

Health Behaviors of Childhood Cancer Survivors: What We've Learned

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There has been a dramatic increase in the number of childhood cancer survivors due to improved cancer treatments. However, these survivors are at risk for numerous late-effects as a result of their cancer therapy. Engaging in health-protective behaviors and limiting risky health behaviors are vitally important for survivors given their increased risks and physical late-effects. For this paper, we systematically reviewed the literature on childhood cancer survivors' health behaviors by searching for published data and conference proceedings using computerized databases and references, and summarized these results. We examined the literature describing the prevalence of a variety of health behaviors among survivors, identifying significant covariates, and describing health behavior interventions. Finally, we provided research recommendations and discussed an ongoing study designed to address some of the limitations in the existing literature. The research to date is limited and recommendations for future studies are outlined.

KEY WORDS: childhood cancer; pediatric psychology; cancer survivors; health behaviors; pediatric cancer; alcohol use; tobacco use; exercise; diet; sun protection.

An estimated 12,400 American children and adolescents under age 20 were diagnosed with cancer in 2000 (American Cancer Society, 2000). The risk of any individual child developing cancer between birth and 20 years of age is roughly 1 in 300. Contemporary therapy for childhood cancer currently includes the use of aggressive multi-agent chemotherapeutic regimens as well as multimodality therapies (e.g., the combination of chemotherapy, radiation therapy, and surgery). As a result of improved cancer treatments, there has been a dramatic increase in the number of young survivors who are living into adulthood (Granowetter, 1994; Ries et al., 2003). Survival rates for childhood cancers have improved dramatically over the past several decades, such that currently in the United States, the overall 5-year survival rate exceeds 75% (Ries et al., 2003).

Long-term survivors of childhood cancer face a wide array of medical complications or disabilities as a result of their cancer therapy. These late complications (i.e., late-effects) span a spectrum from relatively minor and easily treatable (e.g., underactive thyroid) to serious and occasionally fatal (e.g., second new cancer or early heart disease) conditions. As many as two-thirds of childhood cancer survivors are likely to experience at least one late-effect, with approximately one-fourth of survivors experiencing a late-effect that is severe or life threatening (Garre, Gandus, & Cesana, 1994; Oeffinger, Eshelman, Tomlinson, Tolle, & Schneider, 2000; Stevens, Mahler, & Parkes, 1998; Vonderweid et al., 1996). Many of these treatment-induced complications may not become apparent for decades after cancer treatment has completed. Common types of late-effects of childhood cancer include cardiopulmonary problems, endocrine disorders, musculoskeletal problems, neurocognitive and psychological problems, osteopenia or osteoporosis, and second malignancies (Bhatia et al., 1996; Black et al., 1998; Byrd, 1985; Green, 1993; Greenberg, Kazak, & Meadows, 1989; Meadows & Silber, 1985; Oeffinger et al., 2001;

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Robison & Mertens, 1993, Robison et al., 2002; Sklar et al., 2000; Vassilopoulou-Sellin et al., 1999). Childhood cancer survivors have a ten-fold risk of developing an additional primary malignant neoplasm, a risk that continues into adult life (Maxi, Meadows, & D'Angio, 1982; Stevens et al., 1998). In addition to late-effects, childhood survivors are vulnerable to other chronic conditions akin to the general population. Therefore, it is extremely important that survivors minimize preventable risk factors of cardiac, pulmonary, neoplastic, and other major diseases via positive health behaviors.

It is vital to understand the adoption of multiple health behaviors of childhood cancer survivors. Health behaviors may impact the late-effects of cancer treatment by minimizing or preventing some adverse late-effects of cancer treatment or by increasing survivors' vulnerability (e.g., Meister, 1993; Mulhern et al., 1995; Neglia et al., 1991; Shaw, Tweeddale, & Eden, 1989; Tao et al., 1998). Additionally, the cancer experience may alter the adoption of health behaviors as compared to survivors' "healthy" peers. Finally, childhood and adolescence are important developmental periods for the adoption and establishment of lifelong health behaviors.

Lifestyle factors, such as tobacco use, obesity, and sun protection are known to influence an individual's risk of disease in the general population (American Cancer Society, 2005; Siemiatycki, Krewski, Franco, & Kaiserman, 1995; Trichopoulos & Willett, 1996; Willett & Trichopoulos, 1996). Positive health behaviors are known to reduce the risk of cardiovascular disease, diabetes, cancer, and osteoporosis (USDHHS, 2000). For childhood cancer survivors these health behavior recommendations are even more crucial, given the likelihood of cancer recurrence and other negative health outcomes associated with their cancer history. For example, studies have shown that irradiation in combination with cytotoxic therapy, such as doxorubicin, has been associated with liver damage; therefore it is important for survivors to limit alcohol consumption (D'Angio, 1982, 1983; Hollen & Hobbie, 1993; Mike, Meadows, & D'Angio, 1982). Patients treated with cardiopulmonary toxic agents or thoracic radiation therapy should abstain from tobacco use, as it may lead to restrictive lung disease and serious pulmonary complications (Shaw et al., 1989). Additionally, survivors treated with anthracyclines have been found to have an increased risk of congestive heart failure and related cardiac problems if they engage in tobacco use (Lipshultz et al., 1991). Survivors are at increased

risk for endocrinologic toxicity, which contributes to an increased incidence of obesity, and should engage in regular exercise and good nutritional habits (Didi et al., 1995; Odame, Reilly, Gibson, & Donaldson, 1994; Warner & Gregory, 1995). Childhood survivors are also at increased risk of melanocytic nevi (moles), the strongest known risk factors for melanoma (de Wit, de Vaan, de Boo, Lemmens, & Rampen, 1990; Green, 1993; Hughes, Cunliffe, & Bailey, 1989), and have been found to have higher rates of squamous cell skin cancers, making lifetime sun protection a critical goal for young cancer survivors. Therefore, engaging in a healthy lifestyle, by avoiding tobacco use, regularly exercising, having good nutritional habits, limiting alcohol use, and practicing sun protection is particularly imperative for cancer survivors.

A cancer diagnosis during childhood or adolescence may have a unique and lasting impact on the development of lifelong health behaviors (Jessor, 1984; Maggs, Schulenberg, & Hurrelmann, 1997). Smoking has been documented to begin and escalate throughout childhood and adolescence (Chassin, Presson, Rose, & Sherman, 1996) and dietary, exercise and sun protection habits may originate in childhood and are established more permanently during adolescence (Cohen, Brownell, & Felix, 1990). As such, routine follow-up care for cancer survivors diagnosed during childhood and adolescence should aim to encourage the adoption of health-promoting behaviors and strongly counsel avoidance of health-damaging behaviors. This is especially crucial during a developmental period when normative experimentation with health-damaging behaviors and potential future dependence, pose a threat to the overall health and well-being for cancer survivors (La Greca, Prinstein, & Fetter, 2001).

