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Correlates of fear of cancer recurrence in women with ductal carcinoma in situ and early invasive breast cancer

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Abstract

Fear of cancer recurrence (FCR) is a common and persistent concern among breast cancer survivors. Little is known about factors associated with FCR in women with ductal carcinoma in situ (DCIS) or early invasive breast cancer (EIBC). Women with first primary DCIS, or stages I–IIA breast cancer were prospectively enrolled in a quality-of-life study and completed interviews at 4–6 weeks, 6 months, and 2 years after definitive surgical treatment. In three stepwise multivariable linear regression models, including both time-independent and time-varying variables measured at each respective interview, we identified independent correlates of mean FCR scores (range 1–6) using four items from the Concern About Recurrence Scale (CARS) at 2-year follow-up. Of 506 disease-free patients at 2-year follow-up (mean [SD] age, 58 [10] years; 81% White; 34% DCIS), the average FCR score of 2.0 was low. However, 145 (29%) reported moderate-to-high levels of FCR (scores 3.0–6.0). All three models showed that younger age, stage IIA breast cancer (vs. DCIS), lower social support, and elevated anxiety were consistently associated with higher FCR at 2-year follow-up (each $P < 0.05$; final models $R^2 = 0.25–0.32$).

DCIS patients reported lower FCR than stage IIA patients (each $P \leq 0.01$) but had similar FCR as stage I patients. Although mean FCR was low, 29% of DCIS and EIBC survivors reported moderate-to-high levels of FCR at 2-year follow-up. Management of anxiety, provision of social support, and patient education may help reduce FCR among DCIS and EIBC survivors, especially among younger survivors.

Keywords

Breast cancer; Ductal carcinoma in situ; Cancer risk perception; Fear of cancer recurrence; Anxiety; Social support

Introduction

Widespread utilization of mammography for routine breast cancer screening and increased use of adjuvant therapies have led to a growing number of breast cancer survivors during the past two decades, especially among women with ductal carcinoma in situ (DCIS) and early-invasive breast cancer (EIBC). Most women with early-stage breast cancer have a good overall health-related quality of life after completion of treatment [1, 2]. However, fear of cancer recurrence (FCR), defined as the fear or worry that cancer will come back in the same organ or spread to another part of the body [3], is a common and persistent stressor reported by breast cancer survivors [3-7]. Among cancer survivors who have completed cancer treatment, FCR is the most frequently endorsed unmet supportive care need [8].

FCR has been associated with psychological distress [3, 9, 10] and lower quality of life [4, 6]. In addition, FCR has been reported to influence patients' decisions about surgical treatments and health behaviors. Specifically, breast cancer patients who were worried about developing recurrent disease were more likely to prefer mastectomy [11] and be hyper-vigilant about breast self-examination [12]. These findings highlight the importance of understanding factors associated with FCR in breast cancer survivors, especially in women with DCIS, who are at relatively low risk of recurrence but more likely than EIBC patients to overestimate their risk [13]. Breast cancer patients' overestimation of their risk of recurrence was found to be associated with elevated anxiety [13, 14], and might also have an impact on adherence to treatment and to post-treatment surveillance [15].

However, little is known about factors associated with FCR in women with DCIS and EIBC. Among demographic and medical variables examined as predictors of FCR, only younger age at diagnosis was consistently associated with greater FCR [3-6, 16]. Few studies have evaluated psychosocial factors in relation to FCR among cancer survivors. Since low levels of social support have been associated with poor health outcomes in breast cancer patients [17, 18], perceived availability of social support may influence their emotional responses to breast cancer diagnosis and treatment.

Emotional distress is hypothesized to influence FCR [19], and higher levels of anxiety were found to be associated with higher perceived risk of recurrence among breast cancer survivors [14, 20-22]. In a previous analysis, we found that DCIS and EIBC patients reported similar levels of perceived risk of recurrence [14]. But DCIS patients were more likely than EIBC patients to overestimate their risk [13], although DCIS patients generally have a lower risk of recurrence after treatment. According to Protection Motivation Theory, risk perceptions may increase both the level of fear arousal and the likelihood of performing protective health behaviors [23]. However, it remains unknown whether the accuracy of perceived risk of recurrence is related to FCR among women with DCIS or EIBC and whether their FCR differs by cancer stage. Therefore, we sought to identify psychosocial,

demographic, disease-related, and treatment-related correlates of FCR in a cohort of women diagnosed with DCIS and EIBC.

