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Health Behavior Profiles of Young Adult Cancer Survivors in a Southeastern Cancer Center

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An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Behavioral Sciences and Health Education
2015

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Background: Young adult cancer survivors (YACS) are vulnerable to adverse health outcomes that may be amplified by health behaviors. Using a mixed-methods approach, this study aimed to define health behavior profiles of YACS and characterize associated sociodemographic and psychosocial characteristics.

Methods: Young adult cancer survivors from a southeastern cancer center were recruited to participate in this study. To inform the quantitative analysis, we collected cross-sectional surveys from 106 YACS and assessed sociodemographics, cancer treatment, health behaviors, healthcare provider interaction, and psychosocial factors using the Profile of Mood States (POMS), the Patient Health Questionnaire-9 (PHQ-9), and the Multidimensional Scale of Perceived Social Support (MSPSS). We conducted a k-means cluster analysis, clustering on health-related behaviors. We characterized these clusters in relation to sociodemographics and psychosocial factors. For the qualitative analysis, we conducted in-depth semi-structured interviews with 26 participants who completed the quantitative survey and discussed how cancer affected their social life, psychological functioning, engagement in health behaviors (e.g., alcohol use, tobacco use, physical activity), and their knowledge about health risks related to these behaviors.

Results: Overall, the sample surveyed was 51.0% male, 78.8% white, with a mean age of 22.13 (SD=3.18). The cluster analysis yielded three distinct health behavior profiles: Transitioning High Risk (n=25), Collegiate Low Risk (n=40), and Post-Collegiate Moderate Risk (n=39). The Transitioning High Risk cluster had the highest current alcohol, tobacco, and marijuana use; PA; and number of sexual partners ($p<0.001$). They had higher symptoms of tension-anxiety; depression-dejection; fatigue-inertia; and confusion-bewilderment ($p<0.05$). The Post-Collegiate Moderate Risk cluster had lowest PA, highest FV intake, were oldest, most likely to be employed and had most time passed since their initial diagnosis ($p<0.05$). The Collegiate Low Risk cluster had the lowest current alcohol, tobacco, and marijuana use; fewest sexual partners; and least FV intake. This group was youngest, most recently diagnosed, and most likely to be students ($p<0.05$). They had the lowest levels of tension-anxiety; depression-dejection; fatigue-inertia; and confusion-bewilderment ($p<0.05$). Qualitative interview participants were on average 21.73 (SD=2.96) years of age; 53.8% (n=14) female; 100.0% (n=26) non-Hispanic; 84.6% (n=22) White; 26.9% and 42.3% (n=11) were college students. Qualitative data showed that young adult cancer survivors have a diversity of perspectives on how cancer affected their subsequent health behaviors. Participants said that their experience with cancer has a positive, negative, or neutral affect on health behaviors. However, these distinct perspectives did not consistently align with cluster profile findings. Qualitative findings also show that there is opportunity for improving survivorship care regarding patient and provider interactions around health behaviors and identifying risk groups.

Conclusions: This innovative analytic approach suggests that assessing health behavior profiles, rather single health behaviors, is an informative approach for characterizing YACS and targeting survivorship care. There is opportunity for intervention strategies that target sub-groups based on risk profiles.

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INTRODUCTION

Cancer is the second leading cause of death in the United States among both the general population and among children, accounting for nearly one in every four deaths overall (American Cancer Society, 2013). Despite relatively high mortality rates, the majority of people (68%) with cancer survive at least 5 years beyond their initial diagnosis (American Cancer Society, 2013). Five-year survivorship rates have increased considerably in recent decades and can be attributed in part to improvements in screening and diagnosis techniques as well as scientific advances in the treatment of cancer (American Cancer Society, 2013; Centers for Disease Control and, 2007; National Cancer Institute, 2012). Cancer survivors are defined as anyone who has been "diagnosed with cancer, from the time of diagnosis through the balance of his or her life" (Centers for Disease Control and Prevention, 2007). The community of cancer survivors is growing annually, and as of 2012, there are over 13.7 million people living with cancer in the United States (American Cancer Society, 2013; Centers for Disease Control and Prevention, 2007).

Adolescent and childhood cancer survivors are an important subset of the overall cancer survivor population. Childhood or pediatric cancers are defined as cancers that occur in patients 0 to 14 years old, while adolescent cancers occur in patients 15 to 19 years of age (American Cancer Society, 2013; National Cancer Institute, 2012). Childhood cancers are rare, representing about 1% of all cancer diagnoses. However, the 5-year survival rate of children and adolescents diagnosed with cancer is significantly higher than the overall cancer survival rate for other age groups (American Cancer Society, 2014). In fact, some of the most common types of childhood cancer have very high 5-year survival rates, some of which are greater than 95%; for example, 98% of children with retinoblastoma and 96% of children with Hodgkin’s lymphoma survive at least five years beyond their initial diagnosis (American Cancer Society, 2014). Improvements in diagnosing and treating cancer combined with higher rates of survival for adolescent and childhood cancer survivors mean that young adult cancer survivors comprise a growing proportion of the total cancer survivor community.

Health behaviors are modifiable risk factors that can impact health outcomes and are particularly important to consider among young adult cancer survivors. Young adult cancer survivors engage in health behaviors including alcohol use, binge drinking, tobacco use, marijuana use, and sexual behavior at similar rates to the general population but have elevated risk (Bauld, Toumbourou, Anderson, Coffey, & Olsson, 2005; Emmons et al., 2002; Emmons et al., 2003; Florin et al., 2007; Klosky et al., 2007; Rabin, Simpson, Morrow, & Pinto, 2011; Tyc, Lensing, Klosky, Rai, & Robinson, 2007). There little documented about sexual behaviors among young adult survivors of adolescent and childhood cancers. It is also important to note that among young adults in general and also among young adult cancer survivors, engaging in health behaviors does not happen in isolation. Rather, young adult cancer survivors are likely to engage in multiple risk behaviors simultaneously (Tyc et al., 2007). Additionally, young adult cancer survivors are particularly vulnerable to adverse health outcomes related to cancer treatment that may be amplified or mitigated by associated health behaviors.

Post-treatment and long-term cancer survivorship care follows cancer survivors through the life course, beyond their immediate cancer care. The Institute of Medicine recommends that all cancer survivors receive a survivorship care plan with tailored information that is specific to their cancer type and treatment history (Stovall, Greenfield, & Hewitt, 2005). Survivorship plans can include monitoring for late and secondary effects of cancer as well as health promotion strategies that are targeted to the unique needs of this vulnerable population (Stovall et al., 2005). Generally, cancer survivorship plans include records of care and recommendations for future screening. Specifically, survivorship plans include records of treatment received (i.e., radiation and chemotherapy dosage), potential late effects related to these cancer treatments, screening and follow up recommendations, and salient disease characteristics (i.e., size, location, and stage of tumors). Additionally, survivorship plans should provide recommendations for ongoing support services including psychosocial care or nutrition counseling. Alongside treatment information and recommendations, survivorship plans document administrative data regarding patient treatment and care and includes facility, treating physicians, and a post-treatment point of contact (Stovall et al., 2005). Survivorship care plans are intended to provide comprehensive data regarding treatment history and inform long-term primary care outside of care from an oncological specialist or cancer center.

