Published in final edited form as:

J Cancer Surviv. 2011 September ; 5(3): 247–254. doi:10.1007/s11764-011-0177-7.

Improving Short-Term Sun Safety Practices among Adolescent Survivors of Childhood Cancer: A Randomized Controlled Efficacy Trial

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Abstract

Introduction—Skin cancer is one of the most common secondary neoplasms among childhood cancer survivors. However, little evidence exists for effective interventions to promote sun safety behaviors within this population.

Methods—This small-scale randomized controlled trial examined the efficacy of the Survivor Health and Resilience Education (SHARE) Program intervention, a multiple health behavior change intervention designed to increase sun safety practices among adolescent survivors of childhood cancer. Adolescent survivors of childhood cancer (11–21 years) were randomly allocated to a group-based behavioral intervention ($n = 38$) or wait-list control ($n = 37$). Self-reported sun safety behaviors were assessed using a valid, 8-item scale at baseline and 1-month post-intervention.

Results—Controlling for baseline sun safety, gender, and seasonal influences, intervention participants reported significantly more sun safety practices (e.g., using sunscreen, reapplying sunscreen regularly) at 1-month post-intervention than control participants ($B = 2.64$, 95% CI = 1.02, 4.27, $p = 0.002$).

Conclusions—The results suggest that SHARE was efficacious in producing improvements in short-term self-reported sun safety practices among adolescent survivors of childhood cancer. Future research is needed to build upon this work by incorporating objective measures of sun safety behaviors and examining intervention durability.

Implications for Cancer Survivors—Behavioral interventions addressing lifestyle factors, including sun safety behaviors, among adolescent survivors of childhood cancer should be integrated into long-term care to reduce the risk for secondary malignancies and diseases.

Introduction

As a result of significant advances in the detection and treatment of pediatric cancer, the number of survivors of childhood cancer in the United States has grown tremendously over the past several decades. The 5-year survival rate of pediatric cancer now exceeds 80% [1], an increase from the early 1970s when fewer than 60% of children and adolescents were

predicted to live 5 years or longer following cancer diagnosis [2]. While advances in detection and curative treatment for pediatric malignancies have improved childhood cancer survival rates, many therapeutic agents also lead to cancer late effects among survivors, including risk of secondary cancers [3, 4].

Skin cancer is one of the most common forms of secondary cancers among survivors [5, 6]. Specifically, non-melanoma skin cancer is the most commonly occurring secondary neoplasm among survivors, along with melanoma [6, 7]. Recent evidence from the Childhood Cancer Survivor Study Cohort demonstrates that of the survivors diagnosed with a secondary neoplasm 37% had a non-melanoma skin cancer and nearly 4% had a melanoma skin cancer [6]. As noted by others, secondary skin cancer among survivors of pediatric cancer represents a prominent late effect of cancer treatment and an important public health concern for this population [6, 7].

Risk for skin cancer among survivors of childhood cancer is increased by factors related to cancer treatment, such as receiving radiation therapy, young age at treatment, and time elapsed since treatment [5, 6]. Additionally, lifestyle behaviors may increase the risk for secondary skin cancer among young survivors. For example, the risk for skin cancer can be exacerbated by not engaging in behaviors that have been well-established to protect skin [8, 9], such as using sunscreen with sun protection factor (SPF) ≥ 15 , limiting sun exposure, and wearing protective clothing [10]. Moreover, risk for skin cancer is also increased by exposure to ultraviolet (UV) radiation at an early age and with greater total accumulated UV radiation exposure [11].

Health education and health promotion interventions encouraging sun safety behaviors are needed for adolescent survivors of pediatric cancer to foster good skin cancer preventive habits early in life, and to off-set the increasing risk for skin cancer that accumulates over time [5, 6]. Unfortunately, evidence for effective interventions promoting sun safety behaviors within this population remains scarce [9, 12]. In light of this, we conducted a small-scale randomized controlled trial to examine the efficacy of the Survivor Health and Resilience Education (SHARE) Program intervention for improving short-term sun safety behaviors among adolescent survivors of pediatric cancer. SHARE is a manualized, health education and multiple health behavior change intervention for adolescent survivors of childhood cancer focusing in part on improving their sun safety behaviors [13].