A cancer diagnosis may present an opportunity for a "teachable moment" to convey health behavior information and health risks with significant impact (McBride & Ostroff, 2003) or it may present a challenge for survivors. Among adults, several studies have demonstrated that a diagnosis of a life-threatening chronic illness motivates individuals to reduce health risks and engage in health-protective behaviors (Pinto, Eakin, & Maruyama, 2000), while other studies have shown no difference in health behaviors between survivors and non-cancer controls (Coups & Ostroff, 2005). A cancer diagnosis during childhood could foster and motivate the adoption of a healthy lifestyle or may lead to the adoption of risky health behaviors. Alternatively, childhood cancer

survivors may engage in “risky” health behaviors at rates similar to their “healthy” peers, disregarding the additional risks due to their cancer history.

The goal of this article is to identify and critically evaluate the empirical literature published on childhood cancer survivors' health behaviors. This review will attempt to answer the following questions: 1) Do survivors of childhood cancer engage in more positive health behaviors than their peers?; 2) What covariates have been identified in the literature as significantly related to health behaviors among childhood cancer survivors?; and 3) Are interventions to promote healthy behaviors among survivors effective? This article attempts to fill the gap in the literature by synthesizing existing empirical studies and providing a methodological critique. Therefore, it includes a wide range of study designs in order to present a comprehensive picture of the current state of the literature. Finally, we will present an ongoing study (NCI R03 CA101514), designed to address some of the weaknesses in the existing literature on childhood cancer survivors' health behaviors.

METHOD

In preparing this review, we followed published methodologic guidelines for review papers (Weed, 1997). A comprehensive literature search was performed to identify papers and books on childhood cancer survivors' health behaviors published in the English language before June 2005. Relevant articles were identified by using PsychInfo, Medline, Cancerlit, and PubMed computerized databases of psychological and medical literature. Additional literature was identified from references in published papers and books. Unpublished work was excluded unless it appeared in available conference proceedings. Narrative techniques were used to summarize the papers reviewed.

Search parameters included studies published in English focused on individuals diagnosed with cancer during childhood, prior to the age of 21. No limitations were placed on the current age of the survivor or length of time since treatment. The start date for the search was not specified. The computer-based information search used the following key words: adolescent cancer, adolescent cancer survivor(s), alcohol use, cancer patient(s), cancer prevention, cancer survivor(s), childhood cancer, childhood cancer survivor(s), diet, exercise, follow-up care, health behavior(s), health promotion, health protection, lifestyle

behavior(s), long-term follow-up, nutrition, pediatric cancer, pediatric cancer survivor(s), post-treatment, smoking, sun protection, and tobacco use. We did not include papers that focused on treatment or follow-up adherence as the sole health behavior of interest. Using these search terms we identified 42 articles that focused on health behaviors of childhood cancer survivors. Overall, this review is based on the 25 articles that collected original data that met our criteria for review. See Table I for the studies included in the review. Several of the publications included multiple papers based on the same group of survivors and data. The remaining 17 articles provided recommendations or discussion of survivors' health behaviors, however did not collect any original data and were therefore not included. We classified the studies into three main categories: those that solely reported prevalence of health behaviors ($n=8$), those that investigated covariates of health behaviors and behavioral intentions ($n=13$), and those that tested health behavior interventions ($n=4$) among childhood cancer survivors. A majority of the studies described health behaviors of adult survivors of childhood cancers while only a few measured these behaviors during adolescence, a developmental period during which these behaviors are acquired.

RESULTS

Do Survivors of Childhood Cancer Engage in More Positive Health Behaviors Than Peers? Prevalence of Health Behaviors Among Childhood Cancer Survivors

Despite the importance of adopting a healthy lifestyle following the diagnosis and treatment of cancer, there is limited research to date investigating the prevalence of health-protective behaviors (e.g., good dietary practices, regular exercise, and sun protection) among survivors of childhood cancers, especially among adolescents and young adults. There are a larger number of studies focused on health-damaging behaviors (i.e., tobacco, alcohol, and illicit drug use) among this cohort of cancer survivors.

Health-Protective Behaviors

The few studies on health-protective behaviors have examined the prevalence rates of a multitude of behaviors, including dental care, diet, exercise, seatbelt use, sleep habits, cancer screening and medical follow-up (Hudson et al., 2002; Mulhern et al., 1995;

Table 1. Literature on Health Behaviors of Childhood Cancer Survivors

Citation	Type	Participants	Health behaviors	Results
Butterfield et al. (2004)	Prevalence covariates	Childhood cancer survivor cohort (ccss) ^a ; adult survivors of childhood cancer who were current smokers (<i>n</i> = 541)	Tobacco use, alcohol use, physical activity, red meat, multi-vitamin, medical care	(a) 31% of sample engaged in zero or one health-risk behavior in addition to smoking; (b) 63% engaged in 2 or 3 behaviors; (c) 6% engaged in 4 or 5 behaviors
Corkery et al. (1979)	Prevalence	Adult survivors of childhood cancer at least 18 years old (<i>n</i> = 425)	Tobacco use	History of smoking in a close relative was associated with a fivefold higher probability of smoking in female survivors (55 vs. 11%)
Emmons et al. (2002)	Prevalence covariates	CCSS cohort; Adult survivors of childhood cancer (<i>n</i> = 9709)	Tobacco use	(a) 28% were former smokers; (b) 17% were current smokers; (c) 41.5% of current smokers reported a quit attempt in the previous 2 years; (d) Former smokers reported abstinence for an average of 4.8 years. Statistically significant covariates associated with a risk of smoking initiation: (a) older age at diagnosis, lower household income, less education, and not having had pulmonary-related cancer treatment or cranial radiation
Emmons et al. (2003)	Prevalence; covariates	CCSS cohort; adult survivors of childhood cancer who were current smokers (<i>n</i> = 796)	Tobacco use	(a) Participants smoked an average of 14 cigarettes/day; (b) 53.2% were nicotine dependent; (c) 58% had made at least one quit attempt in the past year. Participants reported: (a) high perceived vulnerability to health problems resulting from smoking and high levels of knowledge about tobacco and health. Covariates for higher smoking rates include: (a) older age, lower education, higher proportion of smokers in the social network, a higher score on the BSI-18 indicating greater psychological distress
Glover et al. (1998)	Prevalence	Adult survivors of all (<i>n</i> = 592); siblings (<i>n</i> = 409)	Alcohol use	(a) Fewer female survivors drink than siblings (66% vs. 84%), no difference with males; (b) both groups begin drinking at about the same age (mean age = 20.5 years)
Haupt et al. (1992)	Prevalence	Adult survivors diagnosed before 20 years old (<i>n</i> = 1289); siblings (<i>n</i> = 1930)	Tobacco use	(a) All comparisons were non-significant; (b) survivors were 12% less likely than siblings to have quit smoking, 8% less likely to be current smokers and 13% less likely to be ever smokers
Hollen et al. (1999)	Intervention with follow-up at 1, 6, and 12 months	Adolescent and young adult survivors of childhood cancer 13–21 years old (<i>n</i> = 64); intervention group (<i>n</i> = 21); comparison group (<i>n</i> = 43)	Tobacco use	Intervention significantly improved decision making at 1 and 12 months post; (marginal at 6 months) and intervention dampened motivation for engaging in alcohol use at 1 month
Hollen et al. (2001)	Covariates	Adolescent cancer survivors 14–19 years old (<i>n</i> = 52) Peers (<i>n</i> = 43)	Alcohol use Illicit drug use	Non-resiliency and poor-quality decision-making were significant predictors for risk behaviors in survivors
Hollen and Hobbie (1993)	Prevalence; covariates	Adolescent long-term survivors 14–19-years old, disease free for 5 years (<i>n</i> = 36)	Tobacco use; alcohol use; illicit drug use; pregnancy risk	(a) 53% ever used cigarettes; (b) 67% ever used alcohol; (c) 17% ever used marijuana; (d) 14% reported current cigarette use; (e) 25% current alcohol use; (f) 0% current marijuana use; (g) 27% reported one health risk behavior; (h) 31% reported 2–4 health risks; (i) 42% reported taking no health risks
Hollen and Hobbie (1996)	Prevalence; covariates	Adolescent survivors 14–19 years old, disease free 5 years (<i>n</i> = 52) peers (<i>n</i> = 43)	Tobacco use; alcohol use; illicit drug use	Survivors were significantly less likely to engage in one or more risk behaviors than peers