Methods

Patients and procedure

Data were collected as part of a longitudinal quality-of-life study in women with a pathologically confirmed first primary diagnosis of DCIS or EIBC (stages I or IIA). The sample included newly diagnosed patients between October 2003 and June 2007 at the Siteman Cancer Center at Barnes-Jewish Hospital and Washington University School of Medicine and at Saint Louis University School of Medicine, both in St. Louis, Missouri. Patients were eligible for the study if they were English-speaking, completed definitive surgical treatment, and were 40 years of age or older, as most cases of DCIS are diagnosed following routine screening mammography, and annual mammography is recommended for this age group [24]. Potential participants were excluded if they had a history of DCIS or invasive breast cancer, received neoadjuvant chemotherapy for locally advanced breast cancer, or demonstrated cognitive impairment based on weighted scores >10 on the Orientation-Memory-Concentration Test [25], which was administered to all women 65 years of age and older.

The Institutional Review Boards at Washington University and Saint Louis University Schools of Medicine approved the study. After obtaining informed consent, we abstracted patients' breast cancer stage and treatment data from their medical records. Data for demographic and psychosocial variables of interest were collected using computer-assisted telephone interviews administered 4–6 weeks, 6 months, and 2 years following patients' definitive surgery.

Measures

Fear of cancer recurrence was measured only at the 2-year follow-up interview using the first four items of the Concern About Recurrence Scale (CARS), which address frequency, consistency, intensity, and potential for upset caused by fear of breast cancer recurrence [3]. Items were coded on a 6-point scale, ranging from (1) "Not at all" to (6) "All the time." A mean score measuring patients' overall FCR (range 1–6) was computed. Higher scores indicate greater FCR (Cronbach's alpha = 0.87), with scores rounded to 3 or 4 indicating moderate levels and scores rounded to 5 or 6 indicating high levels of FCR [3, 4].

Perceived availability of social support was measured using the Medical Outcomes Study Social Support Survey (Cronbach's alpha = 0.97) [26]. *Severity of symptoms of anxiety* was measured with the validated Beck Anxiety Inventory® (BAI®; Cronbach's alpha = 0.89) [27]. Elevated anxiety was defined by a total score ≥ 10 on the BAI®, a level indicative of a possible anxiety disorder [27]. The severity of *depressive symptoms* "during the past week" was measured using the validated Center for Epidemiologic Studies-Depression Scale (CES-D; Cronbach's alpha = 0.76) [28]. Elevated depressive symptoms were defined as total scores on the CES-D of 16 or more, a level indicative of clinical depression [28]. Based on the literature [29] and surgeons' anecdotal reports of patients' complaints after surgery, we developed an eight-item measure of the severity of *surgical side effects* with higher scores (range 1–5) indicating more severe side effects related to breast surgery (Cronbach's alpha = 0.84) [30]. Katz's validated adaptation of the *Charlson Comorbidity Index* was used to measure the presence/history of several comorbid conditions [31, 32]. We also asked patients whether or not they had a family history of breast cancer in their first-degree relatives.

Patients' *perceived risk of breast cancer recurrence* was measured using the question, "What do you think the chances are that you will have this disease again some-day?" [33]. Responses ranged from 0%, meaning they definitely will not develop recurrent disease, to 100%, meaning they definitely will develop recurrent disease. We defined "recurrence" broadly as a recurrence in the same breast or in other organs or a metachronous contralateral breast cancer. We categorized their responses into one of six groups: 0%, 1–9%, 10–24%, 25–49%, ≥50%, and uncertain.

