Determinants of Mammography Screening Participation in Adult Childhood Cancer Survivors: Results From the Childhood Cancer Survivor Study

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Purpose/Objectives: To identify treatment, intrapersonal, and provider factors that influence childhood cancer survivors' adherence to recommended mammography screening.

Design: Secondary analysis of data derived from three consecutive surveys within the Childhood Cancer Survivor Study.

Sample: Female childhood cancer survivors: N = 335, $\bar{X}$ age = 30.92, $\bar{X}$ years after diagnosis = 21.79.

Methods: T tests and structural equation modeling.

Main Research Variables: Mammogram recency, health concerns, affect, motivation, and survivor-provider interaction.

Findings: Forty-three percent of the variance was explained in mammogram recency. Survivors most likely to follow the recommended mammogram schedule were directly influenced by cancer treatment exposure to mantle radiation ($p = 0.01$), less intrinsic motivation ($p = 0.01$), positive affect ($p = 0.05$), recent visits to an oncology clinic ($p = 0.01$), discussion of subsequent cancer risks with a physician ($p = 0.001$), perceptions of more severe late effects ($p = 0.05$), age (40 years or older) ($p \leq 0.001$), and a print media intervention detailing breast cancer risks and follow-up strategies.

Conclusions: Perceived symptoms, motivation, affect, provider influences, readiness for medical follow-up, and knowledge of treatment exposures are potential modifiable targets for intervention to support mammography screening in childhood cancer survivors at risk.

Implications for Nursing: (a) Provide written summaries of treatment exposures and recommended schedule of mammography screening at the end of cancer treatment and throughout follow-up; (b) identify and address survivor symptoms and concerns that may negate screening; and (c) enhance motivation for screening by tailoring personal risk information to health concerns, affect, and readiness for follow-up.

Many female childhood cancer survivors ages 20–40 years are at an elevated risk for breast cancer because their developing breast tissue was exposed to radiation during childhood cancer treatment (Hewitt, Weiner, & Simone, 2003; Ries et al., 2007). Survivors of Hodgkin disease comprise the largest proportion of childhood cancer survivors in the group at risk for secondary breast cancer. However, chest radiation also is used routinely in treatment protocols for metastatic Wilms tumor and soft tissue sarcomas as well as other refractory or recurrent pediatric malignancies. Previous investigations indicate that by age 45, 12%–20% of young women treated with radiation therapy will be diagnosed with breast cancer (Bhatia et al., 2003; Kenney et al., 2004; Taylor, Winter, Stiller, Murphy, & Hawkins, 2007). Therefore, the risk of breast cancer after chest radiation for a pediatric malignancy rivals that of women with a *BRCA* mutation, who have an estimated cumulative incidence of breast cancer at age 40 ranging from 10%–19% (Bhatia et al.; Bishop, 1999; Ford et al., 1998; Struewing et al., 1997).

Information about secondary breast cancer following radiation for pediatric malignancies is derived largely from studies of survivors of Hodgkin disease. The risk of breast cancer in this group begins to increase about 8 years after chest radiation (Bhatia et al., 2003; Kenney et al., 2004; Metayer et al., 2000); the interval from Hodgkin disease treatment to breast cancer for pediatric and adult groups is 15–20 years (Bhatia et al.; Cutuli et al., 2001; Kenney et al.; Metayer et al.; Taylor et al., 2007; Wolden et al., 2000). The median age of breast cancer diagnosis is 32–35 (Bhatia et al.; Kenney et al.; Taylor et al.), which is well below the average age of breast cancer onset (age 50 and older) (Ries et al., 2007) in the general population and below the age at which most women routinely begin to undergo mammography (age 40) (American Cancer Society, 2007).

Consistent with the general population (Berry et al., 2005; Vlastos & Verkooijen, 2007), early detection of breast cancer in the population of childhood cancer survivors who are at high risk may lead to increased diagnosis of breast cancers at early stages, thereby requiring less invasive treatments and incurring improved outcomes and enhanced quality of life. Annual screening mammography with adjunct breast magnetic resonance imaging is recommended for childhood cancer survivors, beginning at age 25 or eight years after completion of radiation therapy, whichever occurs last (Children's Oncology Group, 2006). Among Hodgkin

disease survivors who develop secondary breast cancer, 27%–100% of cancers were detected by mammography (Dershaw, Yahalom, & Petrek, 1992; Diller et al., 2002; Wolden et al., 2000); however, many survivors do not adhere to the treatment exposure–based guidelines for screening. For example, only 169 (41%) of 414 survivors at increased risk of breast cancer underwent mammography (Nathan et al., 2007), and fewer long-term survivors of childhood cancer (21%, N = 4,414) reported ever having had a mammogram (Yeazel et al., 2004) compared to survivors of adult cancers (75%–92%, N = 4,785) (Bellizzi, Rowland, Jeffery, & McNeel, 2005). Healthcare providers need to educate and promote mammography to this high-risk population for breast cancer to potentially reduce morbidity and mortality.

