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Age-related longitudinal changes in depressive symptoms following breast cancer diagnosis and treatment

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Abstract

Younger women being treated for breast cancer consistently show greater depression shortly after diagnosis than older women. In this longitudinal study, we examine whether these age differences persist over the first 26 months following diagnosis and identify factors related to change in depressive symptoms. A total of 653 women within 8 months of a first time breast cancer diagnosis completed questionnaires at baseline and three additional timepoints (6, 12, and 18 months after baseline) on contextual/patient characteristics, symptoms, and psychosocial variables. Chart reviews provided cancer and treatment-related data. The primary outcome was depressive symptomatology assessed by the Beck Depression Inventory. Among women younger than age 65, depressive symptoms were highest soon after diagnosis and significantly decreased over time. Depressive symptoms remained stable and low for women aged 65 and older. Age was no longer significantly related to depressive symptoms in multivariable analyses controlling for a wide range of covariates. The primary factors related to levels of and declines in depressive symptomatology were the ability to pay for basics; completing chemotherapy with doxorubicin; and decreases in pain, vasomotor symptoms, illness intrusiveness, and passive coping. Increased sense of meaning/peace and social support were related to decreased depression. Interventions to

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reduce symptoms and illness intrusiveness, improve a sense of meaning and peace, and increase social support, may help reduce depression and such interventions may be especially relevant for younger women.

Keywords

Breast; Cancer; Depression; Survivors; Longitudinal; Aging

Introduction

In 2012, an estimated 226,870 women will be diagnosed with breast cancer, the most common cancer among US women [1]. Depression is a particularly common affective disorder among cancer patients, has a major impact on quality of life, and impacts treatment adherence [2-5]. Prevalence estimates of persistent depressive symptoms in breast cancer patients range from 12 to 25 % [6, 7]. As with general psychological distress, younger age consistently has been shown to be associated with increased depression risk [8-14]. We previously reported results suggesting this age-related difference in depressive symptomatology can be explained largely by the intrusion of cancer and its treatment on specific areas of a woman's life, but also by higher prevalence of pain, chemotherapy with doxorubicin, and passive coping, and lower levels of sense of peace, among younger women [8].

The majority of studies on cancer and depression focus on the first year following a cancer diagnosis when risk of depression is greatest [6, 14-24], although several cross-sectional studies have included cancer survivors further from diagnosis [9, 10, 12]. A few longitudinal studies have examined change in depression in the early years after diagnosis [7, 25-29], but these studies either have a restricted age range (e.g., under 40 [25], under 60 years of age [7], or over 65 years of age [27]), or do not address whether age-associated differences in depression worsen or lessen over time [26, 28, 29].

For example, Burgess et al. [7] conducted a study of women aged 60 and under who were newly diagnosed with breast cancer and followed for 5 years. In adjusted analyses, they found that age was related to depression only at 2–5 years post diagnosis. Another study of breast cancer survivors found that an increase in meaning/peace over 6 months predicted a decline in depressive symptoms [28], but they did not consider age. In a study of older cancer patients (over age 65) newly diagnosed with breast, colon, lung, or prostate cancer and followed for 1 year, Stommel et al. [24] found that higher education and improvement in physical functioning were related to decreased depressive symptoms, while female gender, history of emotional problems, and greater severity of physical symptoms were associated with increased depressive symptoms. Treatment variables did not have a direct effect on depressive symptomatology.

Although these studies provide some insight into factors associated with declines in depression over time, they do not address the specific question of whether younger women continue to have greater depressive symptoms in the early years after diagnosis and what factors can help explain changes in depressive symptoms over time. An understanding of this time course is particularly relevant as women transition from active treatment to survivorship. This transition has been identified as a time when distress is likely to occur [30], and is thus relevant to timing of interventions.