To evaluate the accuracy of patients' perceived risk of recurrence, a patient's 'actual' risk of recurrence was calculated as described previously [13]. Briefly, for DCIS patients, the 10-year risk of recurrence, including local and distant recurrence and contralateral breast cancer, was estimated by type of surgical treatment based on results of randomized trials [34–38]. For EIBC patients, the 10-year estimated risk of local recurrence varied with type of surgical treatment, types of adjuvant therapy, and nodal status [39]. The 10-year risk of distant recurrence among EIBC patients was estimated using *Adjuvant! Online*, a web-based program that predicts 10-year risks of mortality and recurrence for EIBC patients [40]. The risks of contralateral breast cancer for EIBC patients were estimated based on the literature for patients with an intact contralateral breast [41] and patients who underwent bilateral mastectomy [42]. The estimated 10-year risk of recurrence was the sum of estimates of local recurrence, distant recurrence, and contralateral breast cancer. The *Adjuvant!*-derived proportional risk reductions were used to estimate the efficacy of adjuvant systemic therapy on all types of recurrence [40]. In a 20-year follow-up of EIBC patients, 89% of first recurrences had occurred within 10 years of diagnosis [43]; therefore our assumption that the estimated 10-year cumulative risk of recurrence in early-stage breast cancer approximates the estimated lifetime risk is likely valid.

Since receipt of adjuvant therapies was included in the calculation of a patient's actual risk of recurrence and since 37–44% of patients who were supposed to receive chemotherapy and/or radiation therapy had not completed their therapy until 6 months after surgery, the accuracy of each patient's perceived risk of recurrence was assessed at the 6-month and 2-year interviews. We contrasted patients' perceived risk-of-recurrence categories with their respective calculated risk categories at the 6-month and 2-year follow-ups, creating four categories of *accuracy of perceived risk*: underestimated (perceived < calculated risk), accurate (patient's perceived risk fell in the same category as her calculated risk), overestimated (perceived >calculated risk), or uncertain (patients reported not knowing their risk) [13].

Statistical analysis

The potential correlates of FCR that we evaluated in the study included age at diagnosis (continuous), race (white vs. non-white), education (high school or less vs. more than high school), marital status (married or partnered vs. non-married or non-partnered), family history of breast cancer among first-degree relatives, cancer stage (IIA, I vs. DCIS), type of breast surgery (BCS vs. mastectomy), chemotherapy, radiation therapy, adjuvant hormone therapy, accuracy of patients' perceived risk of recurrence (underestimated, overestimated, uncertain vs. accurate), surgical side effects (continuous), comorbidity (score >0 vs. score = 0), perceived availability of social support (continuous), elevated anxiety (BAI® ≥ 10 vs. BAI® < 10), and elevated depressive symptoms (CES-D ≥ 16 vs. CES-D < 16).

Student's *t* test was used to test for differences in FCR scores according to demographic, medical, and psychosocial characteristics. For each potential correlate, Cohen's *d* effect size was computed for the standardized mean difference in FCR. Analysis of differences between multiple groups was performed using one-way analysis of variance with Dunnett's post hoc test. Pearson correlation coefficients were used to measure the correlations between FCR

and each of age at diagnosis, surgical side effects, and perceived availability of social support. Multivariable stepwise linear regression analyses were performed to identify the significant correlates of FCR, with an entry criterion of 0.20 and a stay criterion of 0.05. We developed three multivariable linear regression models, each including time-independent variables (e.g., age at diagnosis, race, education, cancer stage), time-varying variables (including surgical side effects, comorbidity, social support, elevated anxiety, and elevated depressive symptoms) measured at 4–6 weeks (Model 1), 6 months (Model 2), and 2 years (Model 3) after surgery, and accuracy of perceived risk of recurrence measured 6 months (Models 1 and 2) and 2 years (Model 3) after surgery. As cancer stage and patients' accuracy of perceived risk of recurrence were the two predictor variables of primary interest, these two explanatory variables were forced into the regression models. The presence of multicollinearity in the regression analysis was indicated by a variance inflation factor >4 [44]. Analyses were performed using SAS version 9.12 (SAS Institute, Cary, NC). A two-tailed P value <0.05 was considered significant.

