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Trajectories of Illness Intrusiveness Domains Following a Diagnosis of Breast Cancer

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Abstract

Objective—To identify trajectories of illness intrusiveness over the first two years following a breast cancer diagnosis and describe associated patient and treatment characteristics. Illness intrusiveness, or how much an illness disrupts life domains, has been shown to be highly related to quality of life.

Methods—Women recruited within 8 months of a breast cancer diagnosis (n=653) completed questionnaires at baseline and 6, 12, and 18 months post baseline. Group-based trajectory modeling was used to identify trajectories in three established domains of illness intrusiveness: instrumental, intimacy, and relationships and personal development. Bivariate analyses identified contextual, disease/treatment, psychological and social characteristics of women in trajectory groups.

Results—Forty-one percent of women fell into a trajectory of consistently low illness intrusiveness (Low) across all three domains. Other women varied such that some reported illness intrusiveness that decreased over time on at least one domain (9-34%), and others reported consistently high intrusiveness on at least one domain (11-17%). A fourth trajectory of increased illness intrusiveness emerged in the relationship and personal development domain (9%). Characteristics of women in the Low group were older, less likely to have children at home, stage I cancer, fewer symptoms, and better psychosocial status.

Conclusions—Women experienced different patterns of illness intrusiveness in the first two years following a diagnosis of breast cancer with a high percentage reporting Low intrusiveness. However, women differentially followed the other trajectory patterns by domain, suggesting that the impact of breast cancer on some women's lives may be specific to certain areas.

Keywords

breast cancer; quality of life; illness intrusiveness; trajectories

Breast cancer is the most common cancer diagnosed in women, excluding cancers of the skin, with an estimated 226,870 new diagnoses in the United States in 2012 (Howlader et al.,

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Cross-sectional analyses of the baseline data for the same participants are also submitted as a unique manuscript (Avis et al., 2012).

2012). Medical advances in the detection and treatment of breast cancer have increased the five-year survival rate to 89% (Howlader et al., 2012). Despite these improvements, women treated for breast cancer often experience treatment side effects such as fatigue, depression and insomnia that are particularly acute in the first few months following a diagnosis, but have been documented to also last for years in a substantial minority of women (Bower, 2008). These side effects can impact women's lives through changes in their ability to function in daily activities such as work (Tiedtke, de Rijk A., Dierckx de Casterle, Christiaens, & Donceel, 2010), relationships with others, or caring for themselves (Campbell et al., 2012). However, there is considerable individual variation in symptoms and the impact of breast cancer on a woman's quality of life (Berger, Lockhart, & Agrawal, 2009; Helgeson, Snyder, & Seltman, 2004; Henselmans et al., 2010).

Illness intrusiveness, or how much a chronic illness disrupts important life domains, is an important concept in explaining why the same diagnosis and treatment leads to varied quality of life outcomes (e.g., symptoms, depression, physical function) in different women (Devins, 2010; Bloom, Stewart, Johnston, & Banks, 1998; Li et al., 2011). The association between illness intrusiveness and these outcomes is evident in multiple chronic illness populations (Devins, 2010), including women diagnosed with breast cancer (Li et al., 2011; Bloom et al., 1998). In fact, depression was more strongly associated with illness intrusiveness than *any* other contextual, disease/treatment, psychological or social variable in the present data (Avis et al., under review).

Treatment factors are a major contributor to illness intrusiveness in women recently diagnosed with breast cancer (Devins, Bezjak, Mah, Loblaw, & Gotowiec, 2006). Treatments for these women vary (e.g., surgery, chemotherapy, radiation) and thus require different time commitments and result in different side effects (Bower, 2008; Ganz, Kwan, Stanton, Bower, & Belin, 2011). Thus, such individual differences are expected to lead to variability in how much a diagnosis of breast cancer will be intrusive to a woman's life. Indeed, treatment factors and resultant symptoms have significantly explained some of the variance in illness intrusiveness in a cross-sectional study (e.g., Bloom et al., 1998). However, the impact of treatment factors is likely to change over time due to the completion or initiation of new treatments. Longitudinal studies of other chronic illnesses found that illness intrusiveness changed along with changes in treatment (Devins et al., 1990), and that illness intrusiveness mediates the association between disease/treatment factors and quality of life (Bettazzoni, Zipursky, Friedland, & Devins, 2008). In addition, factors such as current work status, family responsibilities, and individual psychological and social resources may also differ between women and impact illness intrusiveness (Bloom et al., 1998; Stanton, Revenson, & Tennen, 2007). Yet, no published study has followed the progression of illness intrusiveness over time in a sample of cancer survivors.

