [12-15]. However, one study reported that 30.1% of cancer survivors exercised less following diagnosis [13].

Positive behavior change is associated with younger age, higher education, longer time since diagnosis, more comorbidities, fear of recurrence, and spiritual well-being [15]. Negative behavior change has been associated with younger age, being non-Hispanic African American, being widowed, divorced or separated, and decreased physical and emotional health [15].

Behavioral theories suggest that perceived severity of disease or fear of recurrence may be a catalyst for health behavior change following a cancer diagnosis [16-20]. Only two studies have assessed the relationship between perceived recurrence risk and health behavior change in breast cancer survivors [14,21]. Burris and colleagues [14] reported that higher perceived recurrence risk was negatively correlated with limiting food intake for the purpose of maintaining or losing weight. O'Neill and colleagues [21] similarly found that recurrence risk perception was unrelated to change in weight, fruit and vegetable consumption, and physical activity. These studies focused on women within two [21] or four [14] years following diagnosis, and thus may not reflect the experience of women farther from their initial diagnosis, especially since behavior change can be difficult to maintain. Understanding how perceived recurrence risk may influence behavior change among breast cancer survivors is important for promoting such changes. The scant literature in this area warrants further research.

Therefore, we investigated the relationships between perceived local and distant recurrence risk and change in specific health behaviors known to affect recurrence risk, namely physical activity, nutrition, and weight, among breast cancer survivors in a secondary analysis of cross-sectional data from the Breast Cancer Survivorship Study. We hypothesized that breast cancer survivors with a higher perceived recurrence risk would be more likely to report changes to these health behaviors.

Materials and Methods

Study population

In 2008 breast cancer survivors were identified through the Baystate Medical Center Tumor Registry, Springfield, MA with the goal of enrolling a population of 300 women into the Breast Cancer Survivorship Study. Eligible patients were diagnosed between 1997-2007 and subsequently treated by the principal investigators (Drs. Makari-Judson, Mertens, and Katz). Additional eligibility criteria included: 1) women at least 18 years of age, 2) diagnosis of stage I, II, or III breast cancer, 3) 12 months or greater since diagnosis, and 4) no distant relapse. Eligible patients received a letter from their physician inviting them to participate in the study. Study exclusion criteria were: 1) male breast cancer, 2) non-English, non-Spanish speaking patients, and 3) patients unable to complete the questionnaire due to dementia or disability. All women gave their written informed consent prior to inclusion in the study. This study was approved by the Institutional Review Board at Baystate Medical Center.

Eligible women were mailed a consent form and questionnaire, and 301 completed questionnaires were included in the study. The majority of participants completed the questionnaire over the phone with a written copy in front of them; some completed the questionnaire with a study representative in person. Women were excluded from the present analysis if they did not provide information about their perceived local or distant recurrence risk or direction of behavior changes (n=34), leaving a final population for analysis of 267. Women who were excluded from analysis due to missing information on perceived recurrence risk or health behaviors, were significantly older and were more likely to have a lower socioeconomic status, stage I breast cancer, no lymph node involvement, no chemotherapy treatment, and perceived local and distant recurrence risk to be <10% (data not shown).

Data collection

The questionnaire collected data on sociodemographic factors, smoking, alcohol use, family history of breast cancer, personal breast cancer history, perceived local and distant recurrence risk, and changes in physical activity, nutrition, and weight. To assess perceived local and distant recurrence risk at the time of diagnosis women were asked, "Thinking back to the day you completed your treatment, estimate your risk of having a breast cancer recurrence at the site of surgery," and "Thinking back to the day you completed your treatment, estimate what you believed to be your risk of recurrence of cancer outside the breast over 10 years from completing therapy". Participants were asked to choose from the following options: 0-10%, 10-30%, 30-60%, or >60%.

