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Factors Supporting Cardiomyopathy Screening Among At-risk Adult Survivors of Pediatric Malignancies

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Abstract

Purpose—Anthracyclines and chest irradiation place adult survivors of childhood cancer at risk of cardiomyopathy; many survivors do not obtain the recommended screening. Based on our recent clinical trial, the addition of telephone counseling to a printed survivorship care plan more than doubled survivors' risk-based screening. Here we sought to measure the impact of specific factors targeted in the intervention for their impact on survivors' screening participation.

Methods—Study population -- survivors participating in a randomized longitudinal intervention trial. Survivor questionnaires and medical records at baseline and one-year follow-up provided the data. Within-and-between-group differences in factors were assessed at baseline and follow-up; structural equation modeling (SEM) identified direct and indirect effects on screening participation.

Results—Of the 411 survivors 55.3% female, 89.3% white, 38.9% college graduates, and age 26–59 years (mean=41 years, SD=7.68 years). At follow-up, the counseling group demonstrated higher scores for intent to undergo screening ($p<0.001$), adherence determination ($p<0.001$), autonomous regulation ($p<0.001$), competency ($p=0.03$), perceived effort warranted for screening ($p<0.001$), and perceived value of screening ($p=0.02$). SEM identified four factors that directly influenced screening participation ($n=411$, RMSEA=0.02 [90%CI=0.000–0.05]; CFI=0.99; TLI=0.99; WRMR=0.63): the counseling intervention ($p<0.0001$), intrinsic motivation

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Compliance with Ethical Standards:

Conflict of Interest: All of the authors (Cox, Zhu, Ojha, Steen, Ogg, Robison, Hudson) declare that they have no conflicts of interest.

Ethical Approval: All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The overall study was approved by the St. Jude Children's Research Hospital Institutional Review Board and at each of the 27 participating institutions in the Childhood Cancer Survivor Study.

Informed Consent: Informed consent was obtained from all individual participants included in the study.

($p<0.0001$), competency ($p<0.0001$), and decisional control ($p=0.001$); intrinsic motivation was also a mediator ($p=0.002$) of screening participation.

Conclusions—Direct interpersonal interaction focused on multiple modifiable, autonomy-supportive factors powerfully enhances the efficacy of a print survivorship care plan in increasing survivors' screening participation. This finding challenges providers to reach beyond the disease-treatment focus and embrace these strategies in their behavior-change efforts.

Keywords

cardiomyopathy; echocardiogram; survivors; pediatric cancer; late effects

INTRODUCTION

Although anthracyclines and chest irradiation contribute significantly to childhood cancer survival, they also confer a risk of asymptomatic left ventricular dysfunction, accelerated atherosclerosis, cardiomyopathy, constrictive pericarditis, heart valve disease, and congestive heart failure [1–4]. In Childhood Cancer Survivor Study (CCSS) investigations, adults treated for cancer during childhood and adolescence experience substantial excess risk of heart failure and death from heart disease compared to age- and gender-matched controls that have not had cancer [5,6]. The risk of congestive heart failure exhibits a strong dose-dependent relation with anthracycline chemotherapy exposure, which is higher among those exposed to chest radiation. Current long-term follow-up (LTFU) guidelines for pediatric cancer survivors [7–11] recommend periodic evaluation of left ventricular systolic function by echocardiography or comparable imaging every 1–5 years, based on age at cancer diagnosis and cumulative dose of cardiotoxic therapies.

Unfortunately, most childhood cancer survivors are not receiving risk-based cardiac screening that considers their unique vulnerability to heart disease following treatment with anthracycline chemotherapy or chest radiation. Despite their serious nature, these cardiovascular effects are frequently subclinical at early stages [2,4], and survivors may be unaware of or unconcerned about them. In the Childhood Cancer Survivor Study, only 511 (28.2%) of 1810 childhood-cancer survivors at high risk of cardiomyopathy reported having undergone screening during the previous 24 months [12]. Cancer centers are encouraged to provide all patients with a printed survivorship care plan (SCP) that summarizes treatment information and outlines health-screening recommendations for LTFU. However, the single prospective pilot study of SCPs found that even with an SCP, only 20% of survivors underwent cardiac screening within the next 2 years [13].