The Illness Intrusiveness Ratings Scale (IIRS) allows for the specification of illness intrusiveness in three life domains: (1) instrumental, (2) intimacy, and (3) relationships and personal development (subsequently referred to as "relationship"). Recent research suggests that interventions should screen for and target these domains (rather than total IIRS score) to optimally improve quality of life (Mah, Bezjak, Loblaw, Gotowiec, & Devins, 2010). Although previous cross-sectional studies have explored these domains (Mah et al., 2010; Mah, Bezjak, Loblaw, Gotowiec, & Devins, 2011), no study has assessed illness intrusiveness domains in cancer survivors over time.

The theoretical framework of illness intrusiveness incorporates contextual, psychological, and social factors as moderators of both how treatment factors influence illness intrusiveness and how illness intrusiveness impacts quality of life (Devins, 2010). The only published study that explored the association of these factors with illness intrusiveness in a breast

cancer sample found that White race, severity of illness, lower perceived attractiveness (i.e., body image), symptom stress, bodily pain, lower physical functioning, and lower general health were related to greater illness intrusiveness (Bloom et al., 1998). Psychological and social resources (i.e., self-esteem; emotional support) did not directly influence illness intrusiveness. However, this study only included women under age 50 and was cross-sectional. Another study found that contextual factors (e.g., younger age, higher level of education) were also associated with higher illness intrusiveness in a heterogeneous cancer population of breast, gastrointestinal, head and neck, lung, lymphoma, prostate cancer (Devins et al., 2006). However, analyses were cross-sectional and only investigated total illness intrusiveness score. The study design did not examine patterns of illness intrusiveness over time or by domain. Research that further elucidates which contextual, disease/treatment, psychological and social factors experienced by women of all ages with breast cancer are associated with patterns of change in each domain of illness intrusiveness may help identify characteristics of women and areas of life of particular importance to target with interventions. Psychological and social factors that are associated with illness intrusiveness are especially lacking. Optimism, spirituality, and social support are consistently found to have protective effects on factors related to adjustment to an illness (i.e., anxiety, depression, pain) (Stanton, et al., 2007; Seeman, et al., 2003) and have yet to be explored in relation to illness intrusiveness in breast cancer survivors.

Illness intrusiveness has been identified as an important correlate of depression in women recently diagnosed with breast cancer (Avis, under review). The current analysis builds upon this finding by investigating patterns of change in illness intrusiveness over time and individual differences in these patterns with two objectives. The first objective was to identify an exploratory number of distinct trajectories of each illness intrusiveness domain (i.e., instrumental, intimacy, relationship) over the first two years following a breast cancer diagnosis and to determine whether the number and pattern of the trajectories that emerged within women were consistent across all three domains. Trajectory analysis allows for discovery of heterogeneity in trends over time and thus can provide more detailed and useful information than analyses of group means over time. The second objective was to identify contextual, disease/treatment, psychological and social characteristics (assessed at baseline or in the retrospective medical chart review) differentially associated with each trajectory. The second hypothesis stated that the direction of associations with contextual factors would be consistent with those found in previous cross-sectional studies discussed (Bloom et al., 1998; Devins et al., 2006) such that younger age, White race, lower income, higher education, increased severity of illness, more symptoms, lower perceived attractiveness and lower scores on psychologically protective factors (i.e., spirituality, social support, optimism) would be generally associated with higher illness intrusiveness. However, these factors might vary by domain. The present analyses address gaps in previous cross-sectional research on illness intrusiveness in women diagnosed with breast cancer that focused on younger women. Longitudinal trajectory analysis can help identify characteristics of women who may report prolonged illness intrusiveness and benefit from additional support or targeted interventions.

Method

Participants and Procedure

Women newly diagnosed with stage I, II, or III breast cancer who were at least 25 years of age were recruited within 8 months of diagnosis through clinics at Memorial Sloan Kettering Cancer Center and the University of Texas - Southwestern Center for Breast Care and advertisements. They were initially screened by chart review or telephone for eligibility from April 2003-February 2006 as part of a larger study investigating mechanisms to explain age associated differences in quality of life among breast cancer patients (Avis et al.,

under review). Consent was obtained by telephone and self-reported data were collected by the Coordinating Center at Wake Forest School of Medicine at four time points following diagnosis (baseline and 6, 12, and 18 months after baseline), with the final measurement occurring between 18 and 24 months post-diagnosis. The protocol was approved by the Human Subjects Internal Review Boards at all sites.