Participants also were asked, "Is there anything in your life you have changed since your breast cancer diagnosis? When did you make the change (for example, right when you were diagnosed)? Have you maintained the change? Check and state how you changed." Participants then indicated in a table whether they had made a change post-diagnosis or post-treatment in physical activity, nutrition, or weight, among other behaviors Participants reporting a behavior change were asked to describe the change in a free text entry. Each behavior change was assessed separately and classified as either "yes" or "no" in regards to the presence of a change.

Based on the free text responses, participants were further classified as either having made a positive or a negative change for each behavior by a single coder (EK) and reviewed with a senior investigator (KWR). Reports of increased physical activity, increased consumption of fruits and vegetables, whole grains, and fiber or decreased amount consumed, and decreased body weight were classified as positive changes. These behaviors were chosen as they have been linked to decreased breast cancer recurrence risk in the literature [9,10,22-25]. Reports of decreased physical activity; increased red meat or fat consumption, decreased consumption of fruits and vegetables, whole grains, and fiber or increased total calorie amount consumed, or increased body weight were classified as negative changes. Participants who indicated a behavior change but did not provide enough information for further classification were

grouped as "unclassifiable" and excluded from our analyses. In cases where participants indicated fluctuations in their behaviors over time (e.g. loss then gain of weight) we used the initial change to classify the direction of change.

Data for covariates were gathered through the questionnaire and medical record abstraction. Covariates gathered by questionnaire included: age, race, socioeconomic status, educational level, family history of breast cancer in 1st degree relatives, alcohol consumption, smoking history, and years since diagnosis. Covariates collected from the medical record included: stage of breast cancer, lymph node involvement, surgical treatment, chemotherapy treatment, hormonal treatment, radiation treatment, estrogen receptor (ER) status, progesterone receptor (PR) status, and actual distant recurrence risk from the *Adjuvant! Online* calculation [26]. *Adjuvant! Online* is a tool used by clinicians to help determine a patients' risk of an adverse cancer outcome (recurrence or mortality) by entering specific information about the woman such as age, tumor size, nodal involvement, histological grade, etc.

Statistical analysis

Perceived local and distant recurrence risk were separately collapsed into three categories (<10%, 10-30%, and >30%) due to the low number of women who perceived their local or distant recurrence risk to be greater than 60%. To assess concordance of distant recurrence risk, we compared women's perceived distant recurrence risk to their *Adjuvant! Online* score and grouped them as accurate, overestimated, or underestimated. We calculated summary statistics for all variables and compared the distribution between levels of each of the aforementioned outcome variables (change in physical activity, nutrition, and weight). Analysis of variance and chi square tests were used for continuous and categorical variables, respectively.

We used multinomial logistic regression to calculate adjusted odds ratios and 95% confidence intervals between perceived local and distant recurrence risk and each health behavior change. Potential confounders were chosen based on knowledge of a relationship [14,21] with perceived recurrence risk and health behavior change and are shown in Table 1. We evaluated each of these variables for inclusion in the multivariable model using likelihood ratio tests. The final model included any covariates with p <0.10 on the likelihood ratio test or that changed the coefficient for the perceived recurrence variable by more than 10%. Separate models were built for each outcome. To assess if behavior changes varied by length of time since diagnosis, analyses were repeated with stratification on time since diagnosis. Data were analyzed using STATA 12.1 (StataCorp, College Station, TX).

Results

The average age in this sample was 59.7 years with over 90% self-identifying as Caucasian (Table 1). Most had attended college, consumed alcohol rarely, and were never or past smokers. Nearly 30% of the sample had a previous family