Table 1 Continued

Citation	Type	Participants	Health behaviors	Results
Hudson et al. (2002); Cox et al. (2005)	Prevalence; covariates; intervention with follow-up at 1, 6 and 12 months	Adolescent cancer survivors 12–18-years old ($n = 266$) randomly assigned to standard care ($n = 135$) or intervention ($n = 131$)	Tobacco use; sun protection; self examination; diet exercise	At baseline: (a) 94% abstained from tobacco; (b) 64% practiced sun protection; (c) 27% performed monthly self-examination; (d) 40% ate nutritious diets; (e) 52% performed regular aerobic exercise; (f) 58% reported a need to change health behavior; (g) 57% wanted to exhibit healthier behavior. Survivors had deficits in baseline health knowledge about health risks following cancer; 52% unaware of risk of 2nd malignancy and 42% for cardiovascular disease. The intervention did not have a significant impact on outcome measures
Larcombe et al. (2002)	Prevalence	Survivors 18–30-years-old ($n = 178$); matched peers ($n = 184$); siblings ($n = 67$)	Alcohol use; tobacco use; drug use; diet/exercise; sun care	(a) Survivors reported lower levels of alcohol, tobacco and recreational drug use than peers; non-significant for sibling comparisons; (b) fewer survivors than controls quit smoking; (c) survivors of childhood cancer are leading healthier lives than peer or sibling comparisons
Mulhern et al. (1995)	Prevalence; covariates	Parents of long term survivors of childhood cancer 11–17-years-old ($n = 110$); Young adult survivors of childhood cancer 18–29-years-old ($n = 40$)	Tobacco use; alcohol use; dental, dietary; seatbelt use; sleep	(a) Tobacco and alcohol use was 8.2% each among those under 18-years-old; (b) tobacco and alcohol use was 17.5 and 72.5% respectively among young adult survivors; (c) health maintenance perceived to be more important for survivors than others
Oeffinger et al. (2003)	Prevalence	CCSS cohort; ALL survivors ($n = 1765$) Siblings ($n = 2565$)	Obesity	Higher dose cranial radiotherapy is associated with an increased prevalence of obesity
Oeffinger et al. (2004)	Prevalence; covariates	CCSS cohort; Adult survivors of childhood cancer ($n = 9434$)	Use of out-patient medical care	(a) 87% reported general medical contact; (b) 71.4% a general physical examination; (c) 41.9% a cancer-related visit; (d) 19.2% a visit to a cancer center; (e) 20% reported not having a general physical examination, a cancer-related visit, or a visit to a cancer center. Significant covariates associated with non-use and decrease in use of medical care: no health insurance, male, lack of concern for future health, age 30 or older, and greater time since diagnosis
Park et al. (2002)	Covariates	Three focus groups of adult survivors Non-smokers ($n = 7$), former and present smokers ($n = 4$), former smokers ($n = 3$); individual interviews ($n = 9$)	Perceived health risks; health behaviors	(a) Survivors expressed uncertainty about control over their health; (b) preventive behaviors include: exercise, proper diet, avoidance of caffeine, alcohol and tobacco
Tao et al. (1998)	Prevalence; covariates	Adult survivors of childhood all ($n = 592$) siblings ($n = 409$)	Tobacco use	(a) Survivors significantly less likely to have ever smoked than siblings (23 vs. 35.7%) or be current smokers (14 vs. 20.3%); (b) survivors were less likely to quit smoking than siblings (26.6 vs. 35.2%)
Tercyak et al. (2004)	Prevalence	Survivors of childhood cancer disease-free for at least 1 year, current mean age of survivors = 15.4-years-old ($n = 28$ survivor/mother dyads)	Tobacco control cancer screening	(a) 25% of survivors had experimented with smoking, 61% thought smoking was definitely harmful; (b) 57% of survivors were interested in screening information, 61% in susceptibility testing