Measures

Primary Outcome—The primary outcome, *Illness Intrusiveness*, was assessed with the Illness Intrusiveness Ratings Scale (IIRS; Devins et al., 1983; Devins, 2010). The IIRS asked participants about how much the diagnosis of breast cancer and its treatment affected 13 life areas. For each item, respondents rated the degree of impact on that area, based on a 7 point scale (1 = *not very much* to 7 = *very much*). If an item was not applicable, participants were instructed to select 1. The IIRS was analyzed as three domains as established in previous studies and validated in cancer populations (Devins et al., 2006; Mah et al., 2011): *instrumental* (health, paid work, active recreation, financial situation; $\alpha = 0.74$); *intimacy* (relationship with spouse, sex life; $\alpha = 0.76$); and *relationships and personal development* (family relations, other social relations, self-expression/self-improvement, religious expression, community and civic involvement, passive recreation; $\alpha = 0.84$). One item on diet is included only in the total score. Domains are reported as mean scores.

Contextual Factors—The following contextual factors obtained at baseline were included in analyses: age at diagnosis (continuous variable), race (White/non-White), married/partnered (yes/no), education (college graduate/not a college graduate), currently employed full or part time (yes/no), presence of children under age 18 in the home (yes/no), and ability to pay for basics (1 = very hard, 2 = somewhat hard, 3 = not very hard).

Disease/Treatment Factors—Disease/treatment factors were abstracted from a comprehensive medical chart review performed by clinical staff on all enrolled participants one year after baseline or after completion of all primary treatment. The following variables were included in study analyses: breast cancer stage at diagnosis (I, II, or III), mastectomy within the first year (versus lumpectomy only), chemotherapy (yes/no), and radiotherapy (yes/no). The following self-reported symptoms were asked at each survey time point: severity of vasomotor symptoms in past month (4-point ordinal scale, with 0 = *no symptoms* to 3 = *severe symptoms*), severity of fatigue in past month (same 4-point ordinal scale), and severity of bodily pain in past month (6-point ordinal scale, with 0 = *no pain* to 5 = *very severe pain*).

Psychological and Social Factors—*Spirituality* was assessed with the Functional Assessment of Chronic Illness Therapy-Spiritual Well-Being (FACIT-Sp), a 12-item scale analyzed and validated with three factors (meaning $\alpha = 0.82$; peace $\alpha = 0.86$; role of faith $\alpha = 0.88$) in a sample of female cancer survivors (Peterman, Fitchett, Brady, Hernandez, & Cella, 2002; Canada, Murphy, Fitchett, Peterman, & Schover, 2008). Each of these factors ranged from 0 to 16. *Perceived attractiveness* was assessed with three items based on the Lasry Body Image Scale developed in women undergoing breast cancer-related surgery (Lasry et al., 1987). These items assessed how a woman perceives her general attractiveness (e.g., I am attractive to others; $\alpha = 0.54$). Scores range from a 3 to 15. *Optimism* was assessed with the 8-item version of the Life Orientation Test (LOT) (Scheier & Carver, 1985), which has been validated in cancer survivors (Carver, Smith, Petronis, & Antoni, 2006). This measure was reported as two subscales in the current analysis, optimism (e.g., “In uncertain times, I usually expect the best”; $\alpha = 0.83$) and pessimism (e.g., “If something can go wrong, it will”; $\alpha = 0.85$). The pessimism items were scored so that higher scores indicated greater pessimism. Scores on the optimism and pessimism scales both range from

0 to 16. *Social Support* was assessed with the total score of the RAND Social Support Scale that was validated in samples of chronically ill patients (α in the current sample = 0.96) (Sherbourne & Stewart, 1991). This 8-item measure of support available is reported as a mean score with a range from 1 (*none of the time*) to 5 (*all of the time*).

Statistical Analyses

Identifying Trajectories—A group-based SAS finite mixture model procedure called TRAJ (Jones & Nagin, 2007; Jones, 2010) was applied to identify distinct subgroups of women who followed similar trajectories over time in their measures of the three illness intrusiveness domains. This technique identifies distinctive time-based progressions and can model variables with a censored normal distribution (Nagin, 2005). The censored normal distribution accurately describes the distribution of scores for each of the illness intrusiveness domains where there are clusters of data at each of the domains' minimum values. In TRAJ, missing data are assumed to be missing completely at random (Nagin, 2005).