The present analysis reports on longitudinal depression data collected over the course of 26 months post breast cancer diagnosis. This article builds on our previous report of baseline

data from this cohort that sought to explain why younger women report greater levels of depression than older women [8]. The present analyses address the questions of whether previously found age-associated differences in depression persist over 26 months and what baseline and time-varying factors are associated with age-related changes in depression.

Patients and methods

Setting and population

This observational study was conducted among women aged 25 years and older who were newly diagnosed with stage I, II, or III breast cancer. Recruitment was conducted at Memorial Sloan Kettering Cancer Center and the University of Texas–Southwestern Center for Breast Care from 2002 to 2006. Women were recruited through hospital clinics and advertisements and initially screened by chart review or telephone for eligibility. Eligibility criteria included first time breast cancer diagnosis stage I–III, completion of baseline survey within 8 months of diagnosis, at least 18 years of age (although no one in the study was younger than age 25), and ability to read and understand English. Eligible women were mailed a baseline questionnaire to complete and return to the Coordinating Center at Wake Forest University. Follow-up questionnaires were administered 6, 12, and 18 months post completion of the baseline questionnaire. Because the baseline questionnaire was administered to women at differing lengths of time following diagnosis, we used the dates of completion of each survey along with the date of diagnosis to create a continuous variable of time since diagnosis (in months). Our time of follow-up thus ranges from 0 months (3 days) after diagnosis to 26 months.

All sites obtained approval from their Institutional Review Boards.

Primary outcome

The primary outcome was *depressive symptomatology* as measured by the Beck Depression Inventory (BDI) version BDI-1A [31], a 21-item scale used to assess depressive symptomatology/general distress. The BDI ranges from a possible low of 0 to a possible high of 84, with a score of 10 and above considered indicative of depression warranting clinical attention [32]. We treated BDI as a continuous variable.

Independent variables

Age categories were adapted from Rowland [33] a priori as follows: 25–44, 45–54, 55–64, 65–74, and ≥75, to allow us to examine the impact of cancer on women at various developmental stages. Age group was included in the model as four categorical (nominal) variables; thus no assumption about a monotonic association between age and BDI score was made.

Time since diagnosis (in months) was included in our model as a continuous variable. (We computed time since diagnosis by subtracting the date of diagnosis from survey completion date.) We also included a quadratic term for time (time squared) in addition to its linear component to allow for expression of nonlinear, and potentially non-monotonic, patterns of change in BDI score. To capture the full interaction of age group with time, we included in our model the eight parameters representing the combination of the interaction of age group with time and of age group with time squared. We selected further independent variables for inclusion in analyses if they were previously found to help explain the effect of age in our baseline analyses (e.g., pain, illness intrusiveness, low social support) [8] or in the literature (minority status [16], financial strain [27, 34], education [24], and children living at home [6]). Independent variables were organized according to a biopsychosocial framework: contextual/patient characteristics, cancer-related factors, and psychosocial factors.

Contextual/patient characteristics—We included race (non-Hispanic white/other), marital/partner status (yes/no), education level (some college or less vs. college graduate), presence of children under age 18 in the home (yes/no), and difficulty paying for basic necessities (very hard, somewhat hard, not hard at all). This latter variable was included in the model as two nominal categorical variables, so again no monotonic ordering assumption was imposed. All of the above sociodemographic variables were considered to be constant (time-stable) in analyses.

Cancer-related variables—A comprehensive medical chart review was performed by clinical staff 1 year after baseline or when primary treatment was completed in order to include all surgeries and treatments related to breast cancer diagnosis during the first year. In addition to time since diagnosis, cancer stage at diagnosis (I, II, or III, included as categorical variables), surgery type (lumpectomy only vs. mastectomy with or without prior lumpectomy), chemotherapy regimen (regimen with doxorubicin, regimen without doxorubicin, and no chemotherapy, included as categorical variables), and radiation therapy (yes/no) were included. Women could either start or complete radiation or chemotherapy, or particularly for chemotherapy (which has a longer duration than radiation in most cases) remain the same in terms of therapy status at different time points. When evaluating the effect of chemotherapy on BDI score, we took into account receipt of doxorubicin because it is a foundational component of aggressive anthracycline chemotherapy regimens, which have been associated with particularly high toxicities and negative side effects [35]. Further, our baseline analyses found that the only chemotherapy associated with increased risk of depressive symptoms was that which included doxorubicin.