Results

In all, 772 patients meeting the inclusion criteria were identified prospectively using the medical record and surgical pathology reports. With permission from each patient's treating physician, study recruitment letters and consent forms were mailed 2–3 weeks following a patient's definitive surgical treatment; 587 patients consented to participate, but 38 were subsequently determined not to be eligible based on exclusion criteria. Thus, 549 (71%) eligible patients completed the first telephone interview a mean 6 weeks following definitive surgery. Participants and non-participants did not differ significantly by marital status ($P = 0.07$), pathological stage ($P = 0.84$), or type of surgery ($P = 0.10$). Compared with non-participants, participants were younger (58 years vs. 61 years, $P = 0.01$) and were more likely to be white (79% vs. 64%, $P < 0.001$). Of the 549 participants, 514 (94%) completed the 2-year follow-up interview at which time patients' FCR was measured. Eight patients who experienced recurrent or contralateral breast cancer at a follow-up were excluded from the analysis.

Table 1 summarizes the characteristics of 506 women with DCIS or EIBC included in this study. Univariate analysis showed that patients who were diagnosed with stage IIA breast cancer, had completed chemotherapy, or had elevated anxiety or elevated *depressive symptoms* at baseline reported greater FCR 2 years after definitive surgery (each $P < 0.01$). Higher FCR scores were moderately correlated with younger age, more severe surgical side effects, and lower social support reported at baseline (Table 2).

The average FCR score was low in our sample with a mean of 2.0 on a 1–6 scale (Table 2). However, 24.8% (123/506) of patients reported moderate levels, and 4% (22/506) reported high levels of FCR. Figure 1 shows the prevalence of moderate and high levels of FCR 2 years after surgery by cancer stage. Moderate-to-high FCR (range 3.0–6.0) was reported by 29.0% of DCIS patients, which was not significantly different from FCR reported by stage IIA patients (38.7%, $P = 0.13$) or stage I patients (26.0%, $P = 0.50$).

Results from the regression models are presented in Table 3. All three models showed that younger age, stage IIA breast cancer (vs. DCIS), lower social support, and elevated anxiety were consistently associated with higher FCR 2 years after diagnosis. When time-varying variables that were measured at baseline were included in the analysis, we found that more highly educated patients reported less FCR and patients who had elevated depressive symptoms at baseline reported higher FCR (Model 1). The effects of education and elevated depressive symptoms on FCR were not observed at the 6-month and 2-year follow-ups. BCS and more severe surgical side effects at 6-month and 2-year follow-ups were significantly

correlated with higher FCR (Models 2 and 3), but were not correlated with FCR at baseline. Compared with patients who accurately perceived their risk of recurrence, patients who overestimated their risk of recurrence at the 2-year follow-up reported greater FCR, and patients who underestimated their risk of recurrence at the 2-year follow-up reported less FCR. Accuracy of perceived risk of recurrence was not a significant predictor of FCR in either Model 1 or Model 2. Variables retained in the three final models accounted for 25–32% of the variance of FCR.

FCR was not associated with race, marital status, family history of breast cancer, comorbidity, or adjuvant therapy.

Discussion

Although mean FCR at 2-year follow-up was low in our sample of DCIS and EIBC survivors, 29% of participants expressed moderate-to-high levels of FCR. We observed a lower prevalence of moderate-to-high FCR among our participants than the prevalence of 46–85% reported previously in studies that included patients with more advanced disease an average 2–3 years after diagnosis [3, 4, 7, 45], but we consider a prevalence of 29% to be high given the large proportion women in our sample with DCIS and stage I disease. DCIS patients reported similar levels of FCR as stage I patients, consistent with their comparable perceived risk of recurrence reported previously [14, 22, 46]. These similar findings for DCIS and EIBC patients' FCR might be explained by a lack of knowledge about DCIS patients' better prognosis generally and/or the similarity in treatment options for DCIS and most stage I patients.

We identified other prognostic factors, such as age and surgical treatment, associated with FCR. Older age at diagnosis predicted less FCR at 2-year follow-up, which is consistent with other studies [3-6, 16]. The literature is inconsistent regarding the impact of type of surgery on FCR. FCR did not differ significantly by type of surgery in some studies [3, 5, 7], but other studies reported that patients with mastectomy were more confident that their cancer had been cured and less concerned about recurrence than patients who received BCS [47, 48], which supports our finding that patients with BCS reported higher FCR than patients with mastectomy.