Given their comprehensive approach, survivorship plans provide an ideal opportunity for needed health promotion interventions among cancer survivors who are particularly vulnerable to the deleterious effects of risky health behaviors. In particular, most survivorship care plans provide health education regarding health behaviors like smoking, substance use, physical activity, and nutrition (COG Survivorship Follow Up Guide, 2004, Landier, 2004, Eshelman 2004). There is a substantial body of literature documenting the feasibility of health promotion during survivorship care, and a need for targeted strategies to meet the unique needs of this diverse group (Emmons, 2008). Adapting health messages across the spectrum of experiences and health behavior profiles is important because a survivor’s level of engagement in a number of health behaviors varies substantially over time and throughout life stages. However, there is little guidance for theory-driven strategies for developing targeted survivorship plans and health messages to the unique needs and profiles of adolescent or young adult patients. For example, adolescents and young adults may engage in multiple risk behaviors simultaneously, or they may engage minimally in health behaviors altogether. The diversity of findings in the literature suggests that there may be distinct health behavior profiles of young adult cancer survivors rather than a clear summative trend across all survivors. Identifying health behavior profiles alongside psychosocial characteristics provides a more holistic view of risk factors and fills a unique gap in the literature.

Given the need for targeted survivorship plans and the unique clinical and developmental experience of young adult cancer survivors, a theory-driven approach to understanding health behaviors profiles is warranted. The Theory of Triadic Influence (TTI) offers an ecologic approach to understanding health behaviors (Flay, Snyder, & Petraitis, 2009). The TTI is often applied to adolescents and young adult populations to understand health behaviors and multiple or combined behavioral outcomes. The TTI is an integrated theory that identifies both levels of causation (i.e., distal, proximal) and streams of influence (i.e., intrapersonal, interpersonal, cultural/environmental) (Flay et al., 2009). There are multiple streams of influence that differentiate young adult cancer survivors from their healthy peers. Young adult cancer survivors are distinct from their peers because their cancer diagnosis may impact health behaviors through the following pathways: individual psychosocial factors; interpersonal interactions with healthcare providers, family and friends; and their changed interactions with their cultural environment. Intrapersonal and interpersonal factors are particularly important for developing behavioral risk profiles; identifying risk factors associated behavioral outcomes, and identifying opportunity for intervention.

Therefore, the TTI provides a useful framework for understanding health behaviors of young adult cancer survivors. This study is informed by the Theory of Triadic Influence and aims to: 1) define health behavior profiles of young adults diagnosed with cancer prior to age 18 using a cluster analysis; 2) document intrapersonal and interpersonal factors associated with cluster assignment; and 3) qualitatively assess factors that influence health behaviors as described by young adult cancer survivors. The results from this research will provide insight into health behavior profiles of young adult cancer survivors, accounting for multiple health behaviors, as well as demographic and psychosocial factors. Furthermore, findings will provide guidance for strategies to target health messages to the unique needs of this vulnerable population.

LITERATURE REVIEW

Young Adult and Childhood Cancer Survivors

While childhood cancers are relatively uncommon and make up less than 1% of all cancer diagnoses every year, it is the leading cause of death by disease among children and adolescents. The burden of these cancers, their subsequent long-term effects, and the growing need for survivorship care is substantial (American Cancer Society, 2013, 2014; National Cancer Institute, 2013). Childhood and adolescent cancers are differentiated based on cancer type and age at diagnosis. Among children (ages 0 to 14), the most common types of cancer are acute lymphocytic leukemia (26%), cancer of the brain and central nervous system (21%), and neuroblastoma (7%) (American Cancer Society, 2014). The American Cancer Society anticipated 10,450 new childhood cancer diagnoses in 2014 with 1,350 of these cases resulting in death. Among adolescents (ages 15 to 19), the most common types of cancer are Hodgkin lymphoma (15%), thyroid carcinoma (11%), and cancer of the brain and central nervous system

(10%) (American Cancer Society, 2014). The American Cancer Society expected that 5,330 adolescents would be newly diagnosed in 2014, with 610 of these cases resulting in death. While cancer diagnosis rates among this population have risen by an average of 0.6% per year in recent decades, mortality rates have declined by an average 2.1% per year (American Cancer Society, 2014). Therefore, there is a growing population of young adult cancer survivors in the United States. As of 2010, there was an estimated 379,112 childhood and adolescent cancer survivors in the United States (American Cancer Society, 2013, 2014). The Children's Oncology Group recommends that childhood and adolescent cancer survivors attend specialized follow-up care to manage the potential long term impacts of their cancers, monitor for emerging side effects and new cancers, and receive health promotion strategies tailored to their unique needs (Landier et al., 2004).

Secondary Effects and Late Effects

All cancer survivors are at risk for developing secondary cancers, given the exposure of cytotoxic cancer treatments to their developing tissues, as well as long term survival rates among this population (Schwartz, 1999). Additionally, cancer survivors are at elevated risk for developing late and long-term effects related to cancer treatment. The aggressive nature of cancer treatment therapies (e.g. chemotherapy, radiation therapy, hormone therapy) make cancer survivors vulnerable to adverse health effects even after treatment is finished, known as late effects (Schwartz, 1999). Reproductive, cardiac, growth/developmental, and endocrine are the most common types of late effects related to cancer treatment (Landier, 2007; Schwartz, 1999). Furthermore, adolescent and childhood cancer survivors have a 10% risk of having a second malignancy diagnosed within 20 years post-treatment (Schwartz, 1999). Young adult cancer survivors have elevated risk for chronic illness following their cancer treatment that is disproportionate compared to the rates of chronic illness among those with no cancer treatment

(Oeffinger et al., 2006). A large retrospective cohort study found that when compared to their healthy siblings, young adult cancer survivors had significantly higher risk of chronic illness following their cancer treatment. Specifically, cancer survivors in this large cohort had 3.3 (CI: 3.0-3.5) times the risk of having any chronic illness, and 8.2 (CI: 6.9-9.7) times the risk of having a severe or life threatening chronic condition compared to their siblings who had not been diagnosed with or treated for cancer (Oeffinger et al., 2006). The excessive and continued burden of disease beyond cancer treatment points to the need for comprehensive follow up care as well as primary and secondary prevention strategies that address modifiable risk factors like health behaviors.

The elevated risk for adverse health outcomes among young adult cancer survivors is well documented and therefore it is important to examine the role of modifiable risk factors as avenues for health promotion interventions. Lifestyle factors including health-related behaviors may have a synergistic effect on long-term health outcomes including late effects of cancer treatment or second cancer diagnoses (Schwartz, 1999). Health behaviors influence long-term and chronic disease health outcomes among the general population, and it follows that the late effects of cancer treatment would also be influenced by health-related behaviors like physical activity, nutrition, tobacco use, and alcohol use (Blanchard, Courneya, & Stein, 2008; Klosky et al., 2012; Schultz et al., 2010; Schwartz, 1999; Tercyak, Donze, Prahlad, Mosher, & Shad, 2006).

Health Behaviors

Tobacco use, alcohol use, nutrition, and physical activity are well-documented health behaviors impacting health in the general population but deserve special attention among adolescent and childhood cancer survivors because they may mediate the onset of secondary cancers or late effects of cancer treatment (American Cancer Society, 2013; Rabin, 2011;

Schwartz, 1999). Sexual health behaviors of young adult cancer survivors are less well documented but contribute to the overall health behavior risk profile of this group. Overall, cancer survivors engage in health-risk behaviors (i.e., tobacco and alcohol use, low physical activity, improper nutrition) at or below that of the general population (Bauld et al., 2005; Blanchard et al., 2008; Emmons et al., 2002; Emmons et al., 2003; Florin et al., 2007; Klosky et al., 2007; Tyc et al., 2007). Furthermore, the literature shows that health-related behaviors are co-occurring among cancer survivors and warrant further investigation (Tercyak et al., 2006). While co-occurring risk behaviors may act simultaneously to increase risk of adverse outcomes, co-occurring health promoting behaviors may have a positive affect on outcomes like health related quality of life compared to effect of single health behaviors (Blanchard et al., 2008).