Quite similar to the general population (Cui et al., 2007; Cummings, Whetstone, Shende, & Weismiller, 2000; Goodwin, Visintainer, Facelle, & Falvo, 2006; Williams, Lindquist, Sudore, Covinsky, & Walter, 2008), factors that predict mammography use in survivors of breast cancer and Hodgkin disease include visits to the oncologist (Field et al., 2008), gynecologist (Doubeni et al., 2006), or primary care physician (Doubeni et al.); having health insurance (Bober, Park, Schmookler, Medeiros Nancarrow, & Diller, 2007); physician support (Bober et al.); worry about breast cancer (Bloom, Stewart, & Hancock, 2006); older age (Bloom et al.); and higher education and income (Breen, Yarbroff, & Meissner, 2007). Childhood cancer survivors who are least likely to report receiving routine mammography are younger and express a lack of concern for future health issues (Yeazel et al., 2004).

In addition to disease and treatment factors, personal and contextual factors influence health behavior choices (Breslow, Lloyd, & Shumaker, 1994; Cox, McLaughlin, Rai, Steen, & Hudson, 2005; Cox, McLaughlin, Steen, & Hudson, 2006; Kraemer, Wilson, Fairburn, & Agras, 2002; Prochaska, 2005; Rejeski, Brawley, McAuley, & Rapp, 2000). The Interaction Model of Client Health Behavior (IMCHB) was chosen to describe the multiple influences on survivors' adherence to mammography screening guidelines (Cox, 1982, 2003; Cox et al., 2006; Cox, Hudson, et al., 2009; Cox, Montgomery, et al., 2008; Cox, Montgomery, et al., 2009), which integrates intrapersonal and contextual variables and has been adapted to the study of childhood cancer survivors (see Figure 1). The IMCHB incorporates physical, social, cognitive, motivational, affective, provider, and environmental antecedents to health behavior. The original empirical support for the model concepts and their relationships is reported in detail elsewhere (Cox, 1982, 1984). Briefly, the model comprises three elements: client singularity (the unique intrapersonal and contextual configuration of the individual), client-professional interaction (the therapeutic content and process that occurs between a provider and patient), and health outcomes (the behavior- or behaviorally related outcome subsequent to a patient-professional interaction). The model's working hypothesis is that the potential for positive health outcomes increases as the provider intervention is tailored to the unique manifestation of each patient relative to a constellation of their background variables, cognitive appraisal, affect, and motivation.

The hypotheses generated by the conceptual model was tested with structural equation modeling (SEM), which combines factor and path analyses into a comprehensive methodology (Kaplan, 2000). SEM tests all hypothesized relationships simultaneously rather than sequentially. The goal was to identify disease, treatment, survivor, provider, and contextual factors that could be targeted with behavioral interventions to support recommended mammography screening.

Methods

Data Source

The Childhood Cancer Survivor Study (CCSS) is a multi-institutional retrospective cohort study started in 1994 to examine the late effects of pediatric cancer treatment. Survivors completed a baseline questionnaire at study entry and responded to follow-up questionnaires sent at regular intervals. In addition, they consented to release their medical records from their participating treatment centers. Questionnaires and sampling methods are detailed in Robison et al. (2002) and are available for review at www.stjude.org/ccss.

The questionnaire at the second follow-up and the **Health Care Needs Surveys** (**HCNS**) provided the data used for this study. The follow-up questionnaire contains questions on demographics, medical care received during the most recent two-year period, medical conditions recently diagnosed, surgical procedures, cancer recurrence or new malignancies, marital status, pregnancy history, offspring, health habits, education, employment, insurance, income, and family history. Most of the questions used in the follow-up questionnaire came from the National Health Interview Survey and were validated in a population of childhood cancer survivors (Louie et al., 2000). The HCNS addresses sociodemographic factors, survivor-related psychological factors, knowledge of late effects, access to health care, and multidimensional health locus of control.