More severe surgical side effects reported 6 months after surgery predicted higher FCR in our sample, although breast surgery-related symptoms reported 4–6 weeks after surgery had no predictive effect on subsequent FCR. Lingering somatic symptoms might be viewed by patients as a constant reminder of their breast cancer, or be misinterpreted as an indicator of breast cancer recurrence. Breast cancer patients reportedly have limited knowledge about treatment side effects and often are confused about a lingering physical symptom (e.g., pain, fever, lymphedema, fatigue) [49, 50]. These results point to the need for patient education about common treatment side effects, both before and after surgical treatment, to reduce FCR. This type of education typically includes information regarding the illness or symptoms, symptom management, and/or discussion of treatment options. But the effects of such patient education on FCR remain unknown.

The psychosocial factors that were consistently associated with greater FCR included lower social support and elevated anxiety symptoms. Evidence suggests that social support helps breast cancer survivors cope with uncertainty [51] and moderates the impact of breast cancer-related intrusive thoughts on quality of life [52]. Consistent with the literature that social support works as a buffer against poorer psychological adjustment to stressful events [53, 54], we found that greater perceived social support predicted both lower perceived risk of recurrence [14] and less FCR. Disclosure of one's thoughts and feelings to a supportive

social network could improve emotional well-being after a traumatic or distressing event [55]. Patients with more social support may be more likely to know (or to have been made aware of) long-term disease-free survival among early-stage breast cancer survivors, and therefore base their own perceived risk of recurrence on the experiences of other survivors or on what their friends and family say to survivors to allay their FCR.

We found that elevated anxiety at baseline and 6-month follow-up predicted greater FCR at 2-year follow-up in women with DCIS and EIBC. Elevated depressive symptoms at baseline also predicted greater FCR, although this association was not observed at 6-month follow-up. Thus, identification of patients with elevated anxiety and depressive symptoms as soon as possible after their surgery, and timely management of their symptoms may help prevent greater long-term FCR among patients with DCIS or EIBC. In addition, our findings suggest that elevated anxiety has a greater impact on FCR than depressed mood after patients complete their adjuvant therapies. A recent longitudinal study examined bi-directional relations between total mood disturbance and fear of the future among women with locoregional or metastatic breast cancer [9]. In that study, reductions in mood disturbance (including anxiety and depressed mood among the six mood factors assessed) over 15 months after diagnosis led to decreases in fear of the future; however, the reverse was not true—a reduction in fear of the future did not lead to a reduction in mood disturbance. The measures for anxiety and depressed mood were not reported separately in that study.

While accuracy of patients' perceived risk of recurrence at baseline and 6-month follow-up was not significantly predictive of higher FCR, we found that accuracy of recurrence-risk perceptions was correlated with concurrently measured FCR. Compared with patients who accurately perceived their risk of recurrence, patients who overestimated their recurrence risk 2 years after surgery reported greater FCR at that time and those who underestimated their recurrence risk reported less FCR. Higher recurrence-risk perception has been associated with greater cancer-specific worries in women with invasive breast cancer [56]. Our study extends the literature by including patients with DCIS, a premalignant breast lesion and by evaluating the relationship between accuracy of recurrence-risk perceptions and FCR.

In our study, education levels were inversely associated with FCR. More highly educated women with breast cancer have been found to have greater knowledge of the disease and treatment prior to undergoing definitive surgery than less-educated patients [57]. Therefore, breast cancer patients with low educational attainment might especially benefit from patient education designed to reduce FCR.

There were several limitations in this study. First, we included only women aged 40 and older with DCIS or EIBC, and our results may not be generalizable to younger women or to women with more advanced breast cancer. Second, because we asked about patients' FCR only once, we were unable to assess changes in FCR over time. Breast cancer patients' worry about their future health was reported to decrease over the first 3 months after surgical treatment, and stabilize afterward [16]. However, most prior studies did not find a change in FCR over time, even 5 years or more after diagnosis of invasive breast cancer [3-6, 45, 47, 49]. Other unmeasured variables, such as known BRCA 1 and 2 mutations, also might be associated with FCR and require further study.