Most of the literature documents cancer survivors using tobacco at rates lower than or comparable to their healthy adolescent counterparts (Bauld et al., 2005; Emmons et al., 2002; Rabin, 2011; Tyc et al., 2007). However, studies report a wide range of smoking prevalence. While prevalence of smoking among young adult and childhood cancer survivors is reported as low as 2% when compared to 22% of controls with no cancer diagnosis (Tyc et al., 2007), even relatively low rates are problematic given the elevated risk for long term health consequences among this cohort.

In contrast to tobacco use behaviors, literature regarding alcohol use among young adult and childhood cancer survivors is mixed. Some studies document young adult and childhood cancer survivors using alcohol and engaging in binge drinking at a higher rate than the general population (Rebholz et al., 2012) while others document lower rates of use among this population (Klosky et al., 2012; Rabin, 2011). Given that young adult and childhood cancer survivors are at elevated risk for secondary and late effects related to cancer treatment, even low rates of engaging in risky health behaviors is unacceptable.

Furthermore, young adult cancer survivors are less likely to meet physical activity and nutrition guidelines (Florin et al., 2007; Ness et al., 2009; Rabin, 2011). For example, when young adult cancer survivors were compared to their siblings without a cancer diagnosis, the cancer survivors were significantly less physically active, which may further elevate the risk of adverse cardiovascular health issues related to previous cancer treatment (Ness et al., 2009). Moreover, cancer survivors have less than optimal nutritional profiles (Cohen et al., 2012). Lower physical activity levels and improper nutrition put cancer survivors at risk for weight gain, further increasing risk for the multiplicative impact of suboptimal health behaviors and late effects of cancer treatment. In addition to impacting long-term health outcomes, low compliance with physical activity and nutrition guidelines may also impact more proximal outcomes like health related quality of life (Blanchard et al., 2008)

Psychosocial Factors

The psychosocial profiles of young adult and childhood cancer survivors are associated with health-related behaviors (Bauld et al., 2005; Klosky et al., 2007; Ness et al., 2009; Rabin, 2011; Tyc et al., 2007). The literature suggests that similar psychosocial correlates influence health behaviors among cancer survivors and among individuals without a prior cancer diagnosis (Klosky et al., 2007; Tyc et al., 2007). However, these psychosocial factors that influence health-related behaviors in the general young adult population may operate differently among young adult and childhood cancer survivors given their medical history and elevated risk for secondary malignancy and late effects of cancer treatment (Tyc et al., 2007). Understanding how a previous cancer diagnosis and treatment may impact a young adult cancer survivor's psychosocial characteristics through intrapersonal and interpersonal factors has implications for survivorship programming and health education.

Intrapersonal Factors

Based on the existing health promotion literature, individual-level psychological and psychosocial factors are associated with health behaviors in young adult and childhood cancer survivors (Coleman, Berg, & Thompson, 2014; Klosky et al., 2012; Krull et al., 2010). Generally, psychographic scales have been used to characterize young adult cancer survivors and their differences from the general population. For example, depression, hope, and health locus of control have a documented association with health behaviors (Berg, Ritschel, Swan, An, & Ahluwalia, 2011; Coleman et al., 2014; Tyc et al., 2007). Furthermore, depression and hope scales have been used to describe nutrition and physical activity behaviors among cancer survivors (Coleman et al., 2014). The Profile of Mood States (POMS) has been used to assess multiple psychological distresses for young adult cancer survivors, and cancer survivors broadly (Glover et al., 2003; Yeh, Chung, Hsu, & Hsu, 2014). The American Cancer Society recommends assessing intrapersonal psychosocial factors when assessing health behaviors of cancer survivors with specific guidance towards using the POMS scale because it assesses multiple key domains (Smith et al., 2007). Intrapersonal factors, intrinsic to the cancer survivor, can function as proximal and distal predictors of health risk behaviors and protective health behaviors among cancer survivors.

In addition to psychosocial factors, sociodemographic and cancer treatment-related factors are important individual level covariates to consider among this population. Experience with cancer treatment fundamentally differentiates individuals from those without a cancer diagnosis (Klosky et al., 2012). However, these experiences with cancer may operate differentially within the population of young adult cancer survivors.

Interpersonal Factors

Interpersonal factors describe the interactions between individuals and others in their community (Flay et al., 2009). Social support is an important interpersonal predictor of health behaviors across the board and has been associated with nutrition and physical activity (Coleman et al., 2014) and tobacco use among young adult and childhood cancer survivors (Tyc et al., 2007). The American Cancer Society uses the Multidimensional Scale of Perceived Social Support to assess social support as both an outcome that differentiates survivors from the general population, and as a predictor for related health and social outcomes (Smith et al., 2007) Interpersonal factors are particularly important to understanding health behaviors among this population given the social pressures associated with substance use among young adults (Bauld et al., 2005). Finally, given the extensive and early experience with the health care system, health behaviors of young adult and childhood cancer survivors may be distally related to survivors' interpersonal interactions with their physician. Survivorship protocols for young adult and childhood cancer survivors dictate ongoing interactions with physicians at a greater frequency than the typical healthy young adult (Landier, 2007). There is little literature documenting the influence of this relationship on health behaviors but is a logical next step when framing social influences.

Theoretical Model

Theoretical frameworks have been used to explain health behaviors in young adult cancer survivors (Bauld et al., 2005) but there is little evidence in the literature of multi-level approaches to addressing health behaviors in young adult cancer survivors. The Theory of Triadic Influence (TTI) is an integrated theoretical framework, used to explain and predict health behaviors (Flay et al., 2009). The TTI is commonly used among young adults and adolescent populations to explain, predict, or alter health risk behaviors including tobacco use (Bricker et al., 2009; Flay, 1999), alcohol use (Donath et al., 2012), and multiple substance use risk behaviors (Sussman et al., 2009). As such, the TTI is ideally suited for evaluating health-related behaviors broadly among young adult cancer survivors. The TTI addresses intrapersonal, interpersonal, and environmental/sociocultural streams of influence (Flay et al., 2009). The current study focuses on the intrapersonal and interpersonal factors that are associated with health behavior profiles among young adult cancer survivors. Given that the TTI is used extensively to assess health behaviors among the general young adult and adolescent populations broadly, it is ideally suited for evaluating health-risk behaviors among young adult cancer survivors (Flay et al., 2009)

Furthermore, the TTI is an ideal model for evaluating health behavior profiles involving both risky and protective behavior categories (Lippke, Nigg, & Maddock, 2012). The absence of or non-compliance with health promoting behaviors (i.e., meeting nutrition and physical activity guidelines) is risky, particularly for young adult and childhood cancer survivors who have elevated risk for adverse long-term health outcomes (Cohen et al., 2012; Florin et al., 2007; Ness et al., 2009). The TTI has been used to address multiple health behaviors (i.e., drug and tobacco use) among young adults (Sussman et al., 2009), but there is no evidence in the literature for its use among young adult cancer survivor populations. Furthermore, the TTI has been used to guide novel analytic approaches for developing multiple health behavior profiles using cluster analyses. For example, Lippke et al. uses the TTI and a cluster analysis procedure to show the relationship between concurrent physical activity, nutrition, and tobacco use behaviors. Findings from this study indicate that health behavior interventions should be targeted toward health behavior patterns and profiles rather than focusing on single health behaviors (Lippke et al., 2012)

Extending the application of the TTI to develop health behavior profiles of young adult cancer survivors is a novel area for research in health promotion. Evaluating multiple health behaviors holistically and through an ecological lens is an appropriate and innovative use of the TTI and will fill a gap in the existing cancer survivorship literature. In fact, using the TTI to document health behaviors addresses a National Cancer Institute priority area for survivorship research which calls for "theory-based descriptive and analytical studies that document the physiologic, psychosocial, and economic effects of cancer and its treatment on survivors' quality of life, functioning, and health" (National Cancer Institute, 2013, p.1).