	Total	
	Mean	SD
Age (years)	59.7	9.6
	N	%
White race	249	93.3
Household income		
<$25,000/year	43	16.1
$25,000-$50,000/year	64	24
$50,000-$100,000/year	87	32.6
>$100,000/year	58	21.7
Educational Level		
High School or less	87	32.6
College	100	37.5
Post Graduate	80	30
Family History of Breast Cancer in 1st degree relatives	77	28.8
>=1 Alcoholic drinks per day	56	21
Smoking History		
Current Smoker	14	5.2
Past Smoker	135	50.6
Never Smoked	114	42.7
Stage of cancer		
Stage I	126	47.2
Stage II	115	43.1
Stage III	24	9
Years Since Diagnosis		
<5 years	99	37.1
5-10 years	126	47.2
>10 years	41	15.4
Lymph Node Involvement	83	31.1
Surgical Treatment		
Lumpectomy	172	64.4
Mastectomy	95	35.6
Chemotherapy	158	59.2
Hormonal Treatment	212	79.4
Radiation Treatment	208	77.9
ER Positive	213	79.8
PR Positive	187	70
Local Perceived Recurrence Risk		
<10%	127	47.6
10-30%	86	32.2
>30%	54	20
Distant Perceived Recurrence Risk		
<10%	89	33.3
10-30%	97	36.3
>30%	81	30.3
Adjuvant! Online Risk Score		
<10%	95	35.6
10-30%	142	53.2
>30%	27	10.1
Accuracy of perceived distant recurrence risk		
Accurate	98	36.7
Overestimate	104	39
Underestimate	62	23.2

Table 1: Description of study population, Breast Cancer Survivorship Study, 2008

history of breast cancer, 47% of women were diagnosed with stage 1 cancer, and more than 62% of women were greater than 5 years past the initial diagnosis.

More than half (52.4%) of the women reported their perceived local recurrence risk to be greater than 10% (Table 1). Only one-third (36.3%) of women perceived their distant recurrence risk to be between 10% and 30%, although more than half (53.2%) of the group had calculated *Adjuvant! Online* distant risk scores in that range. Concordance of perceived distant recurrence risk was assessed within the described groupings: 37% of women accurately perceived their distant recurrence risk, while 39.4% overestimated and 23.5% underestimated compared to the *Adjuvant! Online* score.

Greater than half the population reported making changes in physical activity, nutrition, or weight (Table 2). Reported changes in physical activity and nutrition tended to be positive (33.7% and 43.5%, respectively), while changes in weight tended to be negative (33.0%). Women reporting no change in nutrition were older (mean 61.2 years) compared to those who made a positive (mean 58.6 years) or negative (mean 55.7 years) change in nutrition (p=0.05). Women receiving hormone therapy treatment for their cancer were slightly more likely to make a positive change in nutrition compared to those who did not receive hormone therapy (47.0% vs. 42.9%, respectively, p=0.05). Likewise, women with ER+ disease were more likely to report a positive change in nutrition (46.5% vs. 41.3%, p=0.03). Women reporting no change in physical activity were older (mean 61.2 years) compared to those who made a positive (mean 58.8 years) or negative (mean 57.7 years) change in physical activity (p=0.04). Alcohol consumption of at least one drink per day was associated with increased likelihood of negative weight change (i.e. weight gain) (37.0%) compared to those who rarely (34.7%) or never (32.6%) drank alcohol. Women who never drank alcohol were more likely to report a positive change in weight (i.e. weight loss) (34.9%) compared to those who drank rarely (16.0%) or at least once a week (25.9%; p=0.06). Chemotherapy also was associated with reported negative weight change (42.9%) compared to women who did not have chemotherapy (24.3%; p=0.01). Interestingly, women reporting negative weight change tended to be younger (mean 57.7 years) compared to those reporting no change (mean 60.8 years) or a positive change (mean 61.5 years; p=0.02).

We evaluated whether perceived local and distant recurrence risk was associated with behavior change (Table 3). Women with higher perceived local recurrence risk were more likely to make a positive change in physical activity (OR 1.9, 95% CI 0.9-3.9), though this result was not statistically significant at the 0.05 level, and nutrition (OR 4.0, 95% CI 1.9, 8.2) in adjusted analyses. There was no association between perceived local recurrence risk and change in weight. Similarly, women with higher perceived distant recurrence risk were more likely to make a positive change in physical activity (OR 1.7, 95% CI 0.9-3.4) and nutrition (OR 2.0, 95% CI 1.0-3.9) in adjusted analyses, though the association with physical activity change was again only of borderline statistical significance. Weight change was unrelated to perceived distant recurrence risk.