We recently reported the results of a 1-year randomized trial of an intervention aimed at increasing at-risk adult survivors' cardiomyopathy screening adherence [14]. The standard care (control) intervention comprised a mailed SCP with individualized details about the survivor's treatment, late effects risks, and recommended follow-up and lifestyle modifications, while the experimental intervention comprised the SCP plus two telephone-counseling sessions conducted by an advanced-practice nurse (APN). At the 1-year follow-up, 107 (52.2%) of 205 survivors in the APN group had completed screening compared with 46 (22.3%) of 206 survivors in the SCP-only group ($p=0.001$). The APN counseling group

remained twice as likely as the control group to have completed the recommended cardiomyopathy screening (RR, 2.31; 95% CI, 1.74 to 3.07).

While the intervention's value was demonstrated, the specific impact of factors targeted in the intervention was unknown. Here we sought to identify factors that directly or indirectly affected the likelihood of survivors' cardiomyopathy screening during one year of follow-up.

METHODS

Participants

The clinical trial and associated studies were approved by the St. Jude Children's Research Hospital's Institutional Review Board. The methods of the randomized trial are described elsewhere [14]. Briefly, long-term survivors of childhood cancer recruited for the study were current participants in the CCSS and met the following criteria: they a) had received anthracycline chemotherapy and/or chest irradiation; b) had a diagnosis of leukemia, CNS tumor, Hodgkin lymphoma, non-Hodgkin lymphoma, kidney tumor, neuroblastoma, soft tissue sarcoma, or bone tumor; c) had diagnosis and initial treatment at one of 27 collaborating CCSS institutions; d) had a diagnosis between January 1, 1970 and December 31, 1986; e) were 21 years of age at diagnosis; f) were currently age 25 years; g) had undergone no cardiovascular (CV) screening during the previous 5 years; h) were not being followed at an institution actively recruiting adult survivors to a long-term follow-up program; and i) had a history of satisfactory, non-surrogate response to CCSS surveys. Of the 1257 survivors meeting the eligibility criteria, we achieved our targeted accrual of 509 participants. Of those, 472 enrolled and were randomly assigned: SCP, n=234 and SCP + phone counseling n=238. Those survivors completing the study included 206 participants in the usual care group and 205 in the intervention group. Compared with survivors who were enrolled and randomly assigned, eligible survivors who did not participate were more likely to be men and < 5 years of age at cancer diagnosis, have lower educational attainment and household income, received cranial irradiation, report health status as fair to poor, and have a lower prevalence of grade 2 or 4 chronic health conditions [14].

The counseling intervention

To accomplish the desired behavior change, the advanced-practice nurses promoted motivation for CV health by satisfying 3 primary participant needs [15]: 1) *competency* (providing clear information about behavior outcomes, realistic expectations and self-selected goals, and providing positive, nonjudgmental feedback); 2) *autonomy* (avoiding confrontation and coercion, exploring behavioral options, helping survivors to identify the discrepancy between their behavior and behaviors needed for optimal CV health, and encouraging survivors to choose their course of action and their preferred style of interacting with their care provider); 3) the *need for relatedness* (expressing genuine interest and warmth throughout the interaction, offering empathic and non-contingent support, avoiding criticism or blame) [15, 16].

Theoretical framework

This post-hoc analysis was guided by the Interaction Model of Health Behavior (IMHB) [16], adapted for study of childhood cancer survivors [17]. Its broad base and multiple levels of variables incorporate concepts from cognitive processing theories (e.g., Health Belief Model, Social Cognitive Theory, Self-regulation Theory, Transtheoretical Model) that have guided health behavior intervention studies in the general population. The IMHB enhances the cognitive processing content of these models by including motivational constructs derived from Self-Determination Theory [15] and affective constructs derived from stress and coping theory [18]. Cognitive appraisal constructs (e.g., social norms, health beliefs, knowledge, concerns), motivation constructs (e.g., self-efficacy, intrinsic motivation, self-regulation, intent) and negative affective response constructs (e.g., fear, anxiety, depression, stress) are important covariates, direct predictors, or moderators/mediators of health-behavior outcomes; they can be experimentally manipulated, allowing investigators to estimate the magnitude of an intervention's effect on subsequent behavior. The model recognizes the role of demographics, environmental resources (income, employment, health care access), social influences (e.g., social support, subjective norms), and physical limitations (pain, functional limitations) as potential factors in health behavior choices [17]. The IMHB identifies patients' decisional control in their health care as an important potential barrier or support to behavior change. Key to IMHB assumptions is that the provider's role is not to persuade or coerce, but rather to promote, support and sustain behavior change by helping the individual to obtain information, consider alternatives, and arrive at potential solutions [17,19]. The provider's goal is to facilitate behavior change by helping the survivor resolve knowledge and attitude conflicts and by supporting the competency and motivation to engage in the positive behavior [15, 20]. The constructs described here were deliberately targeted in the counseling intervention, and their specific impact was measured in the present study.