Study Aim

The ecologic approach imbedded within the TTI provides a useful framework for assessing the health behaviors of young adult cancer survivors. Using a mixed-methods study design, quantitative surveys and qualitative interviews were used to assess intrapersonal and interpersonal factors that are associated with health behavior profiles of young adult cancer survivors. Health behavior profiles were developed based on level of engagement with risky and protective health behaviors (i.e., alcohol, tobacco, and marijuana use; physical activity and nutrition; sexual activity), and were compared across sociodemographic, psychosocial, and cancer-related factors among a small sample of young adult cancer survivors ages 18-30 recruited from the a cancer center in the Southeastern U.S. Guided by the TTI, this study aimed to define health behavior profiles of young adult cancer survivors, and to quantitatively and qualitatively explore the relationship between health behavior profiles and intrapersonal and interpersonal factors using cluster analysis and in-depth interviews respectively.

METHODS

Participants and Procedures

The Emory University Institutional Review Board approved this study, IRB# 00055570. An explanatory sequential mixed methods approach was used to examine our research question. In Fall 2012, young adult survivors of childhood and adolescent cancers were recruited from the medical records of a cancer center in the Southeastern U.S. Cancer survivors were eligible if they were diagnosed with cancer before age 18 and were being between 18 and 34 years old at the time of recruitment. There were no further exclusion criteria. Research staff mailed recruitment packets, which included a consent form, the survey, and a self-addressed, stamped envelope for returning their survey. Staff also called potential participants to provide information about the study, indicating that it consisted of a one-time cross-sectional survey. Of the 594 patients identified who had phone numbers on record, 225 had non-working numbers, 53 had incorrect phone numbers, 99 were unable to be reached via phone, 10 were ineligible (i.e., too old, disability), 6 were deceased, 5 were unable to be reached (i.e., family member declined on their behalf, lived internationally), and 5 declined participation. Of the 191 packets mailed, 106 (55.5%) were completed. The survey included a question regarding their willingness to be contacted for a follow-up study involving a telephone-based semi-structured interview. Of the 106 participants, 60.4% (n=64/106) provided permission. Then in the Spring 2013, we recruited a subset of 26 survivors for the semi-structured interviews, attempting to get representations of blood and other cancers.

Quantitative Survey

Individuals who completed the survey were compensated with a $40 gift card. The survey included questions regarding sociodemographics, cancer-related factors, intrapersonal variables, and interpersonal factors. Below are the specific measures used in these analyses.

Measures

Sociodemographic Characteristics. The characteristics we assessed included age, gender, ethnicity, education level, employment status, marital status, and insurance coverage. Ethnicity was categorized as non-Hispanic White, Black, or Other due to the small numbers of participants who reported other race/ethnicities. Employment status included part-time employment, full-time employment, student, and other (unemployed unable to work, disabled, homemaker).

Cancer Diagnosis and Treatment. We assessed type of cancer, time (month and year) of cancer diagnosis, and prior cancer diagnoses. We also asked, "Did your treatment protocol include chemotherapy? surgery? radiation?" with response options of "No" or "Yes". We also assessed presence of other health problems (co-morbidities) occurring since cancer treatment, including second cancer, heart attack, stroke, diabetes, hypertension, high cholesterol, musculoskeletal problems, and reproductive health problems.

Health Behaviors. We assessed alcohol use, tobacco use, marijuana use, physical activity (PA), fruit and vegetable (FV) intake, and sexual activity. To assess alcohol use, participants were asked, "In the past 30 days, on how many days did you drink alcohol?" and "In the past 30 days, on how many of those days did you drink 5 or more drinks on one occasion?" To assess tobacco use, participants were asked, "In the past 30 days, on how many days did you: smoke a cigarette (even a puff)? use cigars, little cigars, or cigarillos? use smokeless tobacco, such as snus or chew? use hookah?" To assess marijuana use, we asked, "During the past 30 days, on how many days did you use marijuana (pot, weed, hashish, hash oil)?" These questions have been used in the American College Health Association (ACHA) surveys, National College Health Risk Behavior Survey (NCHRBS), and Youth Risk Behavior Survey (YRBS), and their reliability and validity have been documented by previous research (American College Health Association, 2012; Centers for Disease Control and Prevention, 1997). We dichotomously categorized each of these behaviors as either not engaging in the behavior or having engaged in that behavior in the past 30 days.

To assess physical activity (PA) participants were asked, “During the past 7 days, on how many of those days did you do moderate intensity cardio or aerobic exercise (caused a noticeable increase in heart rate, such as a brisk walk) for at least 30 minutes?” and “During the past 7 days, on how many of those days did you do vigorous intensity cardio or aerobic exercise (caused large increases in breathing or heart rate, such as jogging) for at least 20 minutes?” The CDC reccommends 2 hours and 30 minutes (150 minutes) of moderate-intensity aerobic activity (i.e., brisk walking) every week or 1 hour and 15 minutes (75 minutes) of vigorous-intensity aerobic activity (i.e., jogging or running) every week (Centers for Disease Control and Prevention, 2008). Thus, we dichotomized responses and created a variable indicating meeting at least one of these criteria versus not. We also asked, “During the past 7 days, on how many of those days did you do 8-10 strength training exercises (such as resistance weight machines) for 8-12 repetitions?” Based on the CDC recommendation to engage in strengths training on at least 2 days per week (Centers for Disease Control and Prevention, 2008), we categorized participants as meeting this recommendation versus not.

To assess fruit and vegetable (FV) intake, participants were asked, “Over the past 7 days, on average how many servings of fruit did you eat per day? Over the past 7 days, on average how many servings of vegetables did you eat per day?” We classified participants who consumed an average of at least 5 fruits or vegetables per day as meeting recommendations for fruit and vegetable consumption (U.S. Department of Agriculture, 2010).

Finally, we assessed number of sex partners in the past year.

Health Care Provider Interaction. Participants were asked, “During your last doctor’s visit, did a healthcare provider discuss any of the following with you: Your smoking status? Your level of alcohol use? Any illicit drug use? Your weight? Your nutrition? Your level of physical activity? Any mental health issues, such as high stress levels or depression? Your level of social support?”

Patient Health Questionnaire – 9 item (*PHQ-9).* Participants completed the PHQ-9 (Kroenke & Spitzer, 2002), which is a 9-item assessment of depressive symptoms (e.g., feeling depressed or blue, little interest or pleasure). Each of the items is scored on a 4-point Likert scale from 0 = “Not at all” to 3 = “Nearly every day”, providing a 0 to 27 severity score. Cronbach’s coefficient alpha in the current study was 0.89 indicating this is a reliable scale for this population. Participants with scores ≥10 were categorized as demonstrating significant symptoms of depression (moderate to severe).