Methods

Setting and Study Participants

The Survivor Health and Resilience Education (SHARE) Program was designed as a randomized controlled trial to test the efficacy of a manualized health education and behavior intervention for multiple lifestyle and health behavior outcomes among adolescent survivors of childhood cancer [13]. The intervention was previously pilot-tested, and the methods for the trial have been described previously and are summarized here [13-15]. Trial eligibility included both male and female adolescents age 11 - 21 years who were previously treated for an oncologic malignancy, 1 or more years post-cancer treatment, and 1 or more years cancer free. Tumor registries from two pediatric cancer research and treatment centers were used to identify patients who were potentially eligible for the trial. The two sites, which are in close proximity to one another (< 5 miles), provide inpatient and outpatient services to large and diverse patient populations and have active pediatric hematology-oncology programs that include follow-up care and late effects programs for survivors of childhood cancer. All study procedures were approved by an institutional review board.

Recruitment

Parents of potentially-eligible patients were mailed a letter from the child's treating oncologist that introduced the trial and referred parents to an enclosed brochure and informed consent/assent form for additional information. Parents were asked to respond to the mailing by contacting a research staff member directly. If parents responded and expressed an interest in their child participating, eligibility screening was conducted by the trial coordinator and active, written informed consent/assent was obtained from eligible patients and their parents. The trial coordinator also initiated telephone calls to all non-responding parents to confirm their receipt of the mailing, learn if they were interested in the trial, and obtain reasons for decline. Among patients who met eligibility criteria, the trial consent rate was 49% [13]. An analysis of differences between trial participants and decliners was published previously [15]. Briefly, decliners lived farther away from the intervention site and had less telephone contact with study staff during trial recruitment [15]. The most commonly cited reasons for declining participation included lack of time and interest [15].

Procedures

Consented participants completed a detailed baseline assessment via two telephone calls lasting approximately 30-40 minutes each. Participants were also asked to maintain a behavioral record for several days as part of the baseline assessment and were provided with instructions to do so. Following completion of the baseline assessment, participants were randomly allocated to either the intervention condition or a wait-list control condition. Participants completed an outcome assessment via telephone approximately 1-month post-intervention. All telephone interviews were administered by a trained research assistant who was masked to participants' trial condition and was not involved in administering the intervention. Only the trial coordinator, who was not involved with data collection, was aware of participants' trial allocation status.

Measures

Demographic and Clinical Characteristics—Demographic characteristics assessed included age, gender, race (white or non-white), household composition (two-parent household or other), and school achievement (mostly A's and B's or other). Clinical characteristics examined included cancer type (Leukemia or other type), age at diagnosis, years since diagnosis, and years since ending treatment.

Sun Safety Behaviors—Sun safety behaviors were assessed using a scale adapted from previous research. The scale has been demonstrated to be valid and reliable and its items have been used to measure the impact of health behavior interventions targeting sun safety practices of parents and children, and behavioral counseling by health care providers [16-18]. Similar scales have been widely used in sun safety behavioral intervention research with sound psychometric properties when compared against objective measures of sun safety behaviors (i.e., direct observation) [19].

The scale consisted of 8 items with 5-point Likert-type response options ranging from "Never" (1) to "Always" (5). Items were introduced by stating: "For each of the following statements I read to you, please respond as if you expect to be exposed to the sun." Items examined how frequently teens engaged in 8 different sun safety behaviors, such as "I apply sunscreen," "I apply sunscreen SPF 15 or greater," and "I take advantage of shade when I'm outside." The scale demonstrated acceptable internal consistency within our sample (Baseline Cronbach's $\alpha = 0.63$, Follow-up Cronbach's $\alpha = 0.80$). For statistical analyses, responses were summed to reflect an overall sun safety score, with higher values indicating more frequent sun safety behaviors (range 8 - 40).