Table 1 Continued

Citation	Type	Participants	Health behaviors	Results
Tercyak et al. (2005)	Prevalence; covariates	Adolescent survivors of childhood cancer ($n = 75$) between 11 and 21 years of age	Tobacco use; physical activity sun protection	(a) 15% had a lifetime history of cigarette use; (b) 20% reported insufficient physical activity; (c) 37% non-adherent to sun protection recommendations; (d) 53% reported no behavioral risk factors, 28% had one risk factor, 12% had two risk factors and 7% reported all three risk factors; (e) older survivors with greater sx. of depression and greater parent-child conflict had higher behavioral risk factor index scores
Troyer and Holmes (1988)	Prevalence	Childhood cancer survivors at least 21 years old ($n = 263$); siblings ($n = 369$)	Tobacco use	Fewer survivors smoke compared to siblings (33.3 vs. 38.2%), more non-smoking survivors compared to siblings (53.6 vs. 45.3%) and fewer former smoker survivors compared to siblings (13 vs. 16.5%)
Tyc et al. (2001a,b)	Prevalence; covariates	Preadolescent and adolescents 10–18-years old, 1–4-years post-treatment ($n = 46$)	Tobacco use	(a) Younger age and higher SES were predictive of health protective behaviors; (b) older adolescent survivors with low tobacco knowledge and current tobacco use reported greater future intentions to smoke
Tyc et al. (2003)	Intervention with 6 and 12 month follow-up	Cancer survivors 10–18 years old ($n = 103$) randomly assigned to either standard care ($n = 50$), or intervention group ($n = 53$)	Tobacco use	Intervention increased knowledge, increased perceived vulnerability, and decreased future intentions to use tobacco at 12 month follow-up
Verrill et al. (2000)	Prevalence	Pediatric cancer survivors, 12–15 years old at diagnosis ($n = 26$); matched control group ($n = 26$)	Tobacco use; alcohol use illegal drug use	(a) Survivors reported significantly less illegal drug use than controls; (b) no significant difference on tobacco and alcohol use
Yeatzel et al. (2003)	Prevalence; covariates	CCSS cohort; adult survivors of childhood cancer ($n = 9434$); siblings ($n = 2667$)	Cancer screening practices	(a) 27.3% women reported performing breast self exam; (b) 78.2% underwent a PAP smear within the previous 3 years; (c) 62.4% underwent a clinical breast exam within the last year; (d) 20.9% had gotten a mammogram at least once in their lifetime; (e) 17.4% males reported performing regular testicular self exam

^aThe CCSS is a multi-institutional collaboration supported by a grant from the National Cancer Institute (U24 CA55727) and has successfully established and followed 14,370 five-year survivors of childhood and adolescent cancer diagnosed between the years 1970–1986 and a sample of 3737 sibling controls.

Tercyak, Donze, Prahlad, Mosher, & Shad, 2005; Tyc, Hadley, & Crockett, 2001a,b). Overall, these studies have found that childhood cancer survivors, during adolescence and young adulthood, engage in healthy habits at low to moderate rates and as frequently as reported for their healthy peers (Mulhern et al., 1995; Tyc, Hudson, & Hinds, 1999; Tyc et al., 2001a,b). More specifically, it has been reported that 40–70% of adolescent cancer survivors have good dietary habits (balanced or nutritious meals) always or most times (Hudson et al., 2002; Mulhern et al., 1995; Tyc et al., 2001a,b). Additionally, between 29 and 41% reported that they engage in greater than 6 hours of exercise per week (Mulhern et al., 1995; Tyc et al., 2001a,b), while only 52% reported that they engaged in regular aerobic exercise (Hudson et al., 2002). Tercyak et al. (2005) found that 80% of their sample of preadolescent and adolescent survivors engaged in adequate physical activity, as defined by the CDC. Mulhern et al. (1995) reported that a significant proportion of survivors in their study were overweight and that 6.4% of their preadolescents/adolescents (11–17 years of age) and 17.5% of their young adults (18–30 years of age) were sedentary and exercised less than one hour a week. A majority (63–64%) of preadolescent and adolescent cancer survivors reported engaging in recommended sun protection (Hudson et al., 2002; Tercyak et al., 2005). A number of other health behaviors have been investigated by Mulhern and colleagues (1995) who reported that less than three-quarters of their sample of pre-adolescents, adolescents, and young adult survivors reported good dental hygiene (brushing their teeth once a day or less). Additionally, less than one quarter of survivors reported eating balanced meals (16.4% of preadolescents/adolescents and 17.5% of young adults) and less than half reported always using seatbelts (49.1% of preadolescents/adolescents and 45% of young adults). Many of the preadolescent/adolescent (80.1%) and young adult survivors (52.5%) got at least 8 hours of sleep per night (Mulhern et al., 1995). These rates of health-promoting behaviors among survivors are generally similar to what is noted for their “healthy” peers in the general population.

Other studies have investigated the cancer screening practices of childhood cancer survivors (Hudson et al., 2002; Oeffinger et al., 2004; Yeatzel et al., 2003). One study found that among adolescent survivors (12–18 years of age) of childhood cancers, 27% reported that they performed monthly breast or testicular self-examination (Hudson et al., 2002).

Among a large cohort ($n = 9000$) of adult survivors of childhood cancers, from the Childhood Cancer Survivor Study (CCSS), a large national study, self-reported cancer screening practices ranged from 17.4% (for monthly testicular self-exam) to 78.2% (Papanicolaou testing within the last three years; Yeatzel et al., 2003). Among female survivors, the authors reported that 62.4% had a clinical breast examination within the last year, 27.3% performed self-breast examinations monthly, and 20.9% ever underwent a mammogram. Overall, the survivors from the CCSS demonstrated a modestly increased likelihood of cancer screening compared to their siblings, however screening rates were still below optimal levels recommended for the general population. Given the risk of second malignant neoplasms or recurrence, the authors concluded that at a minimum, survivors should adhere to screening recommendations for the general population, and among high-risk subgroups of survivors, screening should be performed more intensively.

Regarding survivors' health care utilization, a recent study of the same large cohort of survivors from the CCSS, reported that 80% had a general physical examination, a cancer-related visit, or a visit to a cancer center within the previous two years (Oeffinger et al., 2004). In fact, the likelihood of reporting a cancer-related visit or a general physical examination decreased significantly as the survivor aged or the time from cancer diagnosis increased. This is especially problematic given that the incidence of many modifiable late-effects increase with age (e.g., Garre et al., 1994; Stevens et al., 1998; Vonderweid et al., 1996).

In summary, it is evident from the studies described above that there is a need for behavioral improvement among childhood cancer survivors. While health-promoting behaviors, such as dental care, dietary habits, sleep and exercise were similar between survivors and “healthy” peers, given their risk of late-effects, these percentages are suboptimal. Among the larger studies, it is clear that cancer survivors' screening practices and medical follow-up are also below optimal levels.