Profile of Mood States (POMS). Participants were also asked to complete the POMS, which was developed to assess transient distinct mood states (McNair, Lorr, & Droppleman, 1971; Yokoyama, Araki, Kawakami, & Tkakeshita, 1990). The original form of the measure consisted of 65 adjectives that were rated on a five-point scale from not at all to extremely. Developed on the basis of a series of factor analytical studies, (McNair et al., 1971) six factor-based subscales were derived: tension-anxiety, depression-dejection, anger-hostility, fatigue-inertia, vigor-activity, and confusion-bewilderment. Cronbach’s alpha in the current study was 0.89, 0.90, 0.90, 0.91, 0.91, and 0.87, respectively. We assessed each subscale individually rather than as a total aggregate score.

Multidimensional Scale of Perceived Social Support (MSPSS). Perceived social support from family, friends, and significant others was assessed using the MSPSS, (Zimet, Dahlem, Zimet, & Farley, 1988) which is a 12-item measure comprising three subscales: support from friends, support from family, and support from significant others. There are four items per subscale, each with response options ranging from 1 = "Very strongly disagree" to 7 = "Very strongly agree." Higher scores on each of the subscales indicate higher levels of perceived support, and a sum of the 3 scales yields a summary score. The construct and concurrent validity of the MSPSS has been supported with correlations with relevant measures of anxiety, depression, and previously validated social support scales (Zimet et al., 1988). Previous studies suggest a low impact of social desirability bias influencing subject response (Zimet et al., 1988). The MSPSS has also demonstrated strong internal consistency (Cronbach's alpha = 0.85 to 0.91) and stability (r= 0.72 to 0.85) over a three-month period for all three subscales (G.D. Zimet et al., 1988). Cronbach's alpha in the current study was 0.93, 0.95, and 0.96 for family, friends, and significant other, respectively.

Data Analysis

Participant characteristics were summarized using descriptive statistics. Then, we conducted cluster analyses to characterize potential subgroups of young adult cancer survivors by using their health risk behaviors as the clustering variables. We conducted a k-means cluster analysis, using the pseudo F statistic to indicate the number of clusters. We examined sociodemographic, cancer-related, and psychosocial factors in relation to the clusters. Finally, we developed a logistic regression model using forward stepwise entry of factors associated with cluster assignment per the bivariate analyses at $p<.10$. Only factors associated at $p<.05$ were allowed to remain in the model. SPSS 21.0 was used for all data analyses. Statistical significance was set at $\alpha = .05$ for all tests.

Qualitative Semi-Structured Interviews

Participants were compensated with an $80 gift card for participating in the interviews, which were telephone-based, were audio-recorded, and lasted about 60 minutes. Prior to beginning the structured interviews, participants were read an informed consent and provided oral consent. A trained interviewer (E.S.) facilitated all interviews.

Measures

The discussion guide focused on various topics. The data of focus in the current study focused on the following: 1) engagement in health risk behaviors (e.g., alcohol, tobacco, and other drug use) and health promoting behaviors (e.g., physical activity, nutrition); 2) knowledge about health risks related to these behaviors and sources of information; and 3) provider interactions around health behaviors. To assess each of these domains, we asked a number of open-ended questions related to primary inductive themes. For example, to assess engagement in health behaviors we asked, “How do you think your earlier health problems impacted your tobacco use? Alcohol use? Marijuana use? Physical Activity? Nutrition?” and “What kinds of things do you do to protect your health?” To assess knowledge about resources for health information we asked, “What information did your healthcare providers give you about your specific risks as a cancer survivor?” We also asked, what would make it easier for you to have better nutrition? Engage more in physical activity?” and “What information would be helpful or important to influence how you manage your health?” To assess provider interactions around health behaviors we asked, “What have your doctors told you about the risks of smoking among cancer survivors compared to people who haven’t had cancer? Alcohol? Marijuana?” and “What have your doctors told you about the specific needs for good nutrition among cancer survivors? Physical activity?”

Data Analysis

Qualitative data were analyzed according to the principles outlined in Morgan & Krueger (Morgan & Krueger, 1998). Recorded interviews were transcribed verbatim, and text files were imported into qualitative analysis software. NVivo 10.0 (QSR International, Cambridge, MA) was used for text coding and to facilitate the organization, retrieval, and systematic comparison of data. Transcripts were independently reviewed by the PI, an MPH level staff, and an MPH graduate student to generate preliminary codes. They then refined the definition of primary (i.e., major topics explored) and secondary codes (i.e., recurrent themes within these topics) and independently coded each transcript. The independently coded transcripts were compared and consensus for coding was reached. Two coders independently coded 25% of the narratives. Intra-class correlations for context were 0.92 for the initial 25% of transcripts. The remaining narratives were coded by one of the coders. Themes were then identified and representative quotes were selected.

RESULTS

Univariate Analysis

Of the 106 surveys collected, 104 had sufficient data to be included in the cluster analysis. Two surveys were not included in analysis because they had missing data across multiple health behavior variables that were necessary for cluster analysis. For the quantitative survey sample (see Table 1), participants were on average 22.13 (SD=3.18) years of age; 51.0% (n=53) male; 95.2% (n=99) non-Hispanic; 78.8% (n=82) White; 18.3% (n=19) married or living with a partner; 34.0% (n=35) employed at least part-time; and 50.5% (n=52) were college students. In terms of cancer diagnosis, our sample had the following: Hodgkin's lymphoma (n=24; 23.1%); non-Hodgkin's lymphoma (n=9; 8.7%); Burkitt's lymphoma (n=4; 3.8%); acute lymphoblastic leukemia (n=17; 16.3%); acute myelogenous leukemia (n=3; 2.9%); blastoma (n=6; 5.8%); sarcoma (n=11; 10.6%); thyroid cancer (n=10; 9.6%); and other (n=20; 19.2%). In terms of treatment, 82.7% (n=86) had chemotherapy, 77.9% (n=81) had surgery, and 55.8% (n=58) had radiation. Average time since diagnosis was 8.42 (SD=5.73) years.

Regarding psychosocial factors, 20.4% (n=21) reported significant depressive symptoms based on the PHQ-9 scale. The Profile of Mood States subscale score for tension-anxiety was 4.78 (SD=5.02); depression-dejection was 4.36 (SD=5.05); anger-hostility was 5.33 (SD=5.04); fatigue-inertia was 8.13 (SD=5.99); vigor-activity was 10.61 (SD=5.51); and confusion-bewilderment was 4.15 (SD=4.81). The average Multidimensional Scale of Perceived Social Support score was 68.72 (SD=15.72). Participants reported discussing health behaviors with their provider during their last clinic visit; specifically, 56.7% (n=59) discussed alcohol use; 58.7% (n=61) discussed smoking; 46.2% (n=48) discussed illicit drug use; 66.3% (n=66) discussed weight; 71.2% (n=74) discussed physical activity; 70.2% (n=73) discussed nutrition; 48.1% (n=50) discussed mental health; and 38.5% (n=40) discussed social support.

Regarding participants' self-reported health behaviors, 59.6% (n=62) of the cohort currently used alcohol an average of 6.37 (SD=5.79) days in the last 30 days and 22.1% (n=23) reported binge drinking (more than 5 alcoholic drinks on one occasion) an average of 3.27 (SD =2.75) days in the last 30 days. Current tobacco use prevalence was 19.2% (n=20) with an average of 10.95 (SD = 13.51) days smoked in the last 30 days and an average of 3.35 (SD=5.06) cigarettes smoked per day. Half of participants (50%, n=52) reported engaging in at least 5 days of physical activity for at least half an hour in the last 7 days, while 29.8% (n=31) reported engaging in at least 2 days of strength training for at least 20 minutes in the last 7 days. Regarding diet, 41.3% (n=43) of participants reported eating at least 5 servings of fruits or vegetables per day in the last 7 days. Finally, the average number of sexual partners for this cohort was 0.59 (SD=0.49).