Sample

Originally, 20,346 survivors were contacted to participate in CCSS. Eligible participants were those who had survived five or more years after being treated for a malignant disease diagnosed (before age 21) from 1970–1986. The HCNS randomly sampled 1,600 of the survivors. Of the 978 (61%) participants who completed and returned the survey, 838 (86%) returned the follow-up questionnaire of the CCSS within the same data collection period. Nonrespondents to the HCNS typically were male (59%), minorities (37%), or had less than a high school education

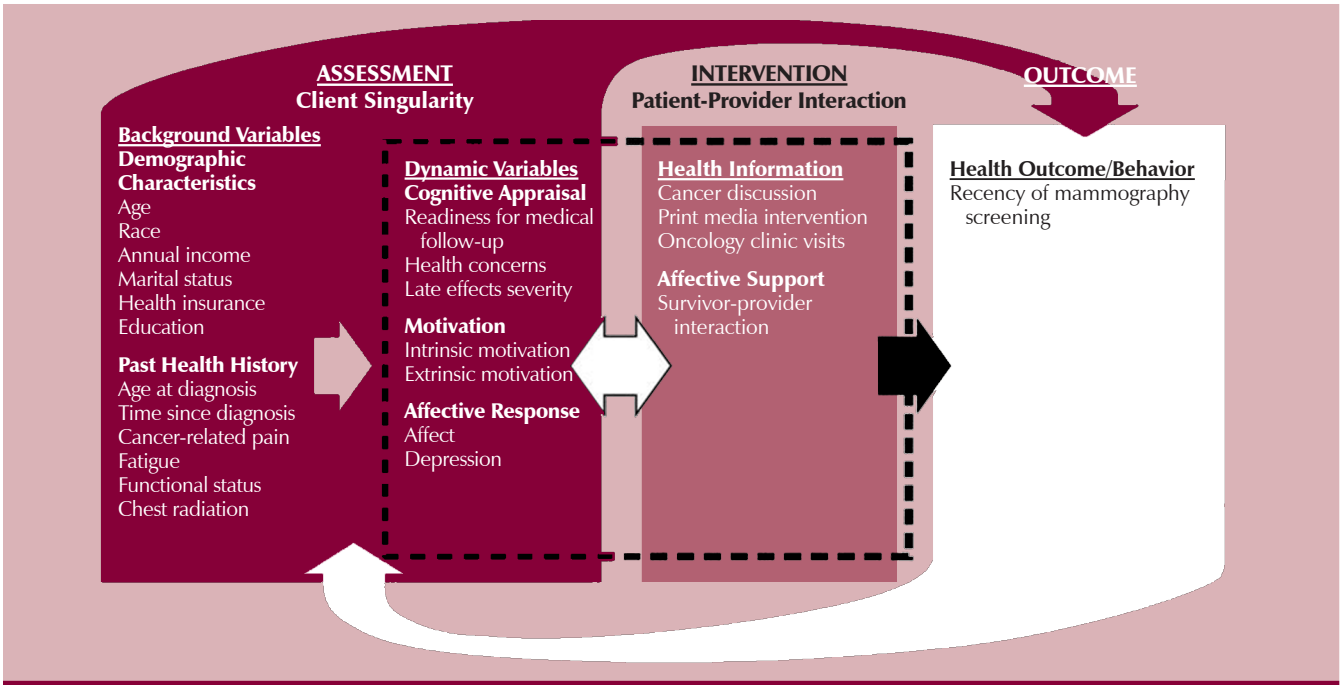


Figure 1. Correspondence of the Interaction Model of Client Health Behavior With Study Variables

Note. From "A Model of Health Behavior to Guide Studies of Childhood Cancer Survivors," by C.L. Cox, 2003, *Oncology Nursing Forum, 30*(5), p. E93. Copyright 2003 by Oncology Nursing Society. Adapted with permission.

(56%). Survivors who completed the HCNS but not the follow-up questionnaire were younger at diagnosis ($p = 0.019$) and diagnosed more recently ($p \leq 0.001$). Data were self-reported. The sample for the analysis included women who had responded to the HCNS and follow-up questionnaire (N = 453); for descriptive comparative purposes, a subset of young women at highest risk for secondary breast neoplasm (exposure to mantle radiation during cancer therapy) (N = 82) were selected and compared to the total female sample (N = 453) (see Table 1).

Outcome Measures

Single items addressed the recency of the last mammogram (1 = never, 2 = five or more years ago, 3 = more than two years but less than five years, 4 = one to two years ago, 5 = less than one year ago) (see Table 2). Survivors who answered "don't know" for any of the screening examinations were excluded from the analysis.

Independent Measures

Two types of variables are modeled in SEM: observed and latent. In contrast to observed variables that can be measured directly (e.g., test scores, diagnostic criteria), latent variables (e.g., depression) are measured indirectly by a set of observed variables (Muthen & Muthen, 2007). The final model had eight directly observed variables and five latent variables that contributed directly or indirectly to the explained variance in frequency of mammography.