Background variables included: marital status, employment status, number of household members, highest household education, and household income. Insurance status, health care access, and regular source of primary care (yes/no) were assessed by using index items from the National Health Interview Survey [21] and the CCSS cohort surveys. Diagnostic data (date, interval since diagnosis/completion of treatment, type and cumulative dose of treatment) were obtained from CCSS files and corroborated by the principal investigators at the respective institutions.

Social influence assessed survivors' perception of the importance of their cardiac health screening to their immediate family and friends [22] with rewording of items to refer to the survivor's long-term follow-up.

Perceived symptoms were assessed using the Somatization subscale of the Brief Symptom Inventory (BSI) [23] adapted for childhood cancer survivors [24]. The National Cancer Institute's *Common Terminology Criteria for Adverse Events (CTCAE)* [25] provides a calculated variable that scores both acute and chronic conditions in cancer patients and survivors of all ages; conditions are graded as none (grade 0), mild (grade 1), moderate (grade 2), severe (grade 3), life-threatening or disabling (grade 4), and fatal (grade 5). If participants had more than one condition, the most advanced grade was used in the analysis.

Cognitive Appraisal (beliefs, concerns, knowledge): Survivors' reported *knowledge* of cancer diagnosis, major treatments, and subsequent long-term health risks was compared to their medical records to calculate a percent-correct knowledge score. *The Heart Disease Fact Questionnaire* [26], adapted to childhood cancer survivors at risk for cardiac sequelae, is a 31-item questionnaire in True-False format. Scores were calculated as percentage correct. *Beliefs* were assessed as (a) *perceived severity* of late effects (a Likert 5-point scale Not serious at all – Very serious); (b) *perceived susceptibility* to late effects (a Likert 5-point scale Very unlikely-Very likely) [27]; (c) *perceived health status* taken from the Behavioral Risk Factor Surveillance System (BRFSS) questionnaire [28] (Excellent=5; Poor=1); and (d) *cancer-related concerns* (cancer returning, having children, the future) were assessed with validated items from the CCSS studies [27].

Motivation: CV self-regulation (autonomous regulation, relative autonomy, controlled regulation), modified from Treatment Self-regulation [29], ascertained preference for cardiac screening and the degree to which the motivation was autonomous. Relative autonomy was computed by subtracting the controlled regulation score from the autonomous regulation score. *Self-efficacy* for obtaining health screening, including confidence in keeping the appointments, was assessed by using an adapted scale previously validated for mammography screening [30]. *Intrinsic motivation* [29] assessed survivors' perceived competence, effort warranted for CV screening, and perceived value/usefulness of CV screening. *Intent to undergo CV screening* was assessed, modified from the Adherence Determination Scale [22].

Affective Response: Depressed mood was assessed by using the depression and anxiety subscales of the Brief Symptom Inventory (BSI) [23]. The Brief Perceived Stress Scale [31] appraised the stress level over the past month. The BSI Global Psychological Distress scale [23] measured an overall distress level.

Survivor-Provider Interaction: The Patient Assessment of Chronic Illness Care measure [32] evaluated the extent of survivors' perceived active participation (decisional control) in their care in two domains, general care and cancer care. *Health Care Climate* [29] assessed the degree to which patients reported their health-care providers to be autonomy-supportive versus controlling.

SEM Measures: In order to reduce the number of items for SEM, we constructed latent variables by combining scales and subscales representing the independent variables in the study. To design these constructs, we used exploratory and confirmatory factor analyses to identify the latent variables and their composition. The latent variables included: 1) **intrinsic motivation**, defined by *intent to adhere to screening recommendations, relative autonomy, perceived effort warranted for screening, and perceived value/usefulness of screening*; **affective response**, defined by *anxiety, perceived stress, and depressed mood*; **cognitive appraisal**, defined by *perceived health status, perceived susceptibility, and cancer concerns*; and **decisional control**, defined by *perceived provider support for autonomy-support and decisional control vs. controlling interaction in general health care and cancer care* and by reported *health care climate*. All other variables tested by factor analysis either failed to

significantly define the latent constructs or did not emerge in the model as significant directly observed variables.