Intervention Condition

SHARE was developed based on a rigorous formative research process that involved members of the target audience as a core component of the intervention development. Details of the SHARE Program intervention have been described previously [13]. Briefly, SHARE Program development was informed by Green and Kreuter's PRECEDE-PROCEED model [20], a multi-organization partnership, formative research conducted within the target population, and a pilot study of the intervention methods [13]. The resulting intervention was comprised of a half-day, group-based interactive workshop that included health promotion content addressing sun safety and other relevant health behaviors for adolescent survivors of childhood cancer.

Intervention content was further informed by health behavior theories including the Health Belief Model, the Transtheoretical Model, and Social Cognitive Theory [21]. Intervention objectives and content were designed to target theoretical mediators of health behavior change as indicated by these theories. Specifically, the intervention objectives were to: (1) increase participants' awareness of cancer late effects, including secondary cancers; (2) reduce barriers and increase benefits to health-promoting behaviors such as sun protection; and (3) improve self-efficacy to lead a healthy lifestyle and prevent cancer late effects [13]. Aspects of the intervention that focused on promoting sun safety practices were included with content that targeted other health behaviors relevant to childhood cancer survivors, such as diet and physical activity. Examples of sun safety behaviors addressed by the intervention included limiting sun exposure, using sunscreen with SPF 15, and wearing protective clothing. The intervention addressed sun safety behaviors through didactic presentations of sun exposure and sun protection, demonstrations of sun safety practices, and reviewing action plans regarding sun safety and other health-promoting behaviors [13]. Intervention participants received gift packs, which included samples of sunscreen (in accord with the intervention's main goals).

Intervention sessions were administered by a masters-level facilitator who was trained by a multi-disciplinary research team, including experts in pediatric oncology, nutrition, and behavioral sciences. A detailed intervention manual was developed to guide implementation, including text, scripts, and intervention handouts, worksheets, and activities. The intervention format allowed the facilitator to follow the structured guide while providing flexibility to accommodate specific dynamics of each group based on participant characteristics. To monitor intervention fidelity, 30% of sessions were videotaped and reviewed by study team members and when necessary feedback was provided to the facilitator to ensure consistency with the intervention manual.

Control Condition

The control condition was a standard care wait-list condition [13]. Control condition participants were offered the intervention at the conclusion of the study.

Statistical Analysis

All analyses were conducted using SAS 9.2 (SAS Institute, Cary, NC). Differences between intervention and control groups based on demographic characteristics, medical information, and baseline sun safety behaviors were assessed with bivariate statistical tests (i.e., χ^2 tests, *t*-tests). A linear regression model was then used to examine whether there was a difference between study groups in sun safety behaviors at 1-month post-intervention, after controlling for baseline sun safety practices, participants' gender, and season of intervention (fall/winter versus spring/summer) [22]. A variable indicating study group was dummy-coded (1 = intervention, 0 = control) and was the focal independent variable in the regression model.

The summary variable indicating each participant's overall sun safety behaviors was the dependent variable in the regression analysis.

Of the 75 participants who initiated the intervention, ten were missing data for sun safety behaviors at 1-month follow-up. For these individuals, the sample mean value for each of the eight sun safety items was imputed, and the overall sun safety outcome variable was computed using the mean imputed values. All analyses were replicated with these participants excluded from the sample, and the statistical decisions were unchanged. Therefore, we included these ten participants in the final analysis with mean imputed data.

Results

Sample Characteristics

Participants allocated to the intervention ($n = 38$) and control ($n = 37$) conditions did not differ statistically based on demographic and clinical characteristics (Table 1), indicating successful randomization. Descriptive statistics for the sun safety behaviors examined at baseline and 1-month post-intervention are displayed in Table 2.

1-Month Sun Safety Behavior Outcomes

Our regression model examining differences between intervention and control groups in total sun safety practices 1-month post-intervention is displayed in Table 3. This model suggests that, after taking into account baseline sun safety, gender, and seasonal influences, participants in the intervention group reported significantly greater sun safety behaviors at 1-month post-intervention ($M = 26.8$, $SD = 5.7$) compared with participants in the control group ($M = 23.8$, $SD = 4.4$) ($B = 2.64$, 95% CI = 1.02, 4.27, $p = 0.002$). Our model explained 59% of the variance in sun safety practices 1-month post-intervention (Table 3).