Directly observed independent variables: (a) number of cancer-related visits in the past two years (1 = none; 7 = more than 20), (b) physician-survivor discussion of subsequent cancer, (c) survivors' perceptions of their late effects (1 = moderate, severe, or life-threatening; 2 = mild or no chronic problems), (d) follow-up care at an oncology clinic in the past two years, (e) age 40 or older, (f) receipt of a print media intervention detailing exposure risks and recommended follow-up for breast sequelae, (g) exposure to mantle radiation during cancer treatment, (h) fatigue (1 = all of the time; 6 = none of the time), and (i) stage or level of readiness for medical follow-up (1 = precontemplation: no cancer-related check-up from a physician in the past two years and little likelihood of having a check-up within the next two years; 2 = contemplation: no cancer-related check-up in the past two years but likely or very likely to have a cancer-related check-up in the next two years; and 3 = action: had a cancer-related check-up in the past two years and likely or very likely to have a cancer-related check-up in the next two years).

Latent independent variables:

- **Health concerns:** Three observed variables comprised this variable: survivors' general concerns about their health, their concerns about the chances of getting sick, and their perceptions about the importance of a check-up (1 = moderate, quite a bit, or extremely concerned; 2 = not at all or a little concerned) ($\alpha = 0.79$).
- **Affect:** Four items from the **SF-36® Health Survey subscale** (Ware, Snow, & Kosinski, 2000) comprised this variable (1 = all of the time; 6 = none of the time): peaceful, happy, downhearted and blue, and not

Table 1. Descriptive Summary for Female Survivors at Lower and Highest Risk for Breast Neoplasm

Variable	Lower-Risk Group (N = 453) $\bar{X}$	SD	Range	Highest-Risk Group (N = 82) $\bar{X}$	SD	Range
Age (years)**	29.78	6.94	17.2–50.4	36.06	7.63	19.1–51.5
Age at diagnosis (years)**	8.18	5.59	0–20.9	13.44	5.63	0.4–20.9
Time since diagnosis (years)[a]	21.61	4.43	14.3–31.9	22.62	5.02	14.5–31.7
Variable	**n**	**%**		**n**	**%**	
Race						
Caucasian	275	75		61	75	
African American	36	10		4	5	
Hispanic	40	11		15	18	
Other	17	5		2	2	
Personal annual income (U.S. $)						
None	63	18		13	17	
Less than 19,999–39,999	235	66		46	58	
40,000–59,999	40	11		15	19	
60,000 or more	20	6		5	6	
Marital status**						
Ever married	136	37		57	70	
Never married	234	63		25	31	
Health insurance						
Yes	320	87		76	93	
No	47	13		6	7	
Education						
1–12 years	7	2		1	1	
Completed high school (or GED)	52	14		7	9	
Post–high school	132	36		31	38	
Training, some college, or college	176	48		42	52	
Graduate or postgraduate	–	–		–	–	
Work	–	–		–	–	
Seen at oncology clinic within past two years*						
Yes	39	9		18	23	
No	318	91		62	78	

*$p < 0.01$; **$p \leq 0.001$

[a] $p = 0.069$

Note. Because of rounding, not all percentages total 100.

Note. N values vary because of missing data.

cheerful. Reverse scoring allowed higher scores to reflect a more positive affect ($\alpha = 0.78$).

- **Intrinsic motivation:** Five observed items from the **Multidimensional Health Locus of Control Scale (MHLC)** (Wallston, Wallston, & DeVellis, 1978) comprised this variable (1 = strongly disagree, 6 = strongly agree) ($\alpha = 0.79$).
- **Extrinsic motivation:** Five MHLC items comprised this variable (1 = strongly disagree, 6 = strongly agree) ($\alpha = 0.8$).
- **Survivor-physician relationship:** Four observed items rated (1 = not at all; 5 = extremely) comprised this variable: doctor took enough time to answer questions, could ask doctor questions about cancer, fears and concerns had been addressed by doctor and nurses, and primary care provider could handle cancer-related problems ($\alpha = 0.78$).

Statistical Analyses

SEM has two components: (a) The measurement model evaluates whether observed measures (e.g., scales, self-reports) adequately represent the latent variables, and (b) model hypotheses are tested with respect to the interrelation of the latent variables and covariates (Raykov & Marcoulides, 2000). SEM was performed with Mplus 4.2 (Muthen & Muthen, 2007). The models are based on a complete data matrix. A sample size of more than 200 is considered large in SEM (Kline, 2005).

Multiple indicators assessed how well the model fit the data (Bentler, 1990; Bollen, 1990; Browne & Cudeck, 1993; Hu & Bentler, 1999). Factor loading values for the latent variables were less than or equal to $p = 0.01$, and factor score determinacy values were greater than 0.9, suggesting strong latent construct measures (Muthen & Muthen, 2007).