In conclusion, although mean FCR was low among DCIS and EIBC survivors, a substantial proportion of these survivors reported moderate-to-high levels of FCR and overestimated their risk of recurrence 2 years following definitive surgical treatment. These findings underline the need for specific psychosocial interventions addressing FCR for this subset of patients with DCIS and EIBC. Management of anxiety and depression, providing social

support, and educating patients about how breast cancer stage and various treatments affect risk of recurrence and treatment side effects may improve recurrence-risk perceptions and help manage FCR in women with DCIS and EIBC, especially in younger patients.

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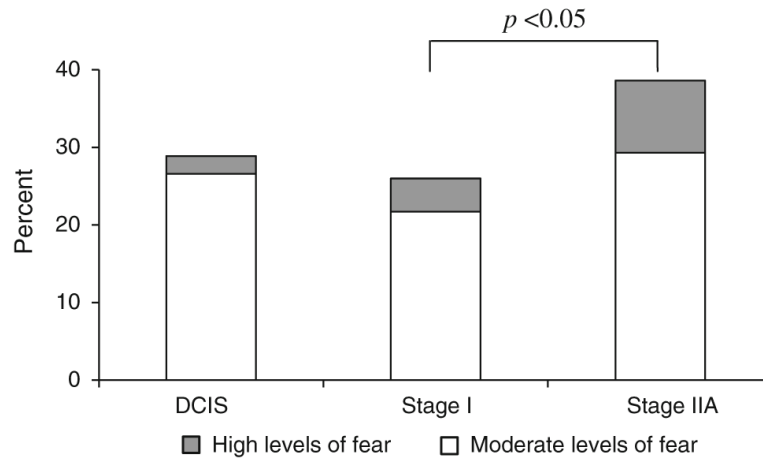


Fig. 1. Prevalence of moderate and high levels of fear of cancer recurrence by cancer stage in women with ductal carcinoma in situ (DCIS) and early invasive breast cancer (stages I and IIA). Moderate levels of fear were defined as scores rounded to 3 or 4 and high levels were defined as scores rounded to 5 or 6 on the CARS [4, 5]. Overall chi-square $P = 0.06$

Table 1

Characteristics of 506 women with early-stage breast cancer and their univariate associations with fear of cancer recurrence measured 2 years after definitive breast surgery

	N (%)	Fear of recurrence		
		Mean score (SD)	P value	Effect size
Race				
White	408 (80.6)	2.05 (0.99)		
Non-white	98 (19.4)	2.00 (1.35)	0.71	-0.04
Marital status				
Married/partnered	313 (61.9)	2.09 (1.01)		
Non-married/non-partnered	193 (38.1)	1.98 (1.15)	0.26	-0.10
Education				
High school or less	153 (30.2)	2.15 (1.21)		
More than high school	353 (69.8)	2.00 (1.00)	0.18	-0.14
First-degree relative history of breast cancer ^d				
No	373 (75.8)	2.07 (1.11)		
Yes	119 (24.2)	1.95 (0.89)	0.22	-0.12
Missing	14			
Pathological stage of breast cancer				
DCIS	173 (34.2)	1.95 (0.99)	<0.001	
Stage I	258 (51.0)	1.99 (1.03)	0.90 ^d	0.04
Stage IIA	75 (14.8)	2.47 (1.26)	<0.001 ^d	0.46
Surgical treatment				
Mastectomy	176 (34.8)	2.12 (1.18)		
Breast conserving surgery	330 (65.2)	2.01 (1.00)	0.31	-0.10
Chemotherapy ^b				
No	380 (75.1)	1.95 (1.01)		
Yes	126 (24.9)	2.33 (1.17)	<0.01	0.35
Radiation therapy ^b				
No	178 (35.2)	2.04 (1.14)		