Discussion

Skin cancer is the most commonly occurring secondary neoplasm observed among survivors of childhood cancer, representing a prominent late effect of cancer treatment and an important public health concern for this population [6, 7]. Risk for skin cancer among survivors of childhood cancer is likely exacerbated by the fact that survivors tend to report low rates of sun safety behaviors that are proven to reduce risk for skin cancer, such as wearing sunscreen with an appropriate SPF and limiting sun exposure [8, 9]. Yet, evidence for effective behavioral interventions to encourage sun safety practices and reduce risk of secondary skin cancer among adolescent survivors of childhood cancer remains scarce [9, 12]. Given that risk for skin cancer is increased by greater exposure to UV radiation at a young age and greater cumulative UV radiation exposure over time [11], interventions to encourage sun safety practices among adolescent survivors of childhood cancer are especially critical to reduce the risk for skin cancer that may accumulate as these youth grow older.

In light of this, our finding that the SHARE Program intervention was efficacious in producing short-term improvements in self-reported sun safety practices among adolescent survivors of childhood cancer is encouraging. To our knowledge, this is among the first studies to report on a behavioral intervention designed to increase sun safety practices within this special population. One earlier study, the Protect Study, tested whether a multi-component behavioral intervention improved health-related perceptions, knowledge, and behaviors among adolescent survivors of childhood cancer [9]. In the Protect Study, participants chose from one of three priority health behavior goals established in consultation with their health care provider, which included improving sun safety practices for some participants. At baseline, more than one third of participants (36%) did not

regularly practice sun safety behaviors, and over half (52%) were unaware of potential risks for secondary cancers. However, only 12% of participants set goals to improve sun safety behaviors, and sun safety practices did not significantly improve from baseline to 1-year follow-up as a result the intervention [9, 23].

Our findings indicate SHARE resulted in modest changes in self-reported sun safety behaviors at 1-month follow-up. Though short-term, these findings highlight important directions for future research to strengthen the evidence-base for sun safety behavior change interventions among adolescent survivors of childhood cancer. Similar to prior studies examining this outcome [19, 24], our investigation relied on self-report. Self-reported assessments of sun safety behaviors, including sun exposure [25, 26], sun screen use [27], and wearing protective clothing [26, 28], appear to be valid when compared with objective measurement methods (e.g., direct observation, UV radiation dosimeters). Nevertheless, self-report behavioral assessments are inherently subject to biases such as inaccurate recall and social desirability [19, 24].

Despite this limitation, self-reported sun protection is by far the most widely used assessment modality in behavioral intervention research [19, 24]. There is an important need to bring to bear more objective methods of sun safety measurement, such as direct observation of sun protective behaviors, personal dosimetry, and skin swabbing to verify sunscreen use in future studies [19, 29]. Using a combination of self-reported and objective methods of sun protection practices will enable researchers to triangulate data collected via multiple sources, and more accurately determine intervention effects on behavioral outcomes [19, 24].

Another important step to build on the promising results of the SHARE Program will be investigations of the durability of these intervention effects over time. Furthermore, the clinical significance of these findings remains unclear beyond the measured changes noted herein. Indeed, an important limitation of sun safety intervention research in general is that few studies utilize clinical outcome measures, such as the occurrence of skin cancer and precancerous lesions [19, 24]. This likely stems from the fact that most intervention studies have been conducted with relatively short-term (i.e., 12 month) follow-up periods, limiting the ability to detect changes that may not accrue until a decade or later for young people [19, 24]. Preliminary evidence examining clinical skin cancer outcomes over prolonged follow-up periods is promising. Findings from one trial evaluating the long-term impact of consistent sunscreen use among adults on clinically-verified skin cancer outcomes [30] suggest that regular sunscreen use significantly reduces the occurrence of squamous cell carcinomas [31] and melanomas [32]. Linking these findings with the long-term clinical impact of sun safety behavioral interventions remains important [19, 24]. Such studies are especially needed among populations at high risk for skin cancer, such as young survivors of pediatric malignancies.