Results

The typical respondent was a Caucasian, unmarried, female college graduate with a personal income of $19,999–$39,999; she had health insurance and had not been seen

at an oncology clinic in the past two years. Tables 1 and 2 compare the total female sample (N = 453) with women at highest risk (exposure to mantle radiation) for secondary breast neoplasm (N = 82). Women in the highest-risk group at the time were older, older at diagnosis, married or previously married, and more likely to have been seen at an oncology clinic more recently. No one in the highest-risk group reported not knowing whether they had ever had a mammogram, and they were more likely than those in the lower-risk group to have had a mammogram more recently. Notably, 78% of those in the lower-risk group had never had a mammogram or had not had one within the past five years compared to 63% of those at highest risk of secondary breast neoplasm. Compared to survivors at lower risk for breast cancer, those at highest risk were more likely to have discussed with their physician the risk of developing a subsequent cancer, had received a print media intervention detailing their risks and suggested follow-up, were at least age 40, were more ready for medical follow-up, were more concerned about their health, and reported more cancer-related physician visits.

Structural Equation Model of Mammogram Recency

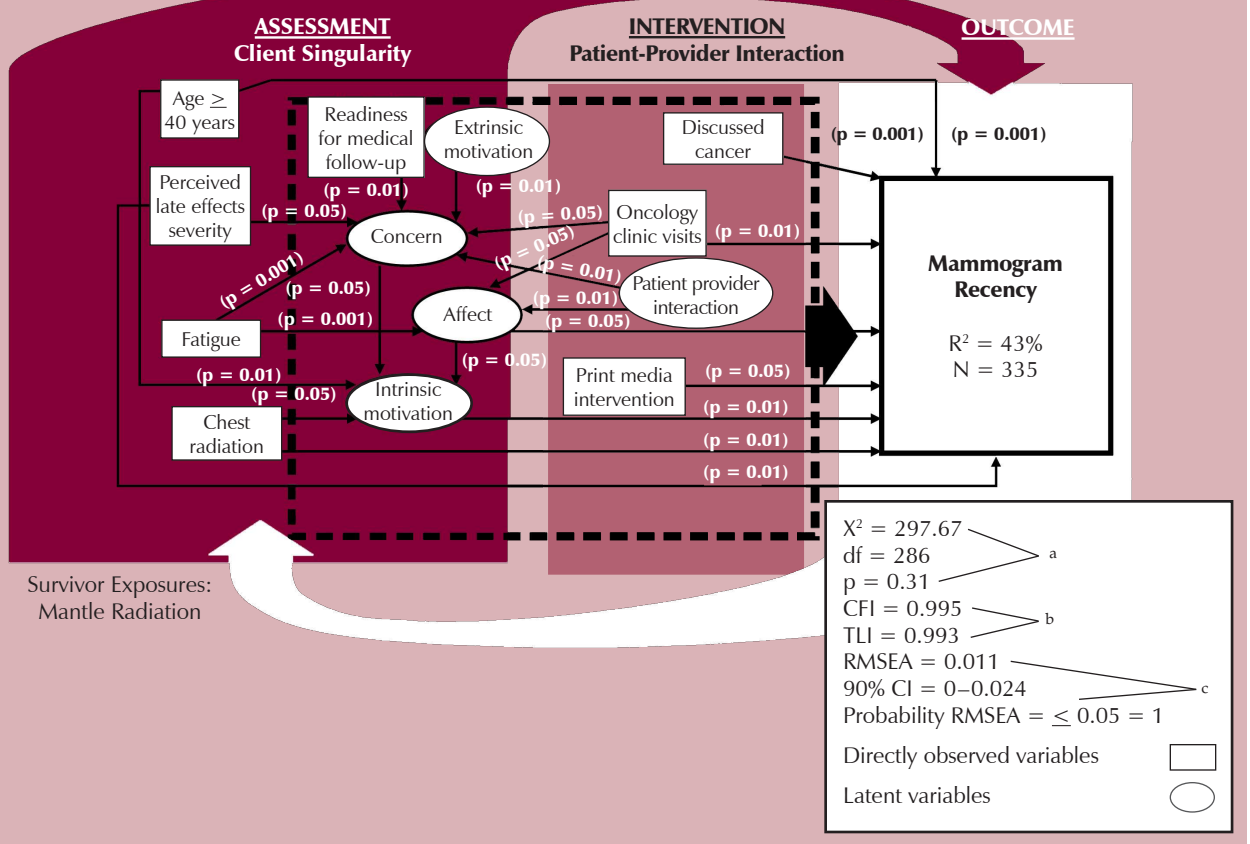
The final model (see Figure 2) had significant parameter estimates corresponding to the hypothesized relationships (see Table 3), met the established SEM fit criteria, and offered the highest percentage of explained variance for mammography screening recency.