Overall, limitations of several of these studies include the relatively small samples obtained from single clinics and findings therefore may not be generalizable. The CCSS findings are more representative of adult survivors of childhood cancers as they were sampled from over 26 cancer centers and hospitals in North America. Additionally, many of the published studies assessed health behaviors using only

a single question, potentially diminishing the reliability and validity of the reported findings. For the most part, all data in the above studies were collected by self-report however, for the younger adolescents in Mulhern et al. study (1995) parents completed the questionnaires, conceivably introducing a response bias and inaccurate reporting. Another major limitation of these prior studies is the combining of the measurement of health-protective behaviors among survivors diagnosed with cancer at considerably varied age ranges, from birth to late adolescence/young adulthood. It is possible that individuals diagnosed at younger ages (i.e., birth to early childhood) may be less knowledgeable about their diagnosis, potential late-effects, or the importance of maintaining a healthy lifestyle. It is also possible that these survivors were not cognitively developed enough to integrate their cancer experience into their health identity and subsequent health behaviors. One final shortcoming of these studies is that no single study examined the full range of health-protective behaviors directly relevant to cancer survivors' increased health risks (e.g., nutrition, exercise, sun protection) within a single cohort.

Health-Damaging Behaviors

With regard to health-damaging behaviors (i.e., tobacco, alcohol, and illicit drug use), research findings have generally indicated that childhood cancer survivors practice high risk behaviors at rates equal to or slightly greater than that of their "healthy" peers (Corkery et al., 1979; Hollen & Hobbie, 1996; Troyer & Holmes, 1988; Tyc et al., 1999; Verrill, Schafer, Vannatta, & Noll, 2000). In fact, whether they were compared to their siblings (e.g., Troyer & Holmes, 1988) or to the general population (e.g., Corkery et al., 1979; Hollen & Hobbie, 1996; Verrill et al., 2000), survivors engaged in tobacco use at similar rates. A majority of the published studies have focused on survivors' tobacco use or future intentions to use tobacco, with fewer studies examining alcohol and illicit drug use.

However, several recent studies have reported that fewer cancer survivors smoke cigarettes compared to individuals in the general population (Emmons et al., 2002; Larcombe, Mott, & Hunt, 2002; Tercyak et al., 2005; Tyc et al., 2001a,b), best friends (Hollen & Hobbie, 1996), or siblings (Larcombe et al., 2002; Tao et al., 1998). Studies have reported prevalence rates of tobacco use among childhood cancer survivors ranging from 8.2

to 28.5% (Emmons et al., 2002; Mulhern et al., 1995; Tao et al., 1998; Tercyak et al., 2004, 2005; Tyc et al., 2001a,b). The lowest rates of tobacco use have been found among preadolescents and adolescents (Mulhern et al., 1995) however this study relied on parents' reports of their child's tobacco use, and may have underestimated the prevalence. A large retrospective study of smoking behaviors of over 1200 childhood cancer survivors found that survivors were 8% less likely than their siblings to be current smokers and were 13% less likely to ever have smoked (Haupt et al., 1992). However, survivors who became smokers were not more likely to quit, compared to their siblings (Haupt et al., 1992; Mulhern et al., 1995; Tao et al., 1998). Contrary to this finding, when compared to age-, sex-, and race-specific rates in the general population, survivors from a large national study (i.e., CCSS) have been found to be slightly more likely to quit smoking (Emmons et al., 2002). Researchers have also described a trend toward increased tobacco use as cancer survivors reach late adolescence or young adulthood (Tao et al., 1998; Tyc et al., 1999).

When examining future intention to use tobacco, younger survivors have reported low intentions to smoke in the future (Tyc et al., 2001a,b). Alternatively, research findings have also indicated that older adolescent and young adult survivors, with lower tobacco-related knowledge, report greater future intentions to smoke (Tyc et al., 2001a,b), which is consistent with findings among healthy adolescents (Moss, Allen, & Giovino, 1995). Self-reported intention to use tobacco has consistently been used as a proximal outcome measure in adolescent smoking research because prospective studies (Conrad, Flay, & Hill, 1992; Eckhardt, Woodruff, & Elder, 1994; Tyc et al., 2003) have demonstrated that smoking intentions are a strong predictor of future smoking behavior.

When examining current smokers, a large, recent study reported that those survivors who smoked heavily, were nicotine dependent, were in lower stages of readiness to quit, and engaged in multiple risk behaviors (i.e., excessive red meat consumption, no multivitamin use, little or no physical activity, drank more alcohol than recommended, and had no primary care provider; Butterfield et al., 2004). This finding indicates that survivors who smoke may also be at increased risk for engaging in multiple risk behaviors.

Several studies have assessed alcohol use among childhood cancer survivors and have found varied

prevalence rates ranging from 8.2 to 84% (Glover et al., 1998; Mulhern et al., 1995; Larcombe et al., 2002; Verrill et al., 2000). Again, this wide range may be due to the varying methods of assessment. Mulhern et al. (1995) obtained an 8.2% prevalence rate for parents' reports of their preadolescent or adolescent children's alcohol use. When they obtained self-reports of alcohol use among the young adults in their sample (18–29-years-old), 72.5% reported that they used alcohol and 12.5% reported that they engaged in binge drinking. A small study of adult survivors of childhood cancers found no difference between alcohol use (i.e., abstainers, infrequent/light, moderate/heavy drinkers) among survivors and case controls (Verrill et al., 2000). Another study of 18 to 30 year old childhood cancer survivors found a lower proportion of survivors used alcohol or engaged in binge drinking when compared to their siblings or matched population controls (Larcombe et al., 2002).

The three studies of illicit drug use by survivors of childhood cancer (Hollen & Hobbie, 1993; Larcombe et al., 2002; Verrill et al., 2000) have found low rates of use. Hollen & Hobbie (1993) found 17% of survivors aged 12–19 years reported trying marijuana, however none were current users at the time of the survey. Among 17–20 year old childhood survivors and matched case controls, Verrill and colleagues (2000) reported that survivors reported significantly less drug use over the prior year than the case controls. On average, survivors reported using illegal drugs approximately one to two times during the preceding year, while the case-controls reported using drugs six to nine times. Compared to epidemiological data, the case-controls did not significantly differ from young adults in the general population on use of marijuana or amphetamines. Additionally, survivors experimented with fewer types of drugs. Larcombe et al. (2002) also found that survivors used recreational drugs less than their siblings or age-matched population based controls. They reported 15% of male survivors and 8% of female survivors reported current recreational drug use, which included use even if less often than once a month.

In summary, the prevalence of tobacco use among survivors appears mixed, with some studies showing no differences between survivors and non-cancer populations and other studies indicating a lower prevalence among childhood cancer survivors. The prevalence of alcohol use and illicit drug use among survivors is typically similar or less than non-cancer populations.