Two symptom variables previously found associated with depressive symptomatology were included in analyses: severity of vasomotor symptoms (measured on a four-point ordinal scale ranging from none to severe, as used in the Women's Health Initiative [36]) and physical pain, measured on a six-point ordinal scale from the SF-36 [37]. Each of these symptom covariates was treated as an ordinal variable in the model, were measured on all surveys, and were time-varying (i.e., they could take on different values on the different surveys).

Psychosocial variables—*Spirituality* was measured by the Functional Assessment of Chronic Illness Therapy-Spiritual Well-Being (FACIT-Sp) scale [38]. This 12-item scale has two subscales: meaning and peacefulness in one's life and the role of faith. Domain scores are the sum of the items (eight items in meaning and peacefulness—scores range from 0 to 32; coefficient alpha = .81); four items in role of faith—scores range from 0 to 16; coefficient alpha = .88) in each domain. Higher scores indicate a greater degree of the construct. The *Illness Intrusiveness Scale* assessed the degree to which breast cancer diagnosis and treatment-affected thirteen life areas: health, diet, paid work, active recreation, passive recreation, financial situation, relationship with spouse, sex life, family relations, other social relations, self-expression, religious expression, and community [39]. We added three items to the standard scale that especially impact younger women: family responsibilities, social activities, and work around the house. For each item, respondents rated the degree that their illness had an impact on that area, based on a seven-point scale, ranging from 1 (not very much) to 7 (very much). The overall illness intrusiveness score was calculated as the sum of the scores for the 16 items (Cronbach's alpha = .93). Scores range from 16 to 112, with a higher score indicating greater intrusiveness.

Coping was assessed with the 28-item Brief COPE scale [40] which measures fourteen types of coping responses. Participants rated the extent to which each response was used in dealing with stresses associated with their cancer diagnosis and treatment. A second-order factor analysis on our data, as recommended by Carver [40], revealed two domains

comprised of eleven of the measure's subscales: active or adaptive coping (e.g., active coping, emotional support, instrumental support, and positive reframing) and passive coping (self-blame, denial, and behavioral disengagement). Overall scores were calculated as the mean for each domain. Scores for adaptive coping and for passive coping both ranged from 1 to 4, with higher scores indicating a greater demonstration of the nominal coping style. In our data, Cronbach's alpha for the eight items making up the active coping scale is .79, while Cronbach's alpha for the 3 items of the passive coping scale is .51.

Social Support was assessed by the RAND Social Support Scale [41] which contains 19 items measuring four aspects of support: emotional support, tangible support, affection, and social interaction. The social support score is the average of the 19 items and ranges from 1 to 5 (coefficient alpha = .97).

All psychosocial covariates were treated as continuous variables in the model, were assessed on all surveys, and were time-varying.

Statistical analyses

We conducted analyses using PROC MIXED in SAS (version 9.2) to model-repeated measures of BDI (measured at the four time points) as a function of age group, time since diagnosis, and both time-stable and time-varying covariates of interest. We included each time-varying covariate in the model using two separate variables, one of which denoted the baseline level of the covariate and the other which denoted the change from baseline in the covariate at each time. Such coding of time-varying covariates allows for easier recognition of predictors of average level of and change in levels of the outcome measure: baseline values of the time-varying covariates (as well as values of the time-stable covariates) can be interpreted as predictors of average levels of BDI across women, while the "change" values for the time-varying covariates can be interpreted as predictors of change in BDI over time within women. Convergence criteria were met for all regression models run.