The total sample (lower- and highest-risk groups combined) of women was used to test SEM. The mantle radiation variable was used as an independent predictor of mammogram recency. The mammogram model fit the data very well (N = 335; $x^2 = 297.67$, df = 286, p = 0.31; Comparative Fit Index = 0.995, Tucker Lewis Index = 0.993; root mean square of approximation [RMSEA] = 0.011; 90% CI = 0–0.024; probability RMSEA ≤ 0.05 =

Table 2. Descriptive Summary of Study Measures Comparing Survivors at Lower and Highest Risk for Secondary Breast Neoplasms

	Lower-Risk Group (N = 453)		Highest-Risk Group (N = 82)	
Variable	**$\bar{X}$**	**SD**	**$\bar{X}$**	**SD**
Intrinsic motivation	17.91	3.78	17.93	3.65
Extrinsic motivation	7.77	3.37	7.32	2.75
Affect	18.15	3.91	18.88	3.84
Health concerns	3.85	0.9	3.56	0.78
Patient-physician relationship	13.63	3.92	13.31	3.27
Number of cancer-related physician visits**	1.78	1.37	2.49	1.72
Exercise frequency at baseline	2.12	2.08	1.82	1.87
Variable	**n**	**%**	**n**	**%**
Recency of mammogram				
Never	265	59	22	27
Five or more years	86	19	30	37
More than two years but less than five years	39	9	15	18
One to two years	28	6	6	7
Do not know	8	2	–	–
Physician discussed risk of developing cancer**				
Yes	125	29	41	51
No	303	71	39	49
Perceived severity of late effects[a]				
Moderate, severe, life-threatening	101	23	30	37
Mild or no chronic problems	348	78	52	63
Received print media intervention*				
Yes	126	28	33	40
No	327	72	49	60
Age 40 or older**				
Yes	65	14	29	35
No	388	86	53	65
Likelihood of cancer-related follow-up**				
Precontemplation	220	50	22	28
Contemplation	127	29	36	46
Action	90	21	21	27

*p < 0.05; **p ≤ 0.001
[a] p = 0.065
Note. Because of rounding, not all percentages total 100.
Note. N values vary because of missing data.



[a] A nonsignificant x^2 test statistic measures the absolute fit of the model to the data but is sensitive to sample size (Bentler, 1990).

[b] The Comparative Fit Index (CFI) and Tucker Lewis Index (TLI) test the proportionate improvement in fit by comparing the target model to an independent base model; a value of 0.90 is minimally acceptable (Bollen, 1990), values approximating 0.95 indicate a good fit, and values at or close to 1 indicate an excellent fit (Browne & Cudeck, 1993).

[c] The root mean square of approximation (RMSEA) represents closeness of fit, and values approximating 0.06 and 0 demonstrate close and exact fit of the model, respectively (Brown & Cudeck, 1993; Hu & Bentler, 1999).

Figure 2. Predictors of Mammography Recency

Note. From "A Model of Health Behavior to Guide Studies of Childhood Cancer Survivors," by C.L. Cox, 2003, *Oncology Nursing Forum, 30*(5), p. E93. Copyright 2003 by Oncology Nursing Society. Adapted with permission.

1) and explained 43% of the variance in recency of mammogram screening. Eight variables predicted more frequent mammograms in keeping with the recommended schedule: (a) a more positive affect, (b) discussion of subsequent cancer with physician, (c) age 40 or older, (d) less intrinsic motivation, (e) visits to the oncology clinic within the past two years, (f) exposure to mantle radiation, (g) receipt of a print media intervention detailing risks and recommended follow-up for those at increased risk for breast cancer, and (h) perceptions of moderate to severe late effects of therapy. A more positive perception of physician interaction, less frequent fatigue, and more recent visits to the oncology clinic predicted a more positive affect. Higher levels of health concern were predicted by higher levels of extrinsic motivation, negative perceptions of the provider, more frequent fatigue, more recent oncology clinic visits, and a higher stage of readiness for medical follow-up. Higher levels of intrinsic motivation were predicted by lower levels of health concern, a more positive affect, older than age 40, and not having been exposed to chest radiation. Being older than age 40 directly predicted mammography recency and indirectly predicted screening recency through intrinsic motivation ($p = 0.05$).