All trajectories were modeled as functions of time since diagnosis. For each domain, models were tested that ranged from two to six trajectory groups. Nagin (2005) notes that, “the choice of the best trajectory model cannot be reduced to the application of a single test statistic... there is no escaping the need for judgment (p. 77)” regarding the capturing of distinct and substantive features of the data in an optimally parsimonious format. For this reason, we used a combination of a statistical criterion (the Bayesian Information Criterion; BIC) and judgment (i.e., minimum observed group size of 10%; and/or distinctively different trajectories) to select the number of trajectory groups. The BIC is a widely-recommended and preferred (Nagin, 2005) statistical measure for inferring the correct number of components in a finite mixture, including the number of groups in the mixture model underlying the group-based method of TRAJ. The BIC takes into account the improvement in model fit gained through additional parameters (groups) but also rewards parsimony by extracting a penalty for added parameters. A higher BIC indicates a better model fit. The AIC (Akaike Information Criterion) is another measure used to infer the correct number of groups in a mixture model; it is very similar to the BIC, although it does not vary with sample size. In each of our trajectory analyses, the AIC duplicated the BIC in terms of information provided about optimal group number.

Based on the recommendation of Nagin (2005), all trajectory groups were modeled including an intercept and a linear and quadratic term for time since diagnosis. The BIC was used as an initial guide in determining the optimal number of trajectory groups within each of the domains. When the BIC pointed to a model where the number of groups appeared higher than optimal because of repetition of similar developmental trajectories, a more parsimonious model with fewer trajectories was chosen. The TRAJ procedure assigns posterior probabilities of group membership to all individuals in the data. These probabilities measure a specific individual's likelihood of belonging to each of the model's trajectory groups. For each of the domains investigated here, individuals were assigned to the trajectory group for which they had the maximum posterior probability. For all graphic displays, we show both the actual, or observed, mean illness intrusiveness scores over time for the women assigned to the particular trajectory group as well as the predicted, or expected, trajectory plot line based on the linear and quadratic terms in the trajectory model.

Trajectory Characteristics—After assigning women to trajectory groups, the association between group membership and variables representing personal characteristics was explored using chi-square tests (for categorical variables) and ANOVA F-tests (for continuous variables).

Results

Participants

A total of 658 women were recruited from 740 mailed questionnaires for an initial response rate of 89%. Five women were subsequently determined to be ineligible, leaving an analytic sample of 653 women. Some women were too sick to complete the 6 or 12-month follow-up, but of the 653 baseline women, 571 women were still in the study at the 18 month follow-up (87%) and 544 (83%) completed all four surveys. The sample was predominantly White, well-educated women who were diagnosed with stage I or stage II disease and had a mean age of 55 (Table 1). Time between diagnosis and completion of the baseline survey ranged from 2 to 221 days for the 653 participants.

Trajectories of Each Domain of Illness Intrusiveness

Three trajectory groups emerged for the instrumental and intimacy domains to optimally characterize the different patterns women followed over 22 months (Figures 1a and 1b, respectively) and four groups optimally characterized the relationship domain (Figure 1c). Tables 2a-c show the BIC values for models containing 1-6 trajectory groups for each of the three domains. Although the BIC continued to increase with additional number of groups above three for the instrumental domain, the smallest observed group size dropped to 6% of the sample, below the minimum criterion of 10%, with the addition of groups beyond three. For the intimacy domain, the BIC reached a local high value at three groups and all observed group sizes were at least 10%. For the relationship domain, the BIC continued to increase with each addition of a group, but at five groups, the smallest group sizes fell below the minimum criterion. Although the smallest group in the four-trajectory model contained 9% of the sample, and was thus technically below the criterion of 10%, the four-group model clearly added important additional information above the three-group model, specifically in the form of a trajectory showing worsening over time.

For each of the three domains, at least 90% of the sample had posterior probabilities of 0.75 or greater for membership in a particular trajectory group; and in the instrumental and intimacy domains, all posterior probabilities were above 0.50. The lowest posterior probabilities pertained to the relationship trajectories, where 10 women (1.5% of the sample) had posterior probabilities at or below 0.50 (ranging from 0.42-0.50) for their group assignment. For each domain, the majority of women reported consistently low illness intrusiveness over time (Low) (Figures 1a-c). The percentage of women who fell into the Low trajectory group ranged from 52% for the instrumental domain to 65% for the intimacy domain. Women who experienced consistently high illness intrusiveness (High) over time on at least one domain ranged from 11% for the intimacy domain to 17% for the relationship domain. The percentage of women whose illness intrusiveness declined over time (Decreasing) was substantial for both the instrumental and intimacy domains (34% and 29% respectively), but smaller for the relationship domain (9%). As mentioned above, an additional fourth distinct trajectory group emerged for the relationship domain (Figure 1c). This trajectory (labeled Increasing; comprising 9% of the sample) began with low relationship illness intrusiveness at baseline that increased over time. A substantial portion of the sample, 41%, fell into the consistently Low group on all three domains; none of the other combinations of trajectory groupings across the domains, considered separately, contained more than 10% of the sample. Seven percent of the sample fell into the Decreasing group in each domain, and 3% fell into the High group in each domain.