Analysis

Table 1 provides descriptive statistics for demographic and treatment variables in the intervention and control groups. Chi-square or Fisher's exact test was used to compare groups. Paired t-tests were used to compare measures at baseline and the one-year follow-up in the intervention and control groups. At T¹ we performed analyses (linear regression) with and without adjustment for those variables that were significantly different between the two groups at baseline: global psychological distress, autonomous regulation, relative autonomy, and exposure to cranial irradiation. Because diagnosis was borderline significant, we grouped diagnoses into hematological malignancies and solid tumors, and performed both adjusted and unadjusted analyses. Because there were no differences in conclusions between the adjusted and unadjusted measures, unadjusted measures are reported.

For SEM, the two groups were combined to measure participation in cardiomyopathy screening (yes/no). We used the *difference* between the baseline and follow-up measures for all variables in SEM thereby capitalizing on all study data. Criteria for SEM fit were: a) a conceptually sound model; b) statistically significant parameter estimates representing the strength of the path between two variables; c) met the established SEM fit criteria (root mean square error of approximation [RMSEA] = 0.05 [33,34], comparative fit index [CFI], Tucker Lewis index [TLI] = 0.90 [35]; and d) weighted root mean square residual (WRMR), an indicator of fit for binary outcome measures, <0.90 [36].

RESULTS

Participants

The sample was 55.3% female, 26–59 years of age (mean=41 years, SD=7.68 years), 89.3% white, and 38.9% college graduates (Table 1). Annual family income was >\$60K in 61.1%, and 90.8% had health insurance. The predominant diagnosis was leukemia (33.9%). There were two peak age ranges at diagnosis, 0–4 years (26.8%) and 10–14 years (25.1%); 56.2% had survived more than 28 years after diagnosis. Treatment comprised chemotherapy in 91.0%, radiation in 67.4%, and both in 58.4%. Most (82.5%) reported at least one CTCAE-defined chronic condition, and 92.7% reported excellent, very good, or good health. The only between-group difference at baseline was a greater number in the intervention group who had received cranial radiotherapy exposure ($p=0.04$). When adjusted for cranial radiation, there were no differences in conclusions between the adjusted and unadjusted models on any of the variables. Unadjusted models are reported.

Comparison of factors in the two groups

Table 2 provides alpha reliability assessment of the measures used at baseline and follow-up, means and standard deviations for all variables by study arm, and p -values for differences within and between groups. Despite randomization, the counseling group reported higher levels of global psychological distress ($p=0.04$), autonomous regulation ($p<0.001$) and relative autonomy ($p=0.02$) at baseline.

In the APN counseling group perceived social value of screening increased, as did intent to receive screening, adherence determination for screening, autonomous regulation, controlled regulation, relative autonomy, self-efficacy, perceived competency, perceived effort warranted for screening, and perceived value/usefulness of CV screening. Both depressed mood ($p=0.01$) and overall psychological distress ($p=0.01$) decreased in the counseling group.

The group receiving SCP only demonstrated increases in the perceived social value of screening, cancer knowledge, intent to obtain screening, adherence determination, autonomous regulation, relative autonomy, self-efficacy, perceived competency, perceived effort warranted for screening, supportive general health care and supportive cancer care. Overall psychological distress decreased ($p=0.04$).

Compared to the SCP only group, intent to receive screening was higher in the APN counseling group, as was adherence determination, autonomous regulation, and perceived competency, effort warranted for screening, and value/usefulness of screening. These significant differences persisted even when T^1 scores were adjusted for the higher baseline scores in the intervention group.

Structural equation modeling

All significant SEM variables and their contributions to the final model are identified in Table 3 and Figure 1. In addition to the primary outcome (screening participation), each variable that had a direct or indirect effect on screening participation (bold headings, Table 3) was also treated as an outcome in the SEM, while other variables (not in bold) significantly influenced those outcomes. Figure 1 illustrates directly observed variables (unshaded rectangles) and latent variables (shaded ellipses). The data demonstrated that a well-fitting model ($N=411$; $CFI=0.99$; $TLI=0.99$; $RMSEA=0.015$, 90% $CI=0.000-0.47$; $WRMR=0.63$) identified the interrelationships among the directly observed and latent variables influencing screening participation.