Cluster Analysis – Profiles of Young Adult Cancer Survivors

A k-means cluster analysis was conducted with eight health behaviors as the clustering variables: alcohol use, binge drinking, tobacco use, marijuana use, physical activity, strength training, fruit and vegetable consumption, and number of sex partners. The cluster analysis procedure and pseudo F statistic indicated three distinct clusters based on health behavior profiles. Chi-Square tests found significant differences between clusters for current alcohol use (p<0.001), binge drinking (p<0.001), tobacco use (p<0.001), marijuana use (p<0.001), physical activity (p<0.001), strength training (p=0.019), and number of sex partners (p<0.001). However, fruit and vegetable consumption was not associated with cluster assignments (p = 0.098). Clusters corresponded to profiles named and described below: Transitioning High Risk (n=25), Post-Collegiate Moderate Risk (n=39), and Collegiate Low Risk (n=40).

Cluster 1 – Transitioning High Risk

The Transitioning High Risk group was older than the Collegiate Low Risk group, younger than Post-Collegiate Moderate Risk group, and were most likely to be male (p=0.005). The Transitioning High Risk cluster experienced more mental health symptoms than Post-Collegiate Moderate Risk and Collegiate Low Risk groups. Specifically, Transitioning High Risk cancer survivors were more likely to have depressive symptoms based on the PHQ-9 scale (p=0.052). They also had the highest scores for tension-anxiety (p=0.004), depression-dejection (p=0.018), fatigue-inertia (p=0.033), and confusion-bewilderment (p=0.022) based on the POMS subscales. The Transitioning High Risk group was also the most likely to report engaging in health-related behaviors and had the highest current alcohol use (p<0.001); highest past 30-day binge drinking (p<0.001); highest current tobacco use (p<0.001); and the highest past 30-day marijuana use ($p<0.001$). The Transitioning High Risk cluster reported having the most number of sexual partners in the last year ($p<0.001$). Finally, the Transitioning High Risk group had the highest levels of self-reported physical activity in the last week for aerobic physical activity ($p<0.001$) and strength training ($p=0.019$).

Cluster 2 – Post-Collegiate Moderate Risk

The Post-Collegiate Moderate Risk group was the oldest ($p<0.001$), the most likely to be female ($p=0.005$), and had the most time passed since their initial diagnosis ($p<0.001$). They were also most likely to be employed part or full time ($p=0.012$) and were least likely to be on their parent's insurance ($p=0.012$). The Post-Collegiate Moderate Risk cluster had the least depressive symptoms based on the PHQ-9 depression scale ($p=0.052$). Furthermore, those in the Post-Collegiate Moderate Risk group were least physically active with the lowest levels of aerobic physical activity ($p<0.001$) and strength training ($p=0.019$) but were most likely to consume ≥5 servings of fruits and vegetables per day ($p=0.098$) in the last week.

Cluster 3 – Collegiate Low Risk

The Collegiate Low Risk group was the youngest ($p<0.001$) and was most recently diagnosed ($p<0.001$). Those in the Collegiate Low Risk group were most likely to be students ($p=0.012$) and were most likely to be on public insurance ($p=0.012$). Overall, the Collegiate Low Risk cluster had the lowest levels of mental health symptoms. Based on subscales for the POMS, the Collegiate Low Risk group had the lowest level of tension-anxiety ($p=0.004$); lowest depression-dejection ($p=0.018$); lowest fatigue-inertia ($p=0.033$); and lowest confusion-bewilderment ($p=0.022$). The Collegiate Low Risk group was the least likely to report engaging in health-related behaviors and had the lowest current alcohol use ($p<0.001$), lowest past 30-day binge drinking ($p<0.001$), lowest current tobacco use ($p<0.001$), lowest past 30-day marijuana use (p<0.001). The Collegiate Low Risk group also had the lowest mean number of sexual partners in the last year (p<0.001) and the lowest fruit and vegetable intake (p=0.098).

Logistic Regression - Predicting Cluster Assignment

We conducted a multivariate logistic regression with risk behavior profile clusters (high, moderate, and low risk groups) as the outcome variable. Sociodemographic and psychosocial factors that were significant in the bivariate analysis were included in the forward stepwise logistic regression procedure and included age, gender, employment status, health insurance status, years since diagnosis, and POMS subscales for tension-anxiety, depression-dejection, fatigue-inertia, and confusion-bewilderment. Level of significance for entry into the model was p=0.10 and the level of significance required for remaining in the model was p=0.05. The only factors associated with risk behavior profiles were age (p<0.001), gender (p=0.006), and fatigue/inertia domain from the POMS scale (p=0.001). The Collegiate Low Risk group was set as the reference group for the logistic regression analysis.

Based on findings from the logistic regression, young adult cancer survivors in the Transitioning High Risk group were more likely to be male (p=0.056), older (p=0.004), and have a higher fatigue-inertia score (p=0.004). Specifically, those in the Transitioning High Risk cluster had 3.783 the odds of being male (CI: 0.966, 14.822) when compared to the Collegiate Low Risk group, and while the confidence interval crosses the null the p-value for the trend approaches significance (p=0.056). Additionally, those in the transitioning High Risk group had 1.418 the odds of being older (CI: 1.117, 1.800), and 1.170 the odds of having a higher fatigue-inertia score (CI: 1.052, 1.301) when compared to the Collegiate Low Risk group.

Those in the Post-Collegiate Moderate Risk group were less likely to be male with an odds ratio of OR=0.319 (CI: 0.101, 1.005) that was approaching significance (p=0.051). They were 1.685 times more likely to be older (CI: 1.342, 2.116). There was no statistically significant difference between Post-Collegiate Moderate Risk and Collegiate Low Risk groups regarding their fatigue-inertia scores (p=0.421).

Qualitative Semi-Structured Interviews

For the qualitative interviews, participants were on average 21.73 (SD=2.96) years of age; 53.8% (n=14) female; 100.0% (n=26) non-Hispanic; 84.6% (n=22) White; 26.9% (n=7) were married or living with a partner; 38.5% (n=10) were employed at least part-time; and 42.3% (n=11) were college students. In terms of cancer diagnosis, our sample were survivors of the following: Hodgkin's lymphoma (n=7); non-Hodgkin's lymphoma (n=2); acute lymphoblastic leukemia (n=4); sarcoma (n=6); thyroid cancer (n=3); and other (n=4). Average time since diagnosis was 6.69 (SD=3.08) years. In terms of treatment, 88.5% (n=23) had chemotherapy, 69.2% (n=18) had surgery, and 57.7% (n=15) had radiation.

Table 3 summarizes representative sample quotes of the major qualitative themes that arose from semi-structured interviews. Overall, participants said that their experience with cancer impacted their health-related behaviors, interactions with healthcare providers regarding health behaviors, and their need for resources to address health behaviors. For example, a female cancer survivor in the Collegiate Low Risk group said, "I definitely think, especially being friends with a bunch of kids who have never had to worry about that kind of stuff, I think I do think a little bit differently. Just because I know if you take care of your body, it will take care of you."

Impact of cancer on health-related behaviors

Following the structure of the TTI, we assessed intrapersonal factors like the perceived impact of cancer on health behaviors using qualitative methods and thematic analysis. Generally, participants reported that their experience with cancer impacted their health behaviors positively, negatively, or not at all. The spectrum of perspectives reflected in qualitative themes echo the distinct health behavior profiles from the cluster analysis.