Characteristics Related to Trajectories by Domain

Tables 3a,b,c present, for each of the three domains, descriptive data (percentages and means) on contextual, disease/treatment, psychological and social factors as they relate to

trajectory group membership. Most of the covariates examined, with the exception of employment, significantly differed across trajectory group membership in bivariate analyses.

In general, the greatest differences appeared between women in the Low trajectory groups and women in the other groups. Women in the Low groups were older, less likely have children under age 18 in the home, more likely to have stage I diagnosis (and consequently, less likely to have chemotherapy and mastectomy), reported fewer symptoms (i.e., pain, fatigue, vasomotor symptoms) and had more favorable scores on all the psychosocial variables except one factor of spirituality (role of faith). Not surprisingly, women who were married or partnered were less likely to be in the Low group for intimacy. Women who were in the High illness intrusiveness group were mostly distinguished by reporting greater difficulty paying for basics.

Discussion

Consistent with the initial hypothesis, multiple patterns of illness intrusiveness over time were identified in the three domains. Approximately half of the women in the sample reported consistently low illness intrusiveness over time for each domain and a large portion of women (41%) reported low intrusiveness across all three domains. These findings suggest that for many women, a cancer diagnosis and the subsequent treatment do not have a large negative impact on any of the life domains assessed. The level of illness intrusiveness in the low trajectory groups corresponds to domain scores of 1.5 - 2.0 on a scale from 1 to 7. Although there are no norms established for the IIRS, this range is lower than mean scores for each domain published from another sample of women with breast cancer: instrumental, $M = 3.0$ ($SD = 1.9$); relationship, $M = 2.0$ ($SD = 1.2$); intimacy, $M = 2.3$ ($SD = 1.8$; Devins, 2010). In addition, the emergence of the Low trajectory group is consistent with literature that reports a large subset of women diagnosed with breast cancer who also do not experience an elevation in distress (36%-63%; Henselmans et al., 2010; Lam et al., 2010) or a disruption in quality of life (43-55%; Helgeson et al., 2004).

However, about 10-17% of women experienced consistently elevated levels of illness intrusiveness in at least one domain throughout the two years following diagnosis, with mean illness intrusiveness scores of close to 5 on a scale from 1 to 7. Illness intrusiveness mean domain scores this high have been reported in only a few disease groups, including those receiving bone marrow transplant (instrumental domain, $M = 4.2 - 4.8$), and those with anxiety disorder (relationship domain, $M = 4.2$) and human immunodeficiency virus (intimacy, $M = 5.3$) (Devins, 2010). Thus the current results revealed a subgroup of women with higher illness intrusiveness scores who would have been missed if only means were assessed. A similar group with consistently elevated distress (15%; Henselmans et al., 2010; Lam et al., 2010) has also emerged in other studies that have applied trajectory analyses in this patient group. The evaluation of trajectory subgroups support a growing sentiment in the literature that targeting interventions to cancer survivors who demonstrate a need for psychosocial intervention may yield stronger, more clinically relevant outcomes and provide more cost-effective care than targeting people for intervention based solely on a cancer diagnosis (Schneider et al., 2010; Tamagawa, Garland, Vaska, & Carlson, 2012).

Although for most women illness intrusiveness remained fairly stable (high or low) following a breast cancer diagnosis, a substantial group of women in each domain reported a decline in illness intrusiveness. This reduction in illness intrusiveness over the first sixteen months following diagnosis may correspond to the physical and psychosocial recovery associated with the end of primary treatment (Ganz et al., 2011). For those women in the Decreasing trajectory groups, the magnitude of the decline in illness intrusiveness score over the observed time period was approximately 0.5 (intimacy), 1.0 (instrumental) and 2.0

(relationship). Given that clinically meaningful changes are frequently estimated to be $\frac{1}{2}$ Standard Deviation of change (Norman, Sloan, & Wyrwich, 2003), which is approximately a change of 1 in absolute units for this scale, the decreases in the instrumental and relationship domains are particularly noteworthy. Further, whereas the instrumental and intimacy domains had three distinct trajectories of illness intrusiveness, the relationship domain had an additional fourth distinct trajectory of increasing intrusiveness over time. In this trajectory group, the increase over time is clinically meaningful (more than half a unit increase over the observed time period) and could be due, in part, to challenges faced during the transition from patient to post-treatment cancer survivor such as alterations in social support that may emerge when a woman aims to return to “normal” (Committee on Cancer Survivorship, 2006). These results also show the value of looking at specific domains of illness intrusiveness. Other than those women who were consistently low in illness intrusiveness, the trajectory pattern for women varied by domain, thus suggesting that the impact of breast cancer on women’s lives may be specific to certain areas.