Discussion

Female adult survivors of childhood cancer often do not adhere to recommended mammography screening guidelines. Approximately 59% of those at lower risk and 27% of those at highest risk had never had a mammogram despite their older age at the time and longer interval since diagnosis and treatment. In keeping with recommendations for the general population (U.S. Preventive Services Task Force, 2002), however, female survivors older than age 40 were more likely than those younger than age 40 to adhere to mammography screening guidelines.

Almost half of those at highest risk for developing secondary breast neoplasm reported having never discussed

Table 3. Structural Equation Modeling Results for Mammogram Recency (R^2 = 43%)

Variable	Estimate	SE	Estimate/SE[a] (z score)	Standard YX[b]
Mammogram recency				
Intrinsic motivation	–0.257	0.089	–2.88	–0.151
Affect	0.168	0.085	1.968	0.095
Discussed subsequent cancer	–0.505	0.157	–3.221	–0.14
Perceived severity of late effects	–0.514	0.172	–2.995	–0.131
Age 40 or older	1.853	0.208	8.919	0.404
Exposure to chest radiation	0.566	0.196	2.88	0.132
Print media intervention	0.361	0.155	2.329	0.1
Seen at oncology clinic in the past two years	–0.773	0.229	–3.376	–0.15
Affect				
Survivor-provider interaction	0.266	0.05	5.334	0.307
Seen at oncology clinic in the past two years	–0.304	0.144	–2.115	–0.104
Fatigue	0.407	0.041	10.031	0.567
Health concerns				
Fatigue	0.068	0.019	3.652	0.233
Readiness for medical follow-up	–0.087	0.03	–2.893	–0.187
Extrinsic motivation	–0.146	0.037	–3.918	–0.308
Survivor-provider interaction	0.094	0.025	3.696	0.268
Seen at oncology clinic in the past two years	0.159	0.075	2.119	0.135
Intrinsic motivation				
Affect	0.188	0.075	2.52	0.182
Health concerns	0.479	0.209	2.294	0.187
Age 40 or older	–0.504	0.172	–2.922	–0.187
Exposure to chest radiation	0.399	0.161	2.483	0.159

[a] z score = 1.96, significant at p=0.05; z score =2.58, significant at p=0.01

[b] An approximation of the strength of the relative contribution of the background variable to the outcome (either the latent construct or the path outcome) obtained by using data that adjust for the differences in measurement scales

SE—standard error

subsequent cancer risks with a physician. Fewer survivors in both groups reported being at the later action stage of readiness for medical follow-up than the earlier precontemplation and contemplation stages.

Fatigue and perceptions of severity of late effects were strong exogenous variables (unaffected by other variables) in the model. Perceptions of more severe late effects supported more recent mammography and contributed to greater health concerns; more frequent fatigue contributed to greater health concerns and to a more negative affect that, in turn, was more likely to result in less frequent mammography. In reports of adult survivors of childhood cancer, 19% of 2,645 survivors (Mulrooney et al., 2008) and 30% of 161 survivors reported fatigue (Meeske, Siegel, Globe, Mack, & Bernstein, 2005). Fatigue can have a negative effect on quality of life in survivors (Meeske et al.) as well as deter health behaviors that can modify late effects (Cox, Montgomery, et al., 2008; Cox, Rai, Rosenthal, Phipps, & Hudson, 2008).

More health concerns contributed to a poorer affect and lower levels of intrinsic motivation; the findings may reflect those patients who are experiencing more late effects sequelae already. More problems increase health concerns and may make survivors feel that their health issues are beyond their control (low intrinsic motivation). Moreover, lack of specific information on risk factors and misconceptions about risk can exacerbate concerns or make survivors deny that significant health problems exist (Hopwood, 2000; Mahdy, Fatohy, Mounir, & El-Deghedi, 1998; Pohls et al., 2004). Having discussed subsequent cancer risks with a healthcare provider, having received a print media intervention detailing personalized risk and recommended follow-up for a secondary breast neoplasm, and having followed up more recently at an oncology clinic predicted more recent mammography screening. The findings are similar to the trend seen in the general population, in which specific healthcare provider recommendations are associated with a higher rate of screening for cervical (Coughlin, Breslau, Thompson, & Benard, 2005), breast (Garbers & Chiasson, 2006; Mayer et al., 2007), prostate (Mayer et al.), colorectal (Katz et al., 2004; Ling, Klein, & Dang, 2006; Matthews, Nattinger, Venkatesan, & Shaker, 2007), and skin cancers (Manne & Lessin, 2006). The extent to which more recent oncology visits predicted more recent mammography screening may reflect an increase in sequelae of treatment, increase in confidence in the knowledge of the specialty provider, familiarity with the facility and its staff in case the treatment was more recent, or more targeted delivery of care than that available in a nonspecialty facility.