Results

Sample characteristics

A total of 740 surveys were mailed out to women deemed eligible from chart reviews or telephone screening; 653 of these women completed baseline surveys and were determined eligible for an initial response rate of 88 %. The age distribution at the baseline survey was as follows: 25–44 years (N = 132), 45–54 years (N = 209), 55–64 years (N = 167), 65–74 years (N = 102), and 75+ (N = 43). Of the 653 women at baseline, 571 remained in the study at the 18 month follow-up (87.4 %) and 544 (83.3 %) completed all four surveys.

Table 1 shows characteristics of the sample at baseline and as measured through the medical chart review, stratified by age group. Over half of the sample (52 %) was under age 55 years when diagnosed. Younger age was significantly related to being married or partnered, having children under age 18 at home, and college education. There were significant differences in stage at diagnosis across the age groups, with younger women more likely to be diagnosed with stage II or III disease than older women. Women under age 55 were more likely to have a mastectomy, either with or without prior lumpectomy, than older women (only one woman out of the 653 reported no surgery of any kind). Younger women were far more likely to receive any chemotherapy, and in particular chemotherapy with doxorubicin, than older women.

There were significant differences by age in all of the baseline psychosocial variables (with the exception of passive coping), including the outcome variable of BDI. For the spirituality variables, illness intrusiveness, and BDI, younger women had scores reflecting worse

psychosocial states than the older women. Older women reported less social support and active coping.

The average time between diagnosis and administration of the baseline survey across all the women in the sample was 4.5 months (SD = 1.3 months; median = 4.8 months; range = 3 days to 7.4 months).

Depressive symptoms over time

Figure 1 shows estimated mean BDI scores at selected times since diagnosis (in months), according to age category. These means are unadjusted for other covariates. There was a significant time by age group interaction ($p = .002$). Although mean BDI scores for the two oldest age groups were remarkably stable over time, the three youngest groups (25–44, 45–54, and 55–64) showed significant decreases over time in BDI value ($p < .01$ for each of these age groups). These results suggest that depressive symptoms significantly decrease for younger women after the first year of diagnosis, yet still remain slightly higher than for older women and remain near the BDI cut-point of 10 for mild depression.

Factors related to change in depressive symptoms over time

Our next set of analyses sought to address the questions of whether age-related changes in depression over time persist after controlling for a wide range of covariates and what factors contribute to changes in depression. Results from our full model adjusting for covariates are displayed in Table 2. In this model, there were no longer significant differences in depressive symptomatology by age group over time. Significant predictors of *average level of BDI score* included the ability to pay for basics ($p = .0002$), and baseline levels of chemotherapy regimen ($p = .04$), pain ($p < .0001$) and vasomotor symptoms ($p = .01$). Three of the psychosocial covariates at baseline (spirituality—meaning/peace, illness intrusiveness, passive coping) were significant predictors of BDI score ($p \leq .0001$).

Significant predictors of *change in BDI score* over time included change in chemotherapy status ($p < .0005$ for overall effect), with completion of chemotherapy with doxorubicin leading to a predicted decline in BDI score, and the start of chemotherapy leading to predicted increases in BDI score. Changes in physical pain ($p = .02$) and in vasomotor symptoms ($p = .01$) were significant predictors of change in BDI score; declines in these symptom scores led to significant declines in depressive symptoms. Similarly, a significant change in BDI score was predicted by change (in the same direction) in illness intrusiveness ($p < .0001$) and passive coping ($p < .0001$). Increases in meaning/peace ($p < .0001$) and social support ($p = .005$) were significant predictors of decline in depressive symptoms.

Discussion

Over the 26 month period following breast cancer diagnosis, our data show that depressive symptomatology as measured by the BDI, is generally low and stable for women over age 65, and decreases slightly for women aged 55–64. While initially high for women aged 24–54, BDI scores greatly decrease, but still remain higher, on average, than for older women up to 26 months after diagnosis. The decrease observed among younger women occurs mostly in the first year following diagnosis with minimal decline thereafter.