	N	%
Physical activity		
No Change	121	45.3
Change		
Positive	90	33.7
Negative	47	17.6
Unclassifiable	9	3.4
Nutrition		
No Change	127	47.6
Change		
Positive	116	43.5
Negative	10	3.8
Unclassifiable	14	5.2
Weight		
No Change	109	40.8
Change		
Positive	53	19.9
Negative	88	33
Unclassifiable	17	6.4

Table 2: Distribution of behavior change among participants (n=267)

We compared women who overestimated and underestimated their distant recurrence risk to those women who perceived it accurately (Table 4). Accuracy of risk perception was unrelated to change in physical activity, nutrition, or weight, although numbers were small for these analyses.

Discussion

In this study of early stage breast cancer survivors, we found that women with higher local and distant perceived recurrence risk were more likely to make positive changes in physical activity and nutrition, though the association with physical activity change was only borderline statistically significant. Though weight change, mostly in the form of weight gain, was common following diagnosis, changes in weight were unrelated to perceived local or distant recurrence risk. Further, the accuracy of women's perception of their distant recurrence risk was unrelated to their self-reported behavior changes.

Psychosocial theories such as the Social Cognitive Theory [16], Parallel Processing Model [19], Behavior Motivation Hypothesis [17], and other cognitive [18]and emotional constructs [20] may explain how risk perceptions could play an important role in behavior change. However, previous literature has found that perceived local recurrence risk was largely unrelated to health behaviors following breast cancer diagnosis [14,21]. Burris and colleagues [14] studied fourteen potential recurrence risk reduction behaviors and found that only two (limit food intake to maintain current weight or lose

Perceived Local Recurrence Risk							
	<10%		10-30%		>30%		
	N	OR	N	OR (95% CI)	N	OR (95% CI)	P Value
Physical Activity[a]							
No Change	60	1.0	40	1.0	21	1.0	
Negative Change	22	1.0	17	1.2 (0.5-2.4)	8	1.0 (0.4-2.6)	0.9
Positive Change	37	1.0	28	1.1 (0.6-2.1)	25	1.9 (0.9-3.9)	0.1
Nutrition[b]							
No Change	73	1.0	37	1.0	17	1.0	
Negative Change	4	1.0	4	2.2 (0.5-9.6)	2	2.4 (0.4-14.2)	0.26
Positive Change	41	1.0	40	2.1 (1.1-3.5)	35	4.0 (1.9-8.2)	<0.01
Weight[c]							
No Change	56	1.0	35	1.0	18	1.0	
Negative Change	37	1.0	33	1.3 (0.7-2.5)	18	1.2 (0.6-2.8)	0.52
Positive Change	25	1.0	14	0.9 (0.4-1.9)	14	1.6 (0.7-3.7)	0.42
Perceived Distant Recurrence Risk							
	<10%		10-30%		>30%		
	N	OR	N	OR (95% CI)	N	OR (95% CI)	P Value
Physical activity[a]							
No Change	45	1.0	44	1.0	32	1.0	
Negative Change	12	1.0	19	1.5 (0.6-3.5)	16	1.8 (0.7-4.3)	0.21
Positive Change	26	1.0	31	1.2 (0.6-2.3)	33	1.7 (0.9-3.4)	0.12
Nutrition[b]							
No Change	47	1.0	49	1.0	31	1.0	
Negative Change	0	1.0	5	--[d]	5	--[d]	
Positive Change	33	1.0	40	1.1 (0.6-2.1)	43	2.0 (1.0-3.9)	0.05
Weight[c]							
No Change	43	1.0	41	1.0	25	1.0	
Negative Change	25	1.0	31	1.1 (0.5-2.2)	32	1.6 (0.8-3.5)	0.22
Positive Change	16	1.0	19	1.1 (0.5-2.5)	18	1.6 (0.7-3.9)	0.28