As shown by the Estimate/SE, the strongest direct influence was intrinsic motivation, followed by sense of competency, the counseling intervention, and decisional control. Intrinsic motivation was strongly influenced by the survivor's sense of self-efficacy and the counseling intervention. Competency was strongly and positively influenced by self-efficacy but negatively influenced by negative affect and by cognitive appraisal. Survivors' self-efficacy was positively affected by the counseling intervention. Cognitive appraisal was influenced nearly equally by affective response and self-efficacy. Affective response was the only latent variable in the model to be influenced by either of the knowledge variables. Two factors positively influenced survivors' perceived health-related decisional control—negative affective response and self-efficacy; the counseling intervention had a negative weak effect. Both motivation and decisional control met the criteria for potential mediators (both influenced screening and were themselves influenced by the counseling intervention); however, only motivation emerged as a significant mediator (Est/SE=3.164, $p=0.002$).

CONCLUSIONS

This post-hoc analysis of data from a randomized intervention trial was designed to penetrate the intervention “black box” and reveal how different factors contribute to survivors’ decisions to participate in screening. We found that the counseling intervention not only directly affected screening participation but also strongly affected other direct and indirect determinants of screening.

Only one significant demographic/medical history difference emerged between the two study groups at baseline; the intervention group had a higher proportion of survivors exposed to cranial radiation. Adjusting for cranial radiation exposure, however, had no impact on any of the study variables. Study participants treated with brain radiation largely comprised [note all but one CNS tumor survivor] survivors of childhood acute lymphoblastic leukemia (ALL). Both chemotherapy and low-dose cranial irradiation (i.e., 18 Gy–24 Gy) administered for the treatment or prevention of CNS leukemia adversely impact neurocognitive function with risk and severity of deficits related to age at diagnosis, time from exposure, and radiation dose. In particular, deficits in executive function, critical to organization and planning, appear to be prominently affected in ALL survivors treated with cranial irradiation and increase in prevalence over time [37]. It is likely that this group benefitted from counseling that systematically addressed barriers to cardiomyopathy screening, especially the logistics of navigating the health care system and physician communication. The significantly higher proportion of cranially irradiated survivors in the APN intervention group suggests that our results may underestimate the magnitude of the intervention in survivors who did not receive radiation.

Both groups demonstrated positive changes between baseline and 1-year follow-up; however, the magnitude of that change was consistently higher in the counseling group. The counseling group demonstrated higher scores at follow-up on all motivational constructs that were deliberately targeted in the counseling intervention. The goal of the counseling intervention was to maximally support the survivor’s increasing self-reliance in initiating and sustaining behaviors to prevent or reduce cardiac sequelae. This self-reliance was reinforced when the behavior: 1) was *internalized*, 2) was *valued* as personally relevant, 3) reinforced *perceived competency*, 4) was *chosen freely*, albeit suggested or advised by the health care provider, and 5) flourished in an *autonomy-supportive health care climate* [38].

SEM identified these same autonomy-supportive factors as important in survivors’ decision to obtain an echocardiogram; intrinsic motivation, competency, and the counseling intervention directly increased screening participation. The counseling intervention also increased intrinsic motivation and self-efficacy. While self-efficacy did not directly influence screening participation, it was influenced by the counseling intervention and contributed substantially to intrinsic motivation, competency, and cognitive appraisal.

The counseling intervention negatively influenced survivors’ perceptions of their health care environment and the extent to which providers were controlling rather than autonomy-supportive. Many primary care providers are not aware of the fact that childhood cancer survivors have a higher risk of cardiomyopathy related to their cancer treatment and the

cardiomyopathy surveillance recommended for them or of resources that summarize these recommendations [39–41]. Several survivors' physicians declined to order an echocardiogram in the absence of symptoms [14]. This refusal may well have contributed to survivors' perception of their health care environment as less supportive of autonomy and more control-based. There was a significant difference between the groups relative to the number of survivors who were denied screening (Usual Care, n=28; Intervention, n=7; p=0.02). We feel this supports a major premise in our intervention: patients need counsel on how to interact with providers who may not know the risks associated with pediatric cancer therapy nor the most recent recommendations for screening and follow-up. The APNs spent considerable effort in working with the survivors on how to present their concerns and offered reprints of recent classics in the field to share with the physician. To what extent this empowered this group can be explored in subsequent studies. At the same time, higher scores on the latent decisional control measure were associated with obtaining an echocardiogram, illustrating the impact of an autonomy-supportive health care environment on behavior change.