Contextual, disease/treatment, psychological and social factors were also identified to characterize women who experience illness intrusiveness. Bivariate analyses showed that most of the factors included in prior studies (Bloom et al., 1998; Devins et al., 2006) and illness intrusiveness theory (Devins, 2010) were important in describing differences among trajectory groups. Younger age, higher education (in the instrumental and relationship domains), and inability to pay for the basics (i.e., lower income) were also associated with higher illness intrusiveness in a previous study of cancer survivors (Devins et al., 2006). In addition, results showed that higher stage (i.e., severity of illness), greater treatment-related side effects and lower perceived attractiveness (i.e., body image) were related to higher illness intrusiveness as also shown by a previous study (Bloom et al., 1998).

Some novel findings also emerged. Contrary to the finding that non-White women had lower illness intrusiveness than White women (Bloom, 1998), White race/ethnicity was related to lower illness intrusiveness in the current analyses. Bloom and colleagues had a more diverse sample that likely included different ethnicities in the non-White group than the current sample. Further, the current analyses revealed that women who reported higher illness intrusiveness after a diagnosis of breast cancer were more likely to have children under age 18 in the home, chemotherapy, mastectomy, and lower scores on the psychosocial variables. On the other hand, these results also characterized the women who do not find breast cancer particularly intrusive. Thus results suggest that intervening with such factors that are potentially modifiable, such as providing childcare or reducing symptoms may lessen illness intrusiveness.

The current study has several limitations. First, similar to many other studies of breast cancer survivors, this sample consisted largely of White women with higher incomes. Although this sample provided sufficient variability to detect differences by race and the ability to pay for basics, the percentages of women in each of the trajectories could change with a more diverse or lower income sample. Second, particularly for the relationship trajectory analyses, a small number of the posterior probabilities were low. Thus there is likely some error in group assignment at the individual level that is important to consider in the interpretation of subgroup analyses. Third, significant associations between a covariate (e.g., ability to pay for basics or pain) and trajectory group membership do not necessarily reflect a causal connection. A fourth limitation of the current analyses is that changes in covariate values over time were not examined. While changes in illness intrusiveness over time were considered, only single-point-in-time values of the covariates were included (baseline values for many of the covariates, and summary medical chart data for the surgery, chemotherapy, and radiation variables). Thus the ability to determine reasons for why some

women who started out with high illness intrusiveness remained high, while others declined, was limited.

Limitations of this study are accompanied by several strengths. The use of trajectory analyses characterized individuals into groups based on patterns of change over time, which captures heterogeneity masked by evaluating means alone. A practical application of these trajectory analyses is the use an illness intrusiveness score at baseline to target an intervention based on the need for intervention by specific life area. Further, these analyses were conducted in the context of a theoretical framework and will thus contribute to the general understanding of how illness intrusiveness can vary over time and how illness intrusiveness domains may differentially relate to contextual, disease/treatment, psychological and social factors.

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Figure 1.

a. Three trajectories that emerged for the mean scores of the instrumental domain of the Illness Intrusiveness Ratings Scale (possible range of scores: 1-7). Percents shown are from the total sample.

b. Three trajectories that emerged for the mean scores of the intimacy domain of the Illness Intrusiveness Ratings Scale (possible range of scores: 1-7). Percents shown are from the total sample.

c. Four trajectories that emerged for the mean score of the relationship domain of the Illness Intrusiveness Ratings Scale (possible range of scores: 1-7). Percents shown are from the total sample.

Table 1

Characteristics of the Total Sample (N = 653)

Characteristic	N (%)
Age (M[SD])	54.9 (12.6)
Race: White	585 (90)
Currently Employed	272 (42)
Ability to Pay for the Basics	
Very Hard	21 (3)
Somewhat Hard	100 (15)
Not Hard	532 (81)
Graduated College	409 (63)
Married or Partnered	468 (72)
Have Children Under 18 Years	171 (26)
Stage	
I	338 (52)
II	262 (40)
III	53 (8)
Mastectomy	237 (36)
Chemotherapy	437 (67)
Radiation	472 (72)

Tables 2a-c
Bayesian Information Criterion (BIC) Values for Determining Number of Trajectories by Domain

1a. Instrumental						
# of groups	BIC	Estimated probabilities (estimated % in each group)				
		1	2	3	4	5 6
1	-4248.38	100				
2	-3780.06	68	32			
3	-3630.41	52	34	14		
4	-3597.90	49	30	15	6	
5	-3574.13	45	17	17	14	6
6	-3551.10	41	17	16	11	9 6