In our subsequent modeling, we sought to understand whether these age differences remained after controlling for a wide range of covariates and to identify factors that might explain these age differences. Adjustment for covariates that were associated with age at diagnosis and that were themselves significant independent predictors of depressive symptoms rendered the age × time effect statistically nonsignificant. Consistent with our

previous baseline manuscript [8], trouble paying for basics, chemotherapy with doxorubicin, and greater symptom levels, lower sense of meaning and peace, greater illness intrusiveness, and greater use of passive coping at baseline were related to depressive symptoms.

The addition of our time varying variables showed that completion of chemotherapy with doxorubicin and declines in pain and vasomotor symptoms were associated with decreased depressive symptoms. Completion of chemotherapy without doxorubicin was not associated with change in depressive symptoms, highlighting the more significant side effects of doxorubicin.

Changes in the psychosocial variables were also related to changes in depressive symptoms. Increases in sense of meaning and peace and in social support were associated with decreased depressive symptoms. Yanez et al. [28] also found that women who showed an increased sense of meaning and peace had decreased depression over 6 months following treatment for breast cancer. Although others have shown in longitudinal studies that social support from family and friends is associated with better emotional health [7, 25, 27], this study provides evidence that *increased* social support over time is also related to decreased depressive symptoms. Consistent with Low [29], we also found that passive coping was associated with depressive symptoms, but adding to the literature, we also found that within-individual increases in passive coping were related to increased depressive symptoms. Within-person decline in illness intrusiveness also predicted significant decline in depressive symptoms. These results suggest specific areas of intervention focus that could potentially lead to reduced depression.

This study has several limitations. The Beck Depression Inventory is a self-report measure of depressive symptomatology and is not a measure of clinical depression. Although characteristic of many samples of breast cancer patients, this sample is relatively homogeneous (mostly white and educated) which limits the generalizability of our findings. Another limitation is that women were only followed up to approximately 26 months post diagnosis. Although the greatest decline in depressive symptoms is shown to occur within the first year after diagnosis and these data cover the time period that women transition from active treatment to survivorship, additional follow-up would provide data on a longer-time trajectory. Finally, these are data from an observational study and it is not possible to draw definitive conclusions regarding direction of causality for some associations (e.g., pain and depression). For such associations, causality may even be bi-directional.

Women completed the first survey up to 8 months post diagnosis, meaning there was no constant baseline with respect to date of diagnosis. However, by using months since diagnosis rather than survey as our marker of time, we were able to analyze the data using an appropriate common time metric.

Strengths of this study include the large sample size and repeated measures of depressive symptoms and a wide range of predictors collected longitudinally over a 26 month period following diagnosis. This length of follow-up enabled us to capture time following end of treatment. Despite finding that age was not independently related to change in depression over time in our adjusted analyses, this result does not mean age is unimportant. In the “real world,” younger women are indeed more likely to present with depression following breast cancer diagnosis than older women, because they are more likely to present with factors (illness intrusiveness, chemotherapy with doxorubicin, pain) that are highly significant independent predictors of depression. Our full model, where age differences over time are rendered (statistically) non-significant, sheds light on why the commonly-found age-depression relation exists. Such understanding may suggest potential avenues for intervention/focus for all women who present, after a breast cancer diagnosis, with factors

highly predictive of depression. Young women will be more likely to fall into such a category.