One major theme discussed by participants was the impact of cancer on their subsequent substance use behaviors. Some participants reported that having a prior cancer diagnosis influenced their substance use behaviors for the better, while others reported that their prior cancer diagnosis made no difference, or negatively influenced their substance use behaviors. For the thematic analysis, increased substance use was considered a negative influence while decreased substance use was considered a positive influence. Specific health behaviors that participants referred to included illicit drug use, alcohol use, tobacco use, and marijuana use. For example, a male participant in the Collegiate Low Risk cluster related his experiences with treatment-related drug therapies to his avoidance of recreational substance use. In contrast, a female participant in the Transitioning High Risk group cited the use of therapeutic marijuana use among cancer patients as a reason for her continued marijuana use after treatment. Participants rationale for their substance use behaviors (increased or decreased) varied substantially; however, frequently participants mentioned that their specific experience in cancer treatment was a primary influence on their substance use. Others perceived that their cancer treatment had no effect on their health behaviors.

Regarding the impact of cancer on physical activity, some participants described that their physical activity as a survivor was better than their healthy peers or compared to their behaviors prior to cancer treatment. For example, a female participant in the Transitioning High Risk cluster said that her experience with cancer made her subsequent physical activity better because, “It feels wrong for me to just sit on my butt when I have muscular ability to do it”. Others described how cancer delayed, made no difference, or made worse their level of physical activity. Interestingly, an overarching theme was that the side effects or lack thereof during a participant's cancer treatment was related to their physical activity behaviors. For example, a male participant in the Post-Collegiate Moderate Risk cluster said that cancer delayed his physical activity citing cancer treatment as a limitation to his ability to engage in physical activity. Specifically, he said, "At first it limited my physical activities…It hasn't been until after college that I explored exercise options and found some things that I really enjoy". Furthermore, a female participant in the Transitioning High Risk cluster attributed her decreased level of physical activity to cancer by saying, "…I think I would be in better shape if I wouldn't have had cancer…".

In addition to substance use and physical activity behaviors, participants discussed the impact of cancer on nutrition behaviors and themes that emerged indicated that cancer influenced diet for the better or made no difference. Both the Transitioning High Risk and Collegiate Low Risk clusters cited improved nutrition behaviors following cancer. For example, a female participant in the Transitioning High Risk cluster said, "I eat a lot better since I had cancer" while a female participant in the Collegiate Low Risk cluster said, "It definitely makes me more aware of the benefits of nutrition and being able to focus on that as a way of promoting good health".

Healthcare providers' interactions regarding health-related behaviors

In addition to intrapersonal factors, we assessed interpersonal factors in the semi-structured interviews. Specifically, we assessed participants' interactions with their healthcare providers regarding their health behaviors following cancer treatment and during survivorship care. Overall, participants reported that their healthcare providers provided little assessment of or intervention for health behaviors. Some participants reflect that health behaviors were addressed broadly, but few experienced tailored interactions.

Major themes related to healthcare provider interactions regarding health-related behaviors were themed around substance use, and physical activity and nutrition behaviors. Regarding substance use, some participants said there was minimal or no assessment or intervention related to substance use while others reported that providers assessed and intervened, or emphasized moderation. Participants referred to tobacco, alcohol, and marijuana when discussing healthcare provider interactions about substance use. For example, a female participant in the Post-Collegiate Moderate Risk group characterized provider and assessment of substance use by saying, “I think it’s just the general talk you get. Don’t smoke, don’t drink and don’t use illicit drugs”. A female participant in the Transitioning High Risk group said that her providers emphasized moderation by saying, “They probably just said moderation”. Regarding nutrition behaviors, a major theme that emerged was education. A second theme that emerged for provider interactions related to physical activity and nutrition behaviors, was a lack of opportunity to discuss physical activity and nutrition attributed to not having recent clinic visits.

Potential resources to address health-related behaviors

To inform survivorship care and contextualize intervention strategies within the culture of the cancer survivorship community participants were asked about resources they may need to support health promoting behaviors during their survivorship care. Themes were not distinct across cluster profiles.

Regarding potential resources to address health-related behaviors, participants expressed interest in having up-to-date information and education available through various authoritative sources. Participants discussed a variety of communication channels and the need for expertise and reliability of the material presented. For example, a male participant in the Collegiate Low Risk cluster cited a desire for “Having a good resource that I’m comfort[able] using, consulting with, and helping incorporate healthier practices into my day-to-day life”. Similarly, a female participant in the Collegiate Low Risk cluster desired “Updated information on what is healthy and what is no longer considered healthy”. Others expressed interest in accessing other resources for addressing specific health behavior challenges. They discussed resources to address targeted health behaviors that may be of concern to young adult cancer survivors. For example, a male participant in the Transitioning High Risk group wanted specific tools to address physical activity like “Maybe having access to a gym membership that you wouldn’t have to pay a monthly fee, or get a discounted monthly fee; that would definitely be really helpful…”

DISCUSSION

Health behavior profiles of young adult cancer survivors

The purpose of this study was to define health behavior profiles of young adult cancer survivors using a cluster analysis procedure and to document intrapersonal and interpersonal factors (including psychosocial and demographic characteristics) that are associated with health behavior cluster assignment as guided by the Theory of Triadic Influence. Additionally, this study sought to explore qualitative evidence regarding health behaviors among young adults following their childhood or adolescent cancer diagnosis and treatment. The k-means cluster analysis identified three distinct health behavior profiles: Transitioning High Risk, Post-Collegiate Moderate Risk, and Collegiate Low Risk. A number of sociodemographic, psychosocial, and cancer treatment-related factors were significantly associated with cluster assignment based on bivariate comparisons. Only age ($p<0.001$), gender ($p=0.006$), and the fatigue-inertia domain from the POMS scale ($p=0.001$) were associated with cluster assignment in the logistic regression analysis. Generally, qualitative evidence supported our quantitative findings that adolescent and childhood cancer diagnosis and treatment affect subsequent health behaviors and related perceptions among young adult survivors. Qualitative findings show that childhood or young adult experiences with cancer may have a positive, negative, or neutral effect on health behaviors. Both health behavior data clusters and interview themes show diversity in young adult cancer survivors' characterization of the magnitude and directionality of the effect of prior cancer experience on health behaviors. However, the perspectives described by the key informants were not always consistent with their group-data cluster profile. These findings were somewhat unsurprising given that the qualitative instrument primarily captured intrapersonal and interpersonal factors while the qualitative interviews allowed participants to describe their experiences within the intrapersonal, interpersonal, and sociocultural contexts. This study used a mixed methods approach to holistically characterize the health behavior profiles of a small cohort of young adult cancer survivors and identify opportunities to improve survivorship care.

Regarding the quantitative analysis, the Transitioning High Risk, Post-Collegiate Moderate Risk, and Collegiate Low Risk profile clusters show three distinct levels of engaging in health behaviors – from high to moderate to low, respectively. While we anticipated a clear clustering across health behaviors, the concurrent clustering across life-stage factors was unexpected. In addition to following a risk gradient, the bivariate comparisons show that cluster assignment also aligned with factors related to changing life stages across young adulthood; participants reflected life stages from college to the young professional workforce. Factors that determined life stage clustering included age, employment status, student status, and time since diagnosis.

Generally, the qualitative findings corroborate our quantitative findings with themes showing that cancer affects health behaviors for the positive, negative, worse, or may make no difference all. Qualitative findings also support and confirm that cancer impacts subsequent health behaviors in both magnitude and directionality for young adults following the treatment of cancer. Both quantitative and qualitative findings show that young adult cancer survivors tend to engage in multiple health behaviors concurrently and across a gradient based on the low- moderate- and high- engaging profiles. These overall findings are consistent with existing literature that shows health-related behaviors are co-occurring among cancer survivors (Blanchard et al., 2008; Tercyak et al., 2006) and that multiple risk behavior profiles can be identified using the Theory of Triadic Influence (Lippke et al., 2012).