1b. Intimacy						
# of groups	BIC	Estimated probabilities (estimated % in each group)				
		1	2	3	4	5 6
1	-4653.04	100				
2	-4114.24	67	33			
3	-3976.09	60	30	11		
4	-3991.60	24	36	29	11	
5	-4007.10	20	22	17	29	11
6	-3923.66	12	16	31	18	15 8

1c. Relationship						
# of groups	BIC	Estimated probabilities (estimated % in each group)				
		1	2	3	4	5 6
1	-3581.63	100				
2	-3146.63	79	21			
3	-3051.34	69	21	10		
4	-3008.26	65	9	17	9	
5	-2987.33	59	14	6	15	7
6	-2965.13	56	16	11	5	8 4

Note. Bold text indicates the number of groups selected for the current analyses

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Table 3a

Characteristics of Instrumental Domain Trajectories (n = 653)

Characteristic	Instrumental Trajectory Groups (%)			Chi-square Results	
	Low	Decreasing	High	χ^2	p-value
Contextual Factors					
Race: White	94	90	74	32.25	<.001
Currently Employed	39	46	42	3.07	0.22
Ability to Pay for the Basics					
Very Hard	1	3	11	84.77	<.001
Somewhat Hard	7	17	39		
Not Hard	91	79	51		
Graduated College	61	68	55	6.10	0.47
Married or Partnered	72	72	69	0.29	0.87
Have Children < 18 Years	19	33	37	21.50	<.001
Disease/Treatment Factors					
Stage					
I	64	41	32	47.11	<.001
II	30	49	56		
III	6	10	13		
Mastectomy	29	43	47	17.42	<.01
Chemotherapy	51	83	87	83.96	<.001
Radiation	75	66	77	6.20	0.05
Characteristic	Instrumental Trajectory Groups (M(SD))			ANOVA Results	
	Low	Decreasing	High	F(ndf, ddf)	p
Contextual Factors					
Age	59.4 (12.4)	50.4 (11.3)	49.7 (9.9)	49.82 (2,650)	<.001
Disease/Treatment Factors					
Vasomotor	0.7 (0.9)	1.1 (1.1)	1.3 (1.0)	17.84 (2,650)	<.001
Pain	1.3 (1.1)	2.3 (1.1)	2.8 (1.0)	96.17 (2,649)	<.001
Fatigue	2.1 (0.8)	2.9 (0.8)	3.1 (0.8)	90.06 (2,650)	<.001
Psychological and Social Factors					

Characteristic	Instrumental Trajectory Groups (%)			Chi-square Results	
	Low	Decreasing	High	χ^2	p-value
Role of Faith	10.1 (4.7)	9.1 (5.2)	10.0 (5.0)	3.31 (2,633)	<0.05
Meaning	14.0 (2.5)	12.5 (3.1)	12.2 (3.1)	24.75 (2,641)	<0.001
Peace	11.6 (3.5)	9.5 (3.7)	8.9 (4.5)	32.24 (2,641)	<0.001
Attractiveness	11.0 (2.1)	9.8 (2.2)	8.7 (2.4)	10.69 (2,650)	<0.001
Pessimism	4.1 (3.1)	5.4 (3.2)	6.0 (3.5)	18.51 (2,650)	<0.001
Optimism	11.1 (3.1)	10.4 (3.1)	10.3 (3.3)	4.53 (2,650)	<0.05
Social Support	4.4 (0.7)	4.3 (0.7)	4.0 (0.8)	49.82 (2,650)	<0.001

Table 3b

Characteristics of Intimacy Domain Trajectories (n = 653)

Characteristic	Intimacy Trajectory Groups (%)			Chi-square Results	
	Low	Decreasing	High	χ^2	p-value
Contextual Factors					
Race: White	91	89	87	1.00	0.61
Currently Employed	39	47	40	3.80	0.15
Ability to Pay for the Basics				9.14	0.58
Very Hard	3	3	5		
Somewhat Hard	13	15	27		
Not Hard	84	82	68		
Graduated College	59	66	74	6.85	<0.05
Married or Partnered	65	81	85	24.18	<0.001
Have Children < 18 Years	16	42	56	58.32	<0.001
Disease/Treatment Factors					
Stage				35.84	<0.001
I	61	37	39		
II	32	53	52		
III	7	9	10		
Mastectomy	28	45	61	35.98	<0.001
Chemotherapy	56	83	84	50.76	<0.001
Radiation	76	68	61	9.20	<0.05
Characteristic	Intimacy Trajectory Groups (M[SD])			ANOVA Results	
	Low	Decreasing	High	F(ndf, ddf)	P
Contextual Factors					
Age	59.2 (12.0)	49.4 (11.0)	46.3 (9.2)	66.77 (2, 650)	<0.001
Disease/Treatment Factors					
Vasomotor	0.7 (0.9)	1.2 (1.0)	1.5 (1.1)	26.50 (2, 650)	<0.001
Pain	1.6 (1.2)	2.2 (1.3)	2.4 (1.4)	23.13 (2, 649)	<0.001
Fatigue	2.3 (0.9)	2.9 (0.9)	3.0 (0.8)	33.07 (2, 650)	<0.001
Psychological and Social Factors					