The mixed findings of the prevalence of health-damaging behaviors may, in part, be due to varying definitions and methods of assessment. For example, studies have defined tobacco use as any use in the past month (Tyc et al., 2001a,b; Verrill et al., 2002), any lifetime use (Tercyak et al., 2005), any use in the past 7 days (Emmons et al., 2003), or at least one cigarette per week (Larcombe et al., 2002). This is a significant limitation as it is difficult to compare prevalence rates of health behaviors across studies and with published normative data. Additionally, further research is required in order to investigate those high-risk subgroups of survivors. Another limitation of these studies is that they assess tobacco and alcohol use at considerably varied age ranges, from preadolescence to adulthood. The studies do not focus on adolescence or young adulthood, the developmental periods where tobacco and alcohol use are initiated, escalated, and adopted. Similar to the literature regarding health-protective behaviors, many of these studies included individuals diagnosed with cancer at varied ages (birth-adolescence) and utilized small, non-representative samples of survivors. Since survivors are at higher risk given their cancer history, even studies that demonstrate lower levels of health damaging behaviors are still alarming. In order to identify high-risk subgroups of survivors, we must identify the significant covariates of health behaviors.

What Covariates Have Been Identified in the Literature as Significantly Related to Health Behaviors Among Childhood Cancer Survivors?

Sociodemographic variables (e.g., older age, male gender, racial minority, lower socioeconomic status) are the most consistent predictors of greater alcohol and tobacco use, as well as poorer dietary and exercise habits among “healthy” children and adolescents from the general population (Millstein et al., 1992; Terre, Drabman, Meydrech, & Hsu, 1992; Terre, Ghiselli, Taloney, & DeSouza, 1992; Turner, Irwin, Tschann, & Millstein, 1993). Other factors affecting risk behaviors of adolescents within the general population include geography, personality, decision making, family structure, parental support, parental rules/guidelines, parental and peer modeling of behaviors, conflict between parents and teens, and peer group influence (Barnes & Welte, 1986; Barnes, Welte, & Dintcheff, 1993; Fiore, 1992; Newcomb, Maddahian, Skager, & Bentler, 1987;

Presson et al., 1984; Windle, Barnes, & Welte, 1989). Knowledge about tobacco-related problems has also been found to play a role in the initiation of tobacco use among “healthy” adolescents (Bruvold, 1993; Moss et al., 1995).

Survivors of childhood cancer are likely to be affected by some of the same behavioral and social factors which influence their peers to engage in preventive and damaging health behaviors. Similar to their “healthy” counterparts, a variety of sociodemographic factors have been found to be related to health behaviors among survivors of childhood cancers. Overall, younger individuals, those of higher socioeconomic status, and those with higher educational achievement have been found to engage in greater protective health behaviors (e.g., good diet and exercise) and less damaging behaviors (e.g., tobacco and alcohol use; Emmons et al., 2002, 2003; Hudson et al., 2003; Tao et al., 1998; Tyc et al., 2001a,b). Two studies reported a significant relationship between health behaviors and race, with Caucasian survivors being more likely to currently use tobacco or drink alcohol (Glover et al., 1998; Tao et al., 1998) and non-Black survivors being more likely to initiate tobacco use (Emmons et al., 2002). One early study reported a gender difference, such that adult female survivors smoked more than male survivors when a close relative was a smoker (Corkery et al., 1979), however this gender difference has not been consistently replicated in the literature (e.g., see Tao et al., 1998).

Several studies have focused on treatment-related covariates and have reported inconsistent findings. Some studies have found a positive relationship between central nervous system treatment and risky health behaviors (Hollen & Hobbie, 1993) while others have reported the opposite relationship between cranial radiation and tobacco initiation (Emmons et al., 2002). Several risk factors for continued smoking among adult survivors of childhood cancers include being younger than 14 years of age at smoking initiation, not having graduated high school, cranial radiation treatment, and being older at diagnosis (Emmons et al., 2002). The likelihood of reporting a cancer-related visit or a general physical examination has been found to decrease significantly as the time since initial diagnosis increases for adult survivors of childhood cancers (Oeffinger et al., 2004).

Other studied covariates of survivors’ health behaviors are knowledge and perceived vulnerability or risk. Preadolescent and adolescent survivors have been found to be moderately knowledgeable

about tobacco-related health risks and have perceived themselves as vulnerable to these risks. However, in one study, less than half were able to accurately identify specific treatment-related health risks that could be exacerbated by tobacco use (Tyc et al., 2001a,b). Those adolescents with lower knowledge scores reported greater intentions to use tobacco, consistent with findings among “healthy adolescents” (Moss et al., 1995). Survivors have a general notion that their health is vulnerable because of their cancer experience (Mulhern et al., 1995), although the specific association between perceived vulnerability and health behaviors has not been adequately studied.

Another covariate that has been investigated is decision making ability (Hollen & Hobbie, 1993, 1996; Hollen, Hobbie, Finley, & Hiebert, 2001). Studies of adolescent survivors have demonstrated a negative relationship between decision making ability (e.g., searching and weighing alternatives, careful deliberation, planning, and follow-up evaluation) and health risk behaviors. The risk factors for poor decision making were central nervous system prophylactic therapy and academic achievement problems (Hollen & Hobbie, 1993). However, the authors did not find a significant difference in decision making between adolescent survivors and their best friends, indicating that this finding may not be unique to survivors.

There are some major limitations of the published studies on covariates of childhood cancer survivors’ health behaviors. First, a majority of the studies have utilized small, non-representative samples, and have included heterogeneous samples of survivors (e.g., varied ages at diagnosis and at assessment). Given that adolescence is a key developmental period in which health behaviors are initiated and adopted, these studies may not identify the most relevant covariates. For example, among “healthy” adolescents, if smoking does not start during adolescence, it is unlikely to occur (U.S. Department of Health and Human Services, 1994). Even infrequent experimental smoking in adolescence significantly increases the risk of adult smoking (Chassin, Presson, & Sherman, 1990). Another limitation is that a majority of these studies have focused on sociodemographic factors as potential covariates of survivors’ health behaviors without including psychosocial variables of interest. There is a large body of literature exploring the initiation and adoption of health behaviors among “healthy” adolescents and young adults however the survivorship literature has not fully utilized these findings to examine differences

between survivors and their "healthy" peers. Many of these studies were a-theoretical, a surprising finding given the breadth of theory-driven health behavior research on adolescents in the general population. By identifying the psychosocial factors related to the adoption of health behaviors high-risk subgroups of survivors who need targeted interventions can be identified and targeted.

Health Behavior Interventions for Childhood Cancer Survivors

Little is known about the efficacy of interventions that motivate survivors to adopt health-protective behaviors and decrease health-damaging behaviors to reduce potential health complications. Several health behavior interventions with childhood cancer survivors have targeted perceived vulnerability to promote health behavior change. Studies have demonstrated that informing people about their personal susceptibility to negative health outcomes can increase preventive health behaviors among the general population (e.g., Blalock, DeVellis, & Afifi, 1990) and can modify perceptions of health risk and reduce health damaging behaviors in adult cancer patients and other patient groups (Harari, O'Connor, Fiore, & Kinsella, 1995; Kreuter & Strecher, 1995; Taylor et al., 1996). However, similar risk counseling approaches targeting perceived vulnerability for childhood cancer survivors have seldom been studied.