[a]adjusted for age
[b]adjusted for age and alcohol use
[c]adjusted for alcohol use, years since diagnosis, and chemotherapy treatment
[d]not estimable due to small numbers

Table 3: Multinomial logistic regressions for the association between perceived local and distant recurrence risk and behavior change

weight and see a mental health professional) were significantly correlated with perceived local recurrence risk. More recently, O'Neill and colleagues [21] reported that adherence to healthy behaviors is unrelated to perceived local recurrence risk. In contrast to our study, these studies questioned women within two or four years post-diagnosis, while the majority of our participants were 5-10 years post-diagnosis. Thus, our participants had a longer opportunity for behavior change to occur, or to deteriorate if a change had taken place. Also, we specifically asked about behavior change in the time since diagnosis, while Burris [14] asked about performing certain health-promoting behaviors within the past month and O'Neill [21] measured current adherence to guidelines related to body mass index, fruit and vegetable consumption, and physical activity. Thus our study was specifically directed at measuring change, while previous studies assessed current behaviors, which may or may not reflect a difference from pre-diagnosis behaviors. Though the relationship between perceived recurrence risk and behavior change following breast cancer diagnosis has been studied sparsely, studies in other patient populations are informative. A study of head, neck and lung cancer survivors reported that perceived recurrence risk three months following diagnosis was positively associated with smoking cessation [27]. However, a study of colorectal cancer patients found that perceived recurrence risk was only associated with intention to change health behaviors, not with actually making such a change fol-

	Accurate		Overestimate			Underestimate	
	N	OR	N	OR (95% CI)	N	OR (95% CI)	P Value
Physical activity[a]							
No Change	46	1	44	1	30	1	
Negative Change	17	1	17	1.1 (0.5-2.3)	12	1.2 (0.5-2.9)	
Positive Change	32	1	42	1.4 (0.7-2.6)	15	0.8 (0.4-1.7)	0.94
Nutrition[b]							
No Change	46	1	48	1	32	1	
Negative Change	6	1	4	0.6 (0.2-2.3)	0	--[d]	
Positive Change	42	1	50	1.1 (0.6-2.0)	22	0.7 (0.4-1.5)	0.76
Weight[c]							
No Change	40	1	38	1	30	1	
Negative Change	36	1	35	1.0 (0.5-1.9)	17	0.6 (0.3-1.4)	
Positive Change	18	1	24	1.2 (0.6-2.7)	10	0.8 (0.3-1.9)	0.99

[a]adjusted for age
[b]adjusted for age and alcohol use
[c]adjusted for alcohol use, years since diagnosis, and chemotherapy treatment
[d]not estimable due to small numbers

Table 4: Multinomial logistic regressions for the association of accuracy of perceived distant recurrence risk on behavior change after breast cancer diagnosis

lowing diagnosis [28]. Our data suggest that perceived local and distant recurrence risk is associated with positive health behavior change following a breast cancer diagnosis, though these findings will require confirmation by additional studies.

Current survivorship literature suggests that maintaining a healthy body mass index [29] and increasing physical activity [9,30] may decrease cancer recurrence risk. Interestingly, the data linking nutritional factors to breast cancer recurrence risk are not particularly strong. Eating a low fat diet [31] or increasing fruit and vegetable intake may have a modest benefit on breast cancer recurrence risk, if any at all [9,24,30,32]. In our study, women were significantly more likely to make a positive behavior change in their nutrition. Despite evidence increased physical activity and weight loss may decrease breast cancer recurrence risk [25,30] positive change in weight or physical activity was less common in our population. Only 33.7% of the population made a positive change in physical activity, a finding both surprising and disappointing to us, as physical activity has been demonstrated to improve survival [25,30], and the clinicians treating the survivors specifically counsel patients to exercise. It is possible that it is easier for breast cancer survivors to make an adjustment to their nutrition than it is to start an exercise routine. Additionally, breast cancer treatment effects can include fatigue and weight gain, making a positive change to physical activity and weight even more challenging1.In our study, a substantial proportion (59.2%) of women were treated with chemotherapy, thus the large number of women reporting weight gain was not surprising.