Characteristic	Intimacy Trajectory Groups (%)			Chi-square Results	
	Low	Decreasing	High	χ^2	p-value
Role of Faith	10.2 (4.7)	9.3 (5.2)	8.6 (4.9)	4.34 (2, 633)	<0.05
Meaning	13.6 (2.7)	12.6 (3.1)	12.5 (3.1)	10.73 (2, 641)	<0.001
Peace	11.5 (3.5)	9.4 (3.9)	8.0 (3.9)	38.57 (2, 641)	<0.001
Attractiveness	10.9 (2.1)	9.6 (2.2)	8.1 (2.4)	54.97 (2, 641)	<0.001
Pessimism	4.3 (3.1)	5.4 (3.5)	6.2 (3.2)	13.56 (2, 650)	<0.001
Optimism	11.0 (3.1)	10.6 (3.2)	10.0 (3.0)	3.68 (2, 650)	<0.05
Social Support	4.3 (0.7)	4.3 (0.7)	4.0 (0.8)	4.48 (2, 650)	<0.05

Table 3c

Characteristics of Relationship Domain Trajectories (n = 653)

Characteristic	Relationship Trajectory Groups (%)			Chi-square Results	
	Low	Decreasing	High	Increasing	χ^2 <i>p</i> -value
Contextual Factors					
Race: White	93	85	79	85	14.78 <0.01
Currently Employed	42	42	40	39	0.27 0.96
Ability to Pay for the Basics					47.69 <0.001
Very Hard	2	7	6	5	
Somewhat Hard	11	13	40	26	
Not Hard	87	80	55	69	
Graduated College	61	73	60	54	7.34 0.06
Married or Partnered	71	71	74	75	0.62 0.89
Have Children < 18 Years	19	41	42	38	34.13 <0.001
Disease/Treatment Factors					
Stage					55.34 <0.001
I	61	29	40	43	
II	32	65	57	41	
III	8	6	4	16	
Mastectomy	33	35	47	52	11.71 <0.01
Chemotherapy	58	91	89	67	55.97 <0.001
Radiation	74	72	60	70	4.26 0.21
Characteristic	Relationship Trajectory Groups (M[SD])			ANOVA Results	
	Low	Decreasing	High	Increasing	<i>F</i> (ndf, ddf) <i>P</i>
Contextual Factors					
Age	57.2 (12.6)	48.3 (9.4)	53.7 (12.7)	50.1 (11.2)	16.42 (3, 649) <0.001
Disease/Treatment Factors					
Vasomotor	0.8 (0.9)	1.5 (1.2)	1.1 (1.0)	1.2 (1.1)	12.68 (3, 649) <0.001
Pain	1.5 (1.2)	2.8 (1.2)	2.3 (1.3)	2.4 (1.2)	33.40 (3, 648) <0.001
Fatigue	2.3 (0.9)	3.2 (0.9)	2.7 (0.9)	3.1 (0.8)	33.70 (3, 649) <0.001
Psychological and Social Factors					

Characteristic	Relationship Trajectory Groups (%)			Chi-square Results	
	Low	Decreasing	High	χ^2	p-value
Role of Faith	9.9 (4.8)	9.5 (5.3)	10.2 (5.0)	0.95 (3, 632)	0.42
Meaning	13.9 (2.6)	11.9 (3.4)	12.2 (2.6)	22.74 (3, 640)	<0.001
Peace	11.5 (3.4)	7.5 (4.6)	9.4 (3.7)	35.84 (3, 640)	<0.001
Attractiveness	10.9 (2.1)	8.3 (2.3)	9.5 (2.2)	35.75 (3, 640)	<0.001
Pessimism	4.2 (3.1)	7.2 (3.9)	5.5 (3.1)	20.44 (3, 649)	<0.001
Optimism	11.1 (3.0)	9.6 (3.5)	10.5 (3.4)	5.16 (3, 649)	<0.01
Social Support	4.4 (0.7)	4.0 (0.8)	4.0 (0.7)	11.66 (3, 649)	<0.001