Both affective response (*anxiety, stress, depressed mood*) and cognitive appraisal (*lower health status, greater perceived susceptibility, greater cancer concerns*) negatively affected self-perceived competence, and by logical extension, feelings of less competence in health matters. A higher cancer knowledge score negatively influenced survivors' affective response (anxiety, stress, depressed mood). Knowing more about their cancer, treatment, and late effects may generate uncertainty, anxiety, and fear of future disability. Moreover, in survivor-specific settings, the focus on physical manifestations of late effects [42] reinforces uncertainty and fear.

While the clinical trial demonstrated the overall efficacy of the intervention ("the black box"), it did not point to what factors directly increased cardiomyopathy screening participation or to other variables that might be indirect influences (mediator, moderator, interaction) on screening participation. This study, in contrast, allowed for the identification of those factors that not only directly contributed to a positive outcome (i.e., intervention, motivation, decisional control, competency, self-efficacy) but equally important, it points to factors that had a major impact on these direct contributors (i.e., self-efficacy, cancer knowledge, affective response, cognitive appraisal). Good interventions not only consider the direct contributors to an outcome, but weight the importance of indirect contributors as well. Subsequent research and/or clinical implementation of the intervention can focus greater attention on the factors identified here. This has the potential to reduce the number of measures in future studies (measures found to have no impact [direct or indirect]) and/or the refinement of our intervention approach, where these factors can receive greater emphasis in clinician training and in intervention delivery.

This study should be interpreted in light of its limitations. Participants demonstrated high socioeconomic status based on education, income, and insurance and thus the findings may not be generalizable to the broader childhood cancer survivor population. The sample comprised long-standing participants in the CCSS study who had been exposed to information about their cancer-related health risks through biannual newsletters, which may similarly limit the generalizability of our findings. We did, however, recruit only survivors

who reported that they had not undergone cardiomyopathy screening during the previous 5 years. These results, therefore, should apply to all survivors who deny or neglect their screening needs. Finally, we lacked the statistical power to analyze the SEM structure in survivor subsamples (e.g., gender, age, diagnosis).

We identified specific factors that can directly and indirectly promote participation in cardiomyopathy screening among at-risk survivors. Survivors' motivation, sense of competency, self-efficacy, and active decisional control in their health-care management were not only modifiable, but very powerful influences in supporting screening participation. This study illustrates the challenge and complexity of helping survivors to internalize a new behavior after previously neglecting or lacking access to an important assessment. Moreover, it demonstrates the positive impact of direct interpersonal interaction, in contrast to print or electronic media only, in supporting behavior change. These findings challenge providers to reach beyond the focus on disease treatment and extend survivorship care interventions to include direct interaction and autonomy-supportive strategies.

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Figure 1.
Structural Equation Model of Cardiomyopathy Screening Participation (n=411)

Table 1

Descriptive summary of the sample

Characteristics	Control group		Intervention group		P value
	N	%	N	%	
COG-recommended screening frequency	43	20.9	43	21.0	0.73
	Every 2 years				
	Every 5 years	36	17.5	30	14.6
	Every year	127	61.7	132	64.4
Gender	Female	112	54.4	115	56.1
	Male	94	45.6	90	43.9
Age at randomization	<30 years	18	8.7	23	11.2
	30 years	188	91.3	182	88.8
Race	White non-Hispanic	186	90.3	181	88.3
	Black	1	0.5	3	1.5
	Other	17	8.3	21	10.2
	Unknown	2	1.0	0	0.0
Education	High school or less	20	9.7	17	8.3
	Post-high school study/some college	55	26.7	59	28.8
	College graduate	81	39.3	79	38.5
	Postgraduate level	50	24.3	50	24.4
Household income	<\$20,000	12	5.8	16	7.8
	\$20,000–\$60,000	62	30.1	57	27.8
	>\$60,000	126	61.2	125	61.0
	Unknown	6	2.9	7	3.4
Health insurance	Yes/Canadian	187	90.8	186	90.7
	No	17	8.3	18	8.8
	Unknown	2	1.0	1	0.5
Diagnosis	Bone cancer	33	16.0	40	19.5
	Central nervous system tumor	1	0.5	0	0.0
	Hodgkin lymphoma	42	20.4	29	14.1
	Wilms tumor	24	11.7	10	4.9