Consistent with results found in a population of survivors of Hodgkin disease, a more positive perception of healthcare provider interaction supported a more positive affect (Bober et al., 2007) and decreased health concerns; the model identified a more positive affect as a predictor of more recent mammography screening. Women, in particular, tend to view healthcare provider interaction as supportive (Hall, Irish, Roter, Ehrlich, & Miller, 1994; Hall & Roter, 1995), rely on provider input for their healthcare decisions, and value their relationship with healthcare providers (Hall et al.; Hall & Roter; Oeffinger et al., 2004; Shaw et al., 2006; Xu & Borders, 2003).

Motivation and stage or level of readiness for medical follow-up were key factors in the model. Extrinsic motivation and a higher stage of readiness for follow-up predicted a higher intensity of health concerns. Extrinsically motivated individuals are more worried and fearful about their health and perceive that they have less control over health matters (Cox, 2003; Cox et al., 2005; Deci &

Ryan, 2002); similarly, individuals who are in the precontemplation or contemplation stage of readiness for health behavior action perceive themselves as less efficacious in exerting control over health matters than those in the action stage (Emmons et al., 2003; Hogenmiller et al., 2007; Tung, Nguyen, & Tran, 2008) and are more likely to rely on healthcare professionals for direction.

Survivors younger than age 40, not exposed to chest radiation during cancer therapy, less concerned about their health, and more positive in affect were more intrinsically motivated. Greater intrinsic motivation, however, resulted in less frequent mammograms. Intrinsically motivated individuals are more self-reliant and self-directed, and generally more autonomous in their behavior choices (Deci & Ryan, 2002) than extrinsically motivated individuals. When more intrinsically motivated individuals do not have accurate information about risk and risk modifications, they are likely to be at greater risk for lack of medical follow-up than those who are more extrinsically motivated who rely more on provider input to direct their healthcare decisions.

Study Limitations

The study sample reflects a subset of the overall CCSS population; therefore, survivors included in the current analysis may not be fully representative of the population from which they were derived. The information used to classify the mammography screening outcome, as well as the independent measures, was based on self-reported data. Lastly, although the CCSS population represents a large and heterogeneous cohort of five-year survivors, results may not be generalizable to all childhood cancer survivors. As a group, CCSS participants may be more informed regarding risks and health promotion because of newsletters received as part of participation in the study.

Implications for Nursing

Regardless of the time since a survivor's diagnosis and treatment (Hudson et al., 2003; Langeveld, Ubbink, Smets, & Dutch Late Effects Study Group, 2000; Meeske et al., 2005), nurses and advanced practice nurses are encouraged to specifically inquire about any treatment-related symptoms, particularly pain, fatigue, and anxiety. The symptoms may share common biologic mechanisms (Cleeland et al., 2003; Lee et al., 2004; Miaskowski & Aouizerat, 2007) and, until addressed, may be a significant deterrent to recommended screening (survivors who are experiencing pain, debilitating fatigue, or anxiety are not likely to participate in routine screening). Nurses and advanced practice nurses should elicit survivors' concerns and address any misconceptions that may contribute to survivors' lack of understanding about the significance of their risks for a secondary breast neoplasm. Personalized information on survivors' specific risks and recommended follow-up delivered verbally and in print will emphasize the seriousness of the potential for this late effect and reinforce the need to adhere to the recommended mammography schedule. A focused responsive interaction between the nurse and survivor can explore survivors' fears, concerns, readiness for follow-up, and misconceptions, and is important to reduce survivors' anxiety about screening, support their motivation to follow the recommended screening schedule, and contribute to a more positive affect.

Conclusions

Several factors can influence female childhood cancer survivors' adherence to mammography screening recommendations, including already established sequelae (e.g., pain, fatigue), the survivor-provider relationship, important intrapersonal factors (affect, motivation, health concerns, level of readiness to seek appropriate follow-up for cancer), and in-print information that details specific risks for secondary breast neoplasm as well as the recommended follow-up to screen for this risk. Tailored verbal and print format interventions (Cox et al., 2006; Cox, Hudson, et al., 2009; Cox, Rai, et al., 2008; Wu & West, 2007) that consider patients' age, motivation, readiness for follow-up, risk perceptions, and affective response to their illness and treatment should be offered to patients and their families nearing treatment completion and in post-therapy follow-up. Supporting patients with written summaries of their treatment, late effects risks, and specific recommendations for follow-up as they transition to survivorship and nonspecialty primary care providers may be useful in promoting continued awareness of the seriousness of the potential for this late effect of treatment and the importance of regular mammography.

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