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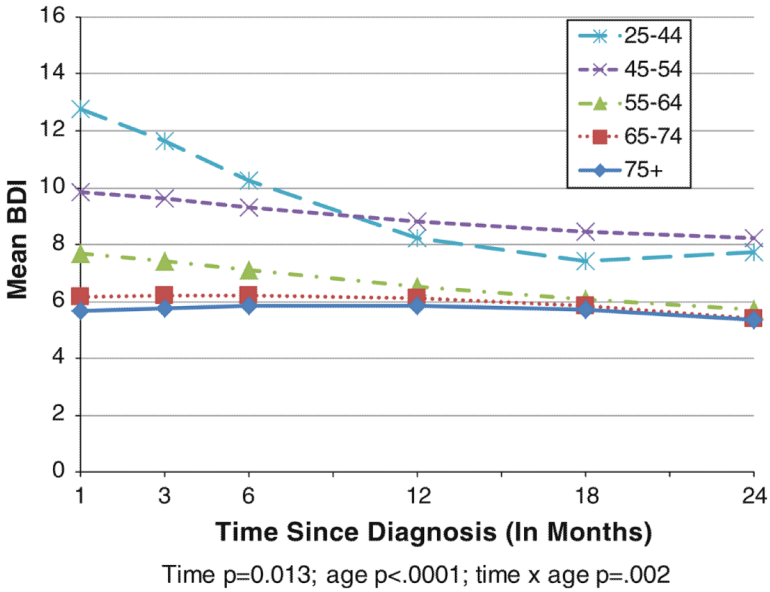

Fig. 1.
Mean BDI score by age group and time since diagnosis

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Table 1

Sample characteristics by age group

Characteristic	Age category										*p* [a]
	25–44 (*n* = 132)		45–54 (*n* = 209)		55–64 (*n* = 167)		65–74 (*n* = 102)		75+ (*n* = 43)		
	No. Mean	Col % SD	No. Mean	Col % SD	No. Mean	Col % SD	No. Mean	Col % SD	No. Mean	Col % SD	
Sociodemographics/patient characteristics											
Non-hispanic white race	116	87.9	189	90.4	143	85.6	95	93.1	42	97.7	0.100
Married/partnered	92	69.7	165	79.0	118	70.7	71	69.6	22	51.2	0.005
Children under age 18 in home	82	62.1	82	39.2	7	4.2	0	0	0	0	<0.0001
Ability to pay for basics											0.12
Very hard	9	6.8	5	2.4	4	2.4	3	2.9	0	0	
Somewhat hard	21	15.9	35	16.8	30	18.0	10	9.8	4	9.3	
Not hard	102	77.3	169	80.9	133	79.6	89	87.3	39	90.7	
Education ≥ college grad	99	75.0	138	66.0	104	62.3	49	48.0	19	44.2	<0.0001
Cancer-related variables											
Stage of disease											0.0002
I	45	34.1	108	51.7	91	54.5	62	60.8	32	74.4	
II	73	55.3	84	40.2	63	37.7	34	33.3	8	18.6	
III	14	10.6	17	8.1	13	7.8	6	5.9	3	7.0	
Mastectomy—yes[b]	75	56.8	88	42.1	42	25.2	27	26.5	9	20.9	<0.0001
Radiation—yes[b]	86	65.2	146	69.9	138	82.6	77	75.5	25	58.1	0.001
Chemotherapy[b]											<.0001
No chemotherapy	19	14.4	58	27.8	57	34.1	55	53.9	36	83.7	
Chemotherapy w/doxorubicin	99	75.0	116	55.5	78	46.7	25	24.5	2	4.7	
Chemotherapy no doxorubicin	14	10.6	35	16.8	32	19.2	22	21.6	5	11.6	
Means and standard deviations											
BDI	11.2	6.9	9.4	6.6	7.3	6.3	6.2	6.5	5.5	5.4	<0.0001
Vasomotor symptoms	1.0	1.0	1.2	1.0	1.0	1.0	0.7	0.8	0.3	0.7	<0.0001
Pain symptoms	1.7	1.0	1.3	1.0	1.3	0.9	1.1	0.9	1.1	0.9	0.0002
Spirituality											