The Transitioning High Risk group had the highest levels of engaging in health-related behaviors (i.e., alcohol use, binge drinking, tobacco use, marijuana use, number of sexual partners, physical activity). Engaging in risky health behaviors like tobacco and alcohol use is particularly dangerous for cancer survivors given their increased vulnerability for second cancers and late effects of cancer treatment (Emmons et al, 2008; Emmons et al 2012; Klosky et al., 2002). Additionally, this group had the highest mental health symptoms across several domains of the Profile of Mood States (POMS) including depression-dejection, tension-anxiety, fatigue-inertia, and confusion-bewilderment. Literature supports the relationship between increased mental health symptoms and higher engagement in risky health behaviors, particularly among young adult cancer survivors (Emmons et al., 2003; Klosky et al., 2007; Tercyak et al., 2006). Furthermore, our study begins to reconcile the existing literature that has mixed findings regarding prevalence rates of young adult cancer survivors engaging in risk behaviors like alcohol and tobacco use (Bauld et al., 2005; Klosky et al., 2007). For example, some survivors may engage in alcohol use and binge drinking at relatively high rates while others may abstain altogether. Rates of engaging in specific health behaviors are likely not generalizable across the whole population of young adult cancer survivors, rather they emerge as distinct health behavior clusters that are concurrently associated with psychosocial and demographic factors. A holistic approach to understanding risk profiles is more useful than extrapolating overall prevalence rates of these health behaviors and applying them to young adult cancer survivors as a whole. This novel approach can be used to inform cancer survivorship care and provides evidence to encourage holistic screening for modifiable risk factors and developing targeted health promotion interventions. Survivorship care plans and healthcare providers should tailor their health messaging based on the unique risk profile of their patients and our findings provide initial evidence and strategy for this approach.

Despite having the highest risky health behaviors and mental health symptoms, the Transitioning High Risk group also had the highest level of physical activity (i.e., aerobic activity and strength training), which is a health promoting behavior. Literature shows that while physical activity may protect against late sequelae of cancer treatment, the side effects of cancer treatment typically serve as a barrier to engaging in this health promoting behavior (Brown, Winters- Stone, Lee, & Schmitz, 2012). Our findings regarding high levels physical activity among a high-risk group differs from the existing literature which says that young adult cancer survivors are less likely to meet physical activity recommendations (Blanchard et al., 2008). It is important to consider that the high levels of physical activity found in our study were based on self-reported values. There is measurement bias inherent in self-reported health behaviors that may skew results via social desirability. However, the use of self-report to assess physical activity among this population is consistent with approaches in the literature and the constraints of our study design. In addition to deviating from the existing body of literature, the high rate of physical activity among the high-risk cluster is particularly surprising given that this group also had the highest level of fatigue-inertia based on the POMS scale. Typically, elevated fatigue has an inverse relationship with rates of physical activity and is documented in the literature (Brown et al., 2012; Schwartz, 2004). The high level of physical activity alongside elevated mental health symptoms and concurrent engagement in risky behaviors deserves further exploration. While studies show the positive impact of physical activity on mental health status for cancer survivors generally (Schwartz, 2004), the motivations for young adult cancer survivors may be unique. For example, body image issues may emerge several years after cancer treatment for adolescent cancer survivors and may impact body image related health behaviors like physical activity and exercise (Pendley, Dahlquist, & Dreyer, 1997). In our study, the Transitioning High Risk group may be motivated to be physically active by diminished body image and related social pressures rather than concern for their health. Another possible explanation is that the elevated fatigue-inertia subscale may be attributed factors not related to cancer treatment; for example, factors that coincide with transitioning life stage, or symptoms of other mental health burdens (e.g., depression, anxiety).

On the other end of the spectrum, the Collegiate Low Risk group had the lowest levels of engaging in health-related behaviors, and also had the lowest mental health symptoms. This group was younger, more likely to be in college and therefore are a part of a distinct social environment compared to the other groups. It is important to note that the average age for the Collegiate Low Risk group was 20.23 (SD = 2.06), which is under than the legal drinking age of 21 in the United States. This life-stage and sociocultural factor provides partial justification for the low levels of alcohol use and binge drinking behaviors among this group. The Collegiate Low Risk group was also less likely to engage in other risky behaviors like tobacco use or marijuana use. The Collegiate Low Risk group also had the fewest sexual partners in the last year; a finding that aligns with their younger age and earlier life stage. This group had moderate levels of physical activity when compared with the Transitioning High Risk and Post-Collegiate

Moderate Risk group, but had the lowest levels of fruit and vegetable consumption. As a cluster of mostly college students, this group may have more demanding academic schedules that limit the time they may have for intentionally engaging in health promoting behaviors like physical activity or nutrition. The collegiate environment may (e.g., demanding schedules, few healthy options in the cafeteria) make it more difficult to meet fruit and vegetable consumption guidelines and maintain a healthy diet. Unsurprisingly, the Collegiate Low Risk cluster had the lowest mental health symptoms across the board. The findings for the Collegiate Low Risk cluster is consistent with the findings from the literature that lower mental health symptoms are associated with lower engagement in risky health behaviors (Emmons et al., 2003; Klosky et al., 2007; Tercyak et al., 2006).

The Post-Collegiate Moderate Risk was statistically distinct from both the Transitioning High Risk group and the Collegiate Low Risk group. The Post-Collegiate Moderate Risk group had moderate health behaviors and associated psychosocial factors compared to the two other clusters. This group was neither the most nor the least engaged with risky health behaviors (i.e., alcohol use, binge drinking, tobacco use, marijuana use). Regarding protective health behaviors, this group was the least physically active (both aerobic and strength training) but had the highest fruit and vegetable consumption. Despite the moderate level of health behaviors, this group was quite distinct in sociodeomographic and life-stage factors. They were the oldest, most female, had the most time passed since their initial cancer diagnosis, were most employed, and were least likely to be on their parent's insurance.

Role of social support for young adult cancer survivors

Despite evidence in the literature for social support being a key psychosocial factor related to health behaviors for young adult cancer survivors (Bauld et al., 2005; Coleman et al., 2014; Tyc et al., 2007), our findings did not show this relationship. Social support, measured using the Multidimensional Scale of Perceived Social Support (MSPSS), was not significantly different across cluster profiles in the bivariate comparisons. These null findings could be attributed to a number of factors. The MSPSS reflects three domains of social support: social support from friends, family, or significant others (Zimet et al., 1988; Zimet, Powell, Farley, Werkman, & Berkoff, 1990). This cohort was young (22.13, SD=3.18) and mostly non-married (85%, n=81.7), therefore the domain of social support from significant others may be difficult to capture in a young cohort with a relatively low proportion of participants reporting they are in serious or married relationships. Additionally, the social environment and subsequent social relationships with friends and family may change substantially during the life stages reflected in our sample. The time between entering and experiencing college, then transitioning to the workforce is relatively short and therefore social contexts are rapidly changing. An adapted social support measure that is sensitive to the rapidly changing social environment of young adulthood may be able to better detect differences in young adult survivor populations. An additional consideration is that social support may be an underlying pathway that influences health behaviors of young adult cancer survivors but is expressed similarly across profile clusters and therefore differences could not be detected in this sample. Ultimately, further exploration of the social environment and social relationships as they change through young adulthood is needed to understand the role of social support on the differential clustering of health behaviors.

Interpersonal factors and physician interactions

While interview data show that experience with cancer may impact