Our multivariate model of sun safety behaviors accounted for important covariates, including seasonal influences and participant gender, and explained a robust proportion of outcome variance (59%). However, aggregate sun safety measures do not provide specific information regarding which sun safety behaviors responded to the intervention [19]. While they should be interpreted as preliminary, our bivariate findings (Table 2) may be useful to inform optimization of behavioral outcome assessments and intervention strategies in future studies. For example, the lack of observed change for some behavioral outcomes (e.g., using sunscreen with SPF 15) may be due to measurement limitations, and these behaviors could be assessed using more sophisticated objective outcome measures in future studies. Additionally, various intervention modalities, such as print materials, video, and counseling by healthcare providers, may differentially affect certain skin cancer prevention behaviors

[19, 33]. Future studies should explore how these and other educational strategies can be adapted and integrated into the SHARE Program model to target specific behavioral outcomes that appear to be more difficult to change.

An interim evaluation of the SHARE Program intervention indicated that participants found the in-person, group-based format to be relevant, understandable, beneficial, and acceptable [13], supporting the use of this intervention approach within this population. Recent research also suggests that cancer survivors tend to prefer distance-based approaches to behavioral intervention, which may be a result of specific barriers to engaging in in-person intervention programs within this population (e.g., distance, travel restrictions, lack of time) [34]. Future studies can improve upon this work by investigating intervention strategies designed to reduce barriers to participation, such as those using distance-based communication technologies as well as other practical strategies (e.g., interventions at multiple locations within the community) to extend the reach of behavioral intervention programs [13].

As the number of survivors of pediatric cancer continues to grow, encouraging healthy lifestyles among survivors of pediatric cancer has become essential to optimum risk-based care and the prevention and management of cancer late effects [3], including secondary skin cancer [6]. Optimum risk-based care entails systematic planning for lifelong screening, surveillance, and prevention of cancer late effects among young survivors [3]. This includes devoting specific attention to risks that may be influenced by factors such as cancer type, therapy received, genetic predisposition, lifestyle behaviors, and co-morbid health conditions [3]. It is also important that risk-based care addresses individual-level survivor-related factors that likely influence lifestyle and behavioral choices, such as knowledge, self-efficacy, and motivation necessary to engage in a healthy lifestyle and address behavioral factors contributing to cancer late-effects [3, 34, 35]. These individual-level factors are central to the SHARE Program intervention approach, which is a health behavior change intervention model that could be integrated into young cancer survivors' risk-based care. Nevertheless, additional research is needed to understand important methodological issues surrounding intervention implementation, such as the optimal time at which to deliver health behavior interventions among pediatric cancer survivors relative to cancer diagnosis and treatment [3, 34, 36].

The findings of this study should be interpreted in light of important limitations, including the homogenous sample and our sample size, and reliance on self-report measures to assess sun safety behaviors. While we used a measure of sun safety behaviors that had previously been demonstrated as psychometrically sound, the internal consistency of the scale was limited at baseline and improved at follow-up. In addition, this work could be improved by employing more objective assessments of sun safety behaviors in future studies. Finally, the short-term follow-up does not enable us to draw conclusions regarding sustained effects of the intervention on sun safety behaviors.

Despite these limitations, our findings are promising, suggesting that the SHARE Program intervention led to modest improvements in short-term self-reported sun safety practices among adolescent survivors of childhood cancer. Future studies can build from this work by incorporating objective measures of sun safety practices (e.g., direct observation, UV dosimetry) and examining the durability of the intervention in larger, more diverse samples over longer follow-up periods. Additional research is also needed to investigate the long-term clinical impact of sun safety behavioral interventions among pediatric cancer survivors over long-term follow-up periods. This study lays the groundwork for understanding how health behavior interventions addressing sun safety and other health behaviors can be integrated into optimal risk-based cancer care for this special population.

Acknowledgments

This research was supported by grants from the American Cancer Society, Lance Armstrong Foundation, and the National Cancer Institute (CA091831) to Kenneth P. Tercyak, PhD. The project was also supported in part by Award Number P30CA051008 from the National Cancer Institute. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Cancer Institute or the National Institutes of Health.