Tyc et al. (1999) conducted an intervention to educate patients about their personal health risks and increase their perceived vulnerability to tobacco-related health hazards in order to reduce future intentions to use tobacco. They compared a patient-centered educational and risk counseling smoking intervention with a standard smoking ask-advise approach for 27 preadolescent and adolescent cancer survivors. The intervention was designed to be relevant to both smokers and non-smokers and was administered in a single session with periodic reinforcement of tobacco goals by telephone. At the 12-month follow-up, survivors in the intervention group demonstrated an increase in their knowledge and perceived vulnerability scores and had a decrease in their intentions for future tobacco use. Conclusions about the study are difficult to draw, as the study utilized a very small sample of survivors and focused on future intentions to smoke rather than actual tobacco use.

Another intervention targeting perceived vulnerability, involved a longitudinal, controlled ran-

domized design of a multi-component risk counseling intervention versus standard care for 272 survivors between 12 and 18 years of age who were 5 years post-diagnosis (Cox, McLaughlin, Rai, Steen, & Hudson, 2005; Hudson et al., 1999, 2002). Standard care involved breast or testicular self-examination teaching (BSE/TSE), clinical assessment by physician/nurse practitioner, and targeted late-effects screening and counseling. The intervention group received standard care plus a multi-behavioral educational intervention which was conducted in a single session with telephone follow-up at 3 and 6 months post-clinic visit to reinforce the behavioral training. The intervention included a written treatment summary and health behavior training of a goal chosen by the survivor. Survivors were invited to choose one of three health behavior goals identified as priorities by the clinician. Participants were assessed on a variety of factors including health knowledge, perceived susceptibility, perceived benefits and barriers of the health behavior, and health practices (i.e., tobacco use, sun protection, self-examination, diet, exercise). There were no significant differences in change scores (pre- to post-intervention) on any of the knowledge or psychosocial variables for the intervention group. Only patients in the self-examination group (BSE/TSE) showed significant improvement with regard to health behavior change. One subgroup in the intervention arm did show improvement in knowledge; female survivors showed greater increases in health knowledge than male survivors in the intervention group. The limited impact of the intervention may be in part due to its limited duration and focus.

Tyc et al. (2003) conducted a randomized controlled trial of tobacco risk counseling for 103 preadolescent and adolescent cancer survivors between 10 and 18-years-old. They concentrated on altering knowledge, perceived vulnerability, and intentions to smoke. They compared standard care (ask and advise) with a single session intervention that included an educational video, a physician feedback letter, tobacco literature and follow-up telephone counseling at 1 and 3 months post-intervention. Most of their participants were nonsmokers with only 13% having ever tried tobacco. The intervention was found to be successful at increasing knowledge and perceived vulnerability and decreasing intentions to use tobacco. Effects were strongest at 12 months post-intervention and were consistent with current models of health behavior indicating an inverse relationship between perceived vulnerability to health risks

and the practice of health damaging behaviors, such as tobacco use (Weinstein, 1993). The intervention had less of an impact for survivors whose parents smoke, indicating the importance of parental influence and family context in health behavior interventions for this age group. Additional limitations include the sole reliance on behavioral intentions and the use of non-standardized measures with limited or no psychometric data.

Other interventions have focused on decision-making programs for risk-reduction among survivors (Cox et al., 2005; Hollen, Hobbie, & Finley, 1999; Hudson et al., 2002). Among “healthy” adolescents several programs have demonstrated that although knowledge is a basis for behavioral change, additional variables (e.g., decision making skills, social support training) are essential determinants of behavioral change (Katz & Varni, 1993). Hollen and colleagues (1999) tested a health-promotional program (focused on tobacco, alcohol, and illicit drug use) for 64 cancer surviving adolescents who were 13–21-years-old and disease-free for at least 5 years. The intervention was conducted in a one-day workshop which integrated four components: survivorship, decision-making skills, adolescent risk behaviors, and social support from peers and healthcare professionals. There was a significant effect of the intervention on decision making at the 1 month and 12 month follow-up periods, however not at six months. There was no significant effect on risk motivation or risk behaviors. The limitations of this intervention were the small sample size, the limited duration of intervention and the lack of a randomized design. The authors compared workshop attendees with non-attendees which may have resulted in a self-selection bias, demonstrated by the fact that the intervention group had poorer decision-making skills and greater risk behaviors at baseline.

In summary, although there are proven health behavior interventions with “healthy” adolescents and young adults (e.g., Bessonnette & Contento, 2001; DeVries, Backbier, Koh, & Dijkstra, 1995; Hagger, Chatzisarantis, & Biddle, 2002; Jackson & Aiken, 2000), very little has been designed, implemented, and investigated for childhood cancer survivors. Therefore little is known about the need for tailored and targeted interventions for childhood cancer survivors. The limited published work to date has taken a fairly a-theoretical approach, utilizing perceived vulnerability and decision making skills with mixed results. These interventions have been conducted in small samples of survivors with limited

dose-intensity. Findings at this point indicate some success with limited intervention strategies in reducing behavioral intentions, but not health behaviors.

DISCUSSION

Evidence from studies of health behaviors of childhood cancer survivors indicates that there are diverse prevalence patterns. These are in part due to methodological limitations in the literature and in part suggestive of individual variation. Overall, it appears that childhood cancer survivors engage in health-protective and health-damaging behaviors as frequently as their “healthy” peers. However, there are some studies suggesting that survivors engage in health-damaging behaviors at lower rates than individuals in the general population. Conclusions have been difficult to draw, as many of the studies have included small, non-representative samples of childhood cancer survivors. Additionally, there is a lack of standardized health behavior assessments and definitions in the existing literature. The field is in its nascent stage and prevalence rates to date appear to be somewhat unreliable. We recommend that future studies in this area utilize widely accepted reliable and valid measures of health behaviors (e.g., YRBSS, NHIS) and use standard health behavior definitions. Additionally, we recommend that prevalence studies include larger, more representative samples (e.g., CCSS cohort) or restrict the focus on specific types of survivors (e.g., adolescents, leukemia survivors), in order to identify various subgroups of high-risk survivors.