Characteristic	Age category										*p* [a]
	25–44 (*n* = 132)		45–54 (*n* = 209)		55–64 (*n* = 167)		65–74 (*n* = 102)		75+ (*n* = 43)		
	No. Mean	Col % SD	No. Mean	Col % SD	No. Mean	Col % SD	No. Mean	Col % SD	No. Mean	Col % SD	
Role of faith	8.8	5.0	9.6	5.1	10.3	4.9	11.0	4.3	8.6	4.5	0.003
Meaning and peace	22.0	5.8	23.3	6.3	24.9	6.2	25.1	5.9	23.8	5.6	<.0001
Active coping	2.7	0.4	2.7	0.5	2.6	0.6	2.3	0.6	2.0	0.7	<0.0001
Passive coping	1.4	0.4	1.3	0.4	1.3	0.4	1.3	0.4	1.3	0.4	0.09
Social support	4.3	0.7	4.4	0.7	4.4	0.6	4.2	0.8	4.1	0.8	0.03
Illness intrusiveness	54.6	20.0	47.1	21.0	40.4	19.5	31.9	17.3	25.7	13.3	<0.0001

[a] *p* Value for differences by age group

[b] At any time following diagnosis

Table 2

Results of full model predicting BDI over time

Variable	Parameter estimate	SE	*p* Value
Time[a]			0.58
Time	−0.17	0.10	
Time × time	0.005	0.004	
Age group			0.72
75+	−0.85	1.26	
65–74	−0.69	0.99	
55–64	−1.16	0.84	
45–54	−0.84	0.76	
20–44	Reference		
Time × age group[b]			0.23
Time × age group			
Time × time × age group			
Sociodemographics/patient characteristics			
Paying for basics			0.0002
Very hard to pay	2.85	0.74	0.0001
Somewhat hard to pay	−0.25	0.37	0.50
Not hard to pay	Reference		
Married/partnered	0.14	0.30	0.64
White race	−0.55	0.44	0.21
College at least graduate	−0.01	0.27	0.96
Children under age 18 at home	0.10	0.34	0.75
Cancer-related			
Cancer stage			0.21
I	−0.22	0.48	
II	−0.62	0.46	
III	Reference		
Mastectomy	0.008	0.26	0.98
Time-varying covariates–baseline levels			
Baseline chemotherapy			0.04
Chemotherapy with doxorubicin	0.98	0.38	0.01
Chemotherapy w/o doxorubicin	0.22	0.46	0.63
No chemotherapy	Reference		
Radiation	1.38	0.80	0.08
Symptoms			
Pain	0.76	0.16	<0.0001
Vasomotor	0.35	0.14	0.01
Psychosocial			
Spirituality			

Variable	Parameter estimate	SE	*p* Value
Meaning and peace	−0.41	0.03	<0.0001
Role of faith	−0.003	0.03	0.91
Social support	−0.18	0.20	0.37
Active coping	0.04	0.25	0.88
Passive coping	3.55	0.36	<0.0001
Illness intrusiveness	0.11	0.008	<0.0001
Time-varying covariates–change			
Change in chemotherapy			0.0005
Start chemotherapy with doxorubicin	1.84	0.88	0.04
Start chemotherapy w/o doxorubicin	3.14	1.68	0.06
Stop chemotherapy w/ doxorubicin	−1.07	0.33	0.001
Stop chemotherapy w/o doxorubicin	0.26	0.43	0.55
No change in chemotherapy status	Reference		
Change in radiation	−0.24	0.50	0.63
Change in symptoms			
Pain	0.25	0.10	0.02
Vasomotor	0.27	0.10	0.01
Change in psychosocial			
Spirituality			
Meaning and peace	−0.39	0.02	<0.0001
Role of faith	−0.05	0.03	0.10
Social support	−0.50	0.18	0.005
Active coping	−0.07	0.18	0.68
Passive coping	2.37	0.28	<0.0001
Illness intrusiveness	0.10	0.007	<0.0001

[a] Due to presence of age group × time interaction, parameter estimates for time pertain to reference age group (20–44), and parameter estimates for age groups pertain to time = 0

[b] Age group × time interaction is captured by 8 parameter estimates not presented in table