Characteristics	Control group		Intervention group		P value
	N	%	N	%	
Leukemia	65	31.6	74	36.1	.
Non-Hodgkin lymphoma	16	7.8	24	11.7	.
Neuroblastoma	11	5.3	7	3.4	.
Soft-tissue sarcoma	14	6.8	21	10.2	.
Age at cancer diagnosis	58	28.2	52	25.4	0.60
0–4 years	38	18.4	46	22.4	.
5–9 years	49	23.8	54	26.3	.
10–14 years	61	29.6	53	25.9	.
15–20 years	97	47.1	83	40.5	0.18
Years since diagnosis	109	52.9	122	59.5	.
28 or fewer	183	88.8	191	93.2	0.13
More than 28	23	11.2	14	6.8	.
Chemotherapy	137	66.5	140	68.3	0.70
Yes	69	33.5	65	31.7	.
No	114	55.3	126	61.5	0.21
Both chemotherapy and radiation	92	44.7	79	38.5	.
Yes	62	30.1	50	24.4	0.16
No	139	67.5	153	74.6	.
Chest radiation	5	2.4	2	1.0	.
Yes	37	18.0	55	26.8	0.04
No	164	79.6	148	72.2	.
Brain radiation	5	2.4	2	1.0	.
Yes	140	68.0	153	74.6	0.14
No	66	32.0	52	25.4	.
Alkylating agent chemotherapy	163	79.1	173	84.4	0.17
Yes	43	20.9	32	15.6	.
No	164	79.6	165	80.5	0.90
Surgery	41	19.9	40	19.5	.

Characteristics	Control group		Intervention group		P value
	N	%	N	%	
	1	0.5	0	0.0	.
Amputation	15	7.3	20	9.8	0.38
	190	92.2	185	90.2	.
	1	0.5	0	0.0	.
Completed cardiovascular screening form	206	100	205	100	0.38
Grade 1–4 chronic condition at any time	39	18.9	33	16.1	0.45
	167	81.1	172	83.9	.
Two or more grade 3–4 chronic conditions at any time	183	88.8	180	87.8	0.75
	23	11.2	25	12.2	.
Health status	194	94.2	187	91.2	0.44
	12	5.8	16	7.8	.
	0	0.0	2	1.0	.

Table 2

Study measures' standardized alphas and within- and between-group differences at baseline (T_0) and follow-up (T_1)

			Intervention Group			Control Group				
MEASURES	Alpha T ⁰	Alpha T ¹	Mean (STD)/T ⁰	Mean (STD)/T ¹	P value	Mean (STD) T ⁰	Mean (STD) T ¹	P value	T ⁰ Group differences P value	T ¹ Group differences P value
<i>Norms, knowledge, perceptions</i>										
Subjective norms about screening	0.88	0.85	16.76 (5.00)	18.80 (4.26)	<0.001	15.91 (5.31)	18.33 (4.32)	<0.001	0.10	0.27
Perceived health status	.	.	2.35 (0.83)	2.33 (0.85)	0.52	2.27 (0.85)	2.20 (0.88)	0.18	0.29	0.16
Cancer knowledge	.	.	12.87 (2.08)	13.13 (1.81)	0.07	12.79 (1.92)	13.26 (1.89)	<0.001	0.70	0.46
Cardiac knowledge	.	.	0.84 (0.08)	0.83 (0.08)	0.02	0.85 (0.07)	0.84 (0.08)	0.18	0.57	0.12
Intent for screening	0.89	0.92	11.11 (4.15)	14.33 (4.29)	<0.001	10.81 (3.82)	12.57 (3.96)	<0.001	0.44	<0.001
Adherence determination for screening	.	.	27.87 (7.89)	33.13 (7.17)	<0.001	26.72 (8.08)	30.90 (7.10)	<0.001	0.15	<0.001
Perceived susceptibility	0.87	0.88	30.74 (8.21)	31.26 (8.48)	0.32	30.23 (8.46)	30.59 (8.94)	0.38	0.53	0.44
Perceived severity	0.92	0.92	35.68 (7.58)	35.40 (7.08)	0.71	34.44 (8.17)	35.46 (7.92)	0.07	0.11	0.94
<i>Affect</i>										
BSI somatization	.	.	50.07 (7.95)	49.46 (8.71)	0.24	49.03 (7.71)	48.23 (7.49)	0.06	0.18	0.13
BSI Anxiety	0.87	0.85	48.24 (10.10)	47.46 (9.39)	0.16	46.50 (9.06)	45.78 (8.38)	0.24	0.07	0.06
Perceived stress	0.77	0.79	4.86 (3.03)	4.67 (3.19)	0.24	4.65 (3.12)	4.58 (3.32)	0.56	0.49	0.79
Cancer worries/fears	0.76	0.78	7.60 (2.62)	7.45 (2.76)	0.20	7.77 (2.63)	7.66 (2.82)	0.59	0.53	0.43
BSI Depressed mood	0.89	0.91	48.63 (9.48)	47.21 (9.08)	0.01	47.16 (8.58)	46.72 (8.85)	0.35	0.10	0.58
BSI Psychological distress	0.9	0.91	48.89 (9.69)	47.48 (10.05)	0.01	46.97 (9.38)	45.90 (9.63)	0.04	0.04	0.845
<i>Motivation</i>										
Autonomous regulation	0.9	0.92	4.79 (1.54)	5.35 (1.41)	<0.001	4.33 (1.62)	4.87 (1.50)	<0.001	<0.001	<0.001
Controlled external regulation	0.82	0.84	2.02 (1.06)	2.24 (1.23)	<0.001	1.96 (1.03)	2.06 (1.02)	0.24	0.55	0.11
Relative autonomy	.	.	2.77 (1.59)	3.12 (1.59)	<0.001	2.38 (1.63)	2.81 (1.51)	<0.001	0.02	0.05
Self-efficacy	0.86	0.91	41.57 (6.08)	44.35 (6.41)	<0.001	41.94 (5.94)	43.27 (6.94)	<0.001	0.53	0.10
Perceived competency	0.9	0.90	25.03 (6.02)	27.27 (5.53)	<0.001	25.11 (5.86)	26.04 (6.06)	<0.001	0.90	0.03
Perceived effort required for screening	0.85	0.90	13.68 (7.29)	21.53 (9.25)	<0.001	13.29 (7.38)	16.13 (7.86)	<0.001	0.59	<0.001