To date, the literature on childhood cancer survivors has been limited in its investigation of the psychosocial mechanisms or factors that motivate individuals to engage in health behaviors. The covariates that have been studied include knowledge (Tyc et al., 2001a,b, 2003), decision-making ability (Hollen, 2000; Hollen & Hobbie, 1993; Hollen et al., 1996, 1999, 2001), and perceived vulnerability (Mulhern et al., 1995; Tyc et al., 2001a,b, 2003). As a result, our understanding of the covariates related to childhood cancer survivors’ health behaviors is extremely limited and inadequate. However, there is a well developed and growing literature examining theoretically-driven covariates related to the initiation and adoption of health behaviors among “healthy” adolescents and young adults in the general population. The survivorship literature would greatly benefit from utilizing these theoretical models and empirical findings to investigate a more broad range

of covariates of health behaviors. Due to the recent dramatic increase in the number of childhood cancer survivors and the importance of maintaining adequate health practices due to potentially deleterious physical late-effects, an improved understanding of the covariates of cancer survivors' health behaviors will help guide future preventive health interventions targeted to at-risk childhood cancer survivors who may require more intensive and targeted assistance. Additionally, we must design and test new interventions for these survivors and investigate the degree to which we can utilize existing health behavior interventions or to what extent tailoring to survivors is necessary.

Although the prevalence rates of health behaviors of childhood cancer survivors vary greatly, it is clear that we need more research efforts and clinical attention focused on multiple health behaviors. While survivors may engage in health-protective and health-damaging behaviors at similar rates as their peers (or perhaps at even lower rates), their treatment history makes them high-risk for deleterious effects. Therefore, we advocate that not only is more research in this area needed, but more clinical attention should be given to childhood cancer survivors' lifestyle behaviors as part of routine physical examinations and medical history. We have the potential to educate survivors about their risks and influence their health behaviors, possibly decreasing their experience of deleterious physical late-effects.

FUTURE DIRECTIONS

Given the limitations of the prior studies investigating health behaviors, we designed a study to investigate the prevalence and multiple covariates of health behaviors among adolescent survivors diagnosed with cancer during late childhood (NCI R03-CA-101514, PI: Dr. Ford). This study was designed to assess theory-driven and cancer-relevant covariates that may facilitate or impede health behaviors and future behavioral intentions among adolescent cancer survivors. We chose to focus on adolescents, as adolescence is a significant developmental period for the initiation and adoption of lifelong health behaviors. We also chose to assess those survivors who were old enough to have conscious recollection of their cancer diagnosis and treatment (i.e., those diagnosed during mid- to late-childhood). We utilized widely used questions and health behavior definitions (e.g., current smoker) from the youth risk be-

havior survey (CDC, 2002) in order to place the prevalence rates of survivors' health behaviors into a context and interpret our findings based on similar (i.e., same gender, age, geography, race, etc) "healthy" adolescents in the general population. We believe that this approach should help avoid some of the methodological weaknesses of previous published literature.

Since a preponderance of the literature on "healthy" adolescents in the general population has utilized the theory of planned behavior (TPB; Ajzen, 2002) as a guiding framework for the examination of covariates of health behaviors, we chose to utilize this theory in selecting our covariates of interest. Several considerations went into the decision to use the TPB as our conceptual framework. First, the TPB is parsimonious and suitable to an initial effort to understand the psychosocial covariates of health behaviors among adolescent cancer survivors. Second, the TPB has been used to understand the adoption of health behaviors among adolescents and guide a variety of health behavior interventions (Conner, Norman, & Bell, 2002; Murphy & Brubaker, 1990). Third, the TPB includes the construct of subjective norms (peer, familial and physician influence) which is one of the most strongly related covariates of "healthy" adolescents' health behaviors. Fourth, the model provides for the addition of independent and related covariates of health behaviors, and is therefore suitable for potentially unique populations, such as cancer survivors. Given that the method to construct the TPB items follows the recommended standardized methods which have produced highly reliable scales, it is expected that the coefficient alpha for each of these TPB covariates exceeds 0.80 and therefore be acceptable (Nunnally, 1978).

With the addition of several cancer-related constructs from the empirical cancer survivorship literature (i.e., perceived risk, fear of recurrence, cancer worry, and coping processes), we hope this expanded model will provide a more comprehensive effort in understanding covariates of childhood cancer survivors' health behaviors. Finally, utilizing a widely used theoretical framework will allow us to compare our findings to literature on "healthy" adolescents thereby enhancing our understanding of behavioral interventions, as well as advancing the TPB and health behavior literature. It will also allow us to determine how similar adolescent cancer survivors are to their "healthy" peers and will assist in guiding crucial health interventions aimed at promoting health-protective behaviors

and decreasing health-damaging behaviors among high-risk adolescent cancer survivors.

After receiving IRB approval for this study, we began obtaining telephone interviews of adolescent cancer survivors. We are assessing a variety of medical and sociodemographic variables, covariates from the TPB (attitudes, subjective norms, and perceived behavioral control), health-protective and health-damaging behaviors (i.e., exercise, diet, sun protection, tobacco, alcohol, illicit drug use), fear of cancer recurrence, cancer worry, coping processes and perceived risk. We are utilizing standardized, validated, reliable psychosocial assessments for our proposed covariates of interest, hopefully increasing confidence in our study conclusions. To date, we have interviewed over 100 (total projected $n=200$) adolescent cancer survivors between 14 and 19 years of age. All survivors were diagnosed with cancer between the ages of 8 and 14, are at least 12 months post-treatment, and currently show no evidence of disease. Preliminary analyses indicate that a significant minority of our survivors have tried smoking (30.1%), alcohol (57.5%), lie outside to tan (41.7%), are sedentary (30%) and are obese (11.4%) or overweight (12.6%) as calculated by their body mass index. Future analyses will include an examination of all measured covariates and the relationship between covariates and current health behaviors and future behavioral intentions. We will accomplish this by using the popular structural equation modeling (SEM) methodology, which is a general modeling approach that permits evaluation of relationships of observed and latent variables. We hope that this study will advance the literature on health behaviors of childhood cancer survivors and will make an eventual contribution to the design and implementation of an effective intervention to promote healthy behaviors among this high-risk group.

As noted throughout this paper, childhood cancer survivors are at risk for numerous physical late-effects as a result of their cancer therapy. In recent decades, there has been a dramatic increase in the number of childhood cancer survivors and understanding modifiable factors related to their long-term health is extremely important. This growing population is at risk for cardiac, pulmonary, neoplastic, and other major diseases, and it is imperative that survivors minimize preventable risk factors through positive health behaviors. Developing a better understanding of multiple health behaviors and their related covariates, as well as behavioral interventions for this special population, are sorely needed. For

child health psychologists in medical settings, this circumstance affords numerous opportunities to conduct research and impact clinical practice with survivors. Over time, the beneficial public health impact of increased attention to these issues may be sooner realized.

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