While many women (37%) had an accurate perception of their distant recurrence risk in our study, many women overestimated (39.4%) or underestimated (23.5%) this risk. However, the accuracy of perception of risk was not related to changes in physical activity, nutrition, or weight. It is possible that women's risk perceptions were influenced by additional factors, such as molecular characteristics of disease, that their oncologist may have discussed yet do not inform the *Adjuvant! Online* score. Though numbers were small for these exploratory analyses, our results may suggest that women who underestimated their distant recurrence were less likely to make positive changes in these health behaviors, although results were not statistically significant. If true, these results may suggest that clinicians should specifically target women who underestimate their recurrence risk for behavioral interventions. Further study is needed to clarify how accuracy of perceived recurrence risk relates to behavior change among breast cancer survivors.

Strengths of this study include the use of a standardized questionnaire, the collection of data on a wide variety of confounders, and the use of medical record data for treatment and disease information. Furthermore, all of the survivors were treated within the same medical practice so they likely received similar medical care and advice after diagnosis and treatment.

A limitation of this study is the assessment of the behavior change inquiry on the questionnaire. Women were asked to define whether or not they made a behavior change, but quantitative information about the change was not systematically gathered. Additionally, maintaining weight following a breast cancer diagnosis is also health-promoting, yet our study only measured change in weight (i.e. gain or loss). Thus we could not assess how risk perception was related to weight maintenance, which also requires behavioral modification to avoid weight gain while undergoing chemotherapy. Among breast cancer survivors, it is common for chemotherapy to cause weight gain, so it is important to note that we also could not

distinguish between weight changes resulting from behavior changes from those due to treatment regimen, nor could we distinguish between intentional and unintentional weight loss.

As mentioned previously, the majority of women in this study were between five and ten years since diagnosis. The length of time since diagnosis may have caused women to report their current perceived recurrence risk rather than thinking back to the day treatment was completed. Reported behavior changes may also have been affected by the length of time since diagnosis, as women may have reported changes that have occurred over time, rather than as a result of their breast cancer diagnosis. This also could have led to misclassification and have attenuated the study results. However, we observed generally similar results when we stratified on time since diagnosis (data not shown). Also, as this was a cross-sectional study, temporality cannot be established. We cannot definitively state whether an increased perception of local or distant recurrence risk led to behavior change, or if the reverse is true. There also is a possible volunteer bias, in that the women most motivated to participate may also have been those who were most fearful of recurrence and/or most likely to make a behavior change. Lastly, the small sample size limits the power available for our analyses, and our findings should be confirmed within a larger cohort of breast cancer survivors.

Conclusion

We found that women with higher perceived local or distant recurrence risk were more likely to make positive change in their nutrition and possibly physical activity following their breast cancer diagnosis. Making significant lifestyle changes to weight and physical activity can be difficult as compared to modifying diet. Weight management and increasing physical activity are the strongest predictors for lowering breast cancer recurrence risk, yet in our study even the women with the highest perceived recurrence risk did not make these behavior changes. Women who underestimated their distant recurrence risk may be less likely to make behavior changes, suggesting a group for clinicians to target for interventions. Future research should include gathering quantitative information about behavior changes and establishing temporality.

The conclusion of treatment for breast cancer presents a "teachable moment" at which women may be particularly receptive to efforts to modify health behaviors that can reduce recurrence risk. As the population of breast cancer survivors continues to grow, health promotion among breast cancer survivors is an increasingly important women's health issue. Understanding each woman's perceived recurrence risk, and how this perception relates to actual recurrence risk, may help clinicians target messages and programs to encourage behavior change among breast cancer survivors.

Acknowledgements

This study was funded by Rays of Hope, Springfield, MA.

The authors would like to thank Ruth Barham for her assistance with this study.

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