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Table 1

Baseline sample characteristics by study condition

	Study Sample (n = 75)				Intervention (n = 38)				Control (n = 37)				p-value
<u>Sociodemographics</u>	m	sd	n	%	m	sd	n	%	m	sd	n	%	
Age	14.2	2.4			14.2	2.0			14.2	2.8			0.96
Race/Ethnicity													0.16
White			56	74.7			31	81.6			25	67.6	
Black			9	12.0			5	13.2			4	10.8	
Hispanic			4	5.3			2	5.2			2	5.4	
Asian			3	4.0			0	0.0			3	8.1	
Other			3	4.0			0	0.0			3	8.1	
Gender													0.57
Male			36	48.0			17	44.7			19	51.4	
Female			39	52.0			21	55.3			18	48.6	
Household Composition													0.80
2 parent home			62	82.7			31	81.6			31	83.8	
Other composition			13	17.3			7	18.4			6	16.2	
School Achievement													0.63
Mostly A's/B's			57	76.0			28	73.7			29	78.4	
Other			18	24.0			10	26.3			8	21.6	
<u>Clinical Characteristics</u>													0.16
Primary Diagnosis													
Leukemia			39	52.0			21	55.3			18	48.9	
Nervous System			12	16.0			9	23.7			3	8.1	
Kidney/Liver			9	12.0			2	5.3			7	18.9	
Lymphoma			7	9.3			2	5.3			5	13.5	
Sarcoma			5	6.7			3	7.9			2	5.3	
Other			3	4.0			1	2.5			2	5.3	
Time since diagnosis (years, range 1.0 – 17.0)	9.0	3.4			9.5	3.5			8.4	3.3			0.17
Age at end of treatment (years, range 0.5 – 19.0)	7.2	4.1			6.9	3.0			7.4	4.9			0.57

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	Study Sample (n = 75)		Intervention (n = 38)		Control (n = 37)		p-value
Time since end of treatment (years, range 1.0 – 16.7)	7.1	3.5	7.3	3.5	6.8	3.5	0.48

Table 2
Sun Safety Behaviors at Baseline and 1 Month Follow-up (Mean [Standard Deviation])

	Baseline		1-Month		p-value
	Intervention (n = 38)	Control (n = 37)	Intervention (n = 38)	Control (n = 37)	
Total Sun Safety Behaviors	25.1 (5.2)	24.5 (4.5)	26.8 (5.7)	23.8 (4.4)	0.01
Apply sunscreen	3.5 (1.2)	3.4 (1.2)	3.3 (0.8)	3.1 (1.0)	0.28
Apply sunscreen 30 min before going outside	2.5 (1.2)	2.3 (1.0)	2.8 (1.2)	2.4 (0.9)	0.10
Use SPF 15	3.9 (1.2)	3.9 (1.2)	4.2 (1.0)	3.9 (1.1)	0.33
Wear protective clothing	3.4 (1.1)	3.2 (1.2)	3.3 (0.9)	3.1 (0.8)	0.19
Reapply every 1.5 – 2 hours	2.5 (1.1)	2.6 (1.3)	3.0 (1.2)	2.4 (1.0)	0.03
Reapply after swimming/sweating	2.8 (1.2)	2.5 (1.2)	3.0 (1.3)	2.6 (1.0)	0.10
Use shade	3.6 (1.1)	3.6 (1.1)	4.1 (0.8)	3.7 (0.9)	0.04
Limit time outside	2.9 (1.1)	2.9 (1.1)	3.1 (1.0)	2.7 (1.1)	0.07

Response options for each item ranged from (1) “Never” to (5) “Always.” The total of sun safety behaviors reflects the summary score of all items.

Table 3

Analysis of 1-Month Sun Safety Behavior Outcomes

	1-Month Sun Safety Behaviors
Intervention Condition	$B = 2.64^*$
(1 = Intervention, 0 = Control)	95% CI = 1.01, 4.27
Season at 1-Month Follow-Up	0.97
(1 = Spring/Summer, 0 = Fall/Winter)	95% CI = -1.22, 2.17
Gender	$B = 0.43$
(1 = Female, 0 = Male)	95% CI = -1.30, 2.17
Baseline Sun Safety Behaviors	$B = 0.76^{**}$
	95% CI = 0.59, 0.93
Adjusted R²	0.59

*
 $p < 0.01$

**
 $p < 0.001$