MEASURES	Alpha T ⁰	Alpha T ¹	Intervention Group			Control Group			T ⁰ Group differences <i>P</i> value	T ¹ Group differences <i>P</i> value
			Mean (STD)/T ⁰	Mean (STD)/T ¹	<i>P</i> value	Mean (STD) T ⁰	Mean (STD) T ¹	<i>P</i> value		
Perceived value/usefulness of screening	0.94	0.95	38.92 (9.11)	40.79 (9.16)	<0.001	37.87 (9.32)	38.58 (9.45)	0.37	0.25	0.02
<i>Patient-provider interaction</i>										
General health care survivor participation	0.84	0.86	15.83 (5.35)	16.52 (5.60)	0.51	14.93 (5.43)	16.65 (5.50)	<0.001	0.16	0.84
Cancer follow-up care survivor participation	0.93	0.94	29.04 (14.19)	31.55 (14.30)	0.37	27.41 (12.33)	31.75 (15.00)	<0.001	0.35	0.91
Health care climate	0.91	0.92	28.12 (6.31)	28.37 (6.70)	0.80	27.91 (7.43)	28.73 (6.28)	0.08	0.81	0.63

Abbreviations: SD, standard deviation; BSI, Brief Symptom Inventory
T-tests for paired and independent samples were used to derive *P* values.

Table 3

Direct and indirect factors influencing survivor participation in cardiomyopathy screening

	Estimate	SE	Estimate/SE	P
Direct Effects on Screening Participation				
Intrinsic motivation	0.02	0.003	8.12	<0.0001
Competency	0.07	0.011	6.32	<0.0001
Counseling intervention	0.69	0.13	5.32	<0.0001
Decisional control	0.01	0.003	3.32	0.001
Indirect Effects on Screening Motivation				
Intrinsic Motivation				
Self-efficacy	1.17	0.12	9.92	<0.0001
Counseling intervention	6.38	1.85	3.46	0.001
Competency				
Self-efficacy	0.15	0.03	5.27	<0.0001
Affective response	−0.06	0.02	−3.35	0.001
Cognitive appraisal	−0.07	0.02	−2.85	0.004
Self-efficacy				
Counseling intervention	1.63	0.64	2.57	0.010
Cognitive Appraisal				
Self-efficacy	0.21	0.06	3.59	<0.0001
Affective response	0.08	0.03	2.95	0.003
Affective Response				
Cancer knowledge	0.88	0.38	2.30	0.021
Decisional Control				
Affective response	0.27	0.08	3.31	0.001
Self-efficacy	0.67	0.21	3.27	0.001
Counseling intervention	−8.11	3.40	−2.38	0.017

Abbreviations: SE, Standard error; Estimate/SE, Estimate divided by the standard error