	N (%)	Fear of recurrence		
		Mean score (SD)	P value	Effect size
Yes	328 (64.8)	2.05 (1.03)	0.87	0.01
Hormonal therapy ^b				
No	233 (48.7)	2.13 (1.13)		
Yes	245 (51.3)	1.95 (0.96)	0.06	-0.17
Missing	28			
Comorbidity score				
0	340 (67.2)	2.06 (1.07)		
>0	166 (32.8)	2.02 (1.06)	0.67	-0.04
Elevated anxiety (BAI@ ≥ 10 in the past week) ^c				
No	394 (77.9)	1.85 (0.90)		
Yes	112 (22.1)	2.72 (1.31)	<0.0001	0.77
Elevated depressive symptoms (CES-D ≥ 16 in the past week) ^c				
No	426 (84.2)	1.88 (0.90)		
Yes	80 (15.8)	2.90 (1.43)	<0.0001	0.85
Accuracy of perceived risk of recurrence ^b				
Accurate	81 (16.5)	2.06 (1.04)		
Underestimated	220 (44.9)	1.86 (0.92)	0.26e	-0.20
Overestimated	109 (22.2)	2.37 (1.15)	0.11 ^e	0.28
Uncertain	80 (16.3)	1.92 (1.06)	0.66 ^e	-0.13
Undetermined	16			

^aThe variable was measured 1 year after definitive breast surgery

^bThe data were collected 6 months after definitive breast surgery

^cThe variable was measured at baseline (4–6 weeks after definitive breast surgery)

^dThe P value of the post hoc test for the comparison with DCIS

^eThe P value of the post hoc test for the comparison with 'accurate'

Table 2

Pearson correlations of fear of cancer recurrence measured 2 years after definitive breast surgery with age at diagnosis, surgical side effects, and perceived availability of social support, which were measured 4–6 weeks after definitive breast surgery, in 506 women with early-stage breast cancer

	Mean (range)	1	2	3	4
1. Fear of cancer recurrence	2.0 (1.0–6.0)	1.00	-0.31*	-0.21*	0.23*
2. Age at diagnosis	58.3 (40.0–89.0)		1.00	0.03	-0.33*
3. Perceived availability of social support	4.5 (1.4–5.0)			1.00	-0.08
4. Surgical side effects	1.69 (1.0–4.6)				1.00

* $P < 0.0001$

Table 3

Multivariable stepwise linear regression analyses of factors associated with fear of cancer recurrence in 506 women with early-stage breast cancer

	Model 1 ^d		Model 2 ^b		Model 3 ^c	
	Standardized β	P	Standardized β	P	Standardized β	P
Age at diagnosis	-0.25	<0.0001	-0.26	<0.0001	-0.21	<0.0001
Education						
High school or less	Reference		-		-	
More than high school	-0.09	0.02				
Cancer stage						
DCIS	Reference		Reference		Reference	
I	0.04	0.44	0.05	0.29	0.04	0.33
IIA	0.14	<0.01	0.14	<0.01	0.11	0.01
Type of surgery						
Mastectomy	-		Reference		Reference	
Breast-conserving surgery			0.09	0.04	0.11	<0.01
Side effects of breast surgery			0.22	<0.0001	0.24	<0.01
Social support	-0.11	<0.01	-0.13	<0.01	-0.12	<0.01
Elevated anxiety (BAI@ \geq 10 in the past week)	0.16	<0.001	0.15	<0.01	0.15	<0.01
Elevated depressive symptoms (CES-D \geq 16 in the past week)	0.14	<0.01	-		-	
Accuracy of perceived risk of recurrence						
Accurate	Reference		Reference		Reference	
Underestimated	-0.10	0.08	-0.11	0.06	-0.13	0.01
Overestimated	0.08	0.13	0.06	0.31	0.14	<0.01
Uncertain	-0.01	0.81	0.00	0.93	0.02	0.59
Adjusted R ²	0.25		0.27		0.32	

^aThe stepwise linear regression analysis included time-independent variables (age at diagnosis, race, education, marital status, family history of breast cancer among first-degree relatives, cancer stage, and type of breast surgery), time-varying variables (including surgical side effects, comorbidity, chemotherapy, radiation therapy, and adjuvant hormonal therapy, social support, elevated anxiety, and elevated depressive symptoms) that were measured at the baseline (4–6 weeks after definitive surgery) interview, and accuracy of perceived risk of recurrence evaluated at the 6-month follow-up interview

^bThe analysis was similar as Model 1 except time-varying variables were measured at the 6-month follow-up interview

^cThe analysis was similar as Model 1 except time-varying variables were measured at the 2-year follow-up interview

^dThe variable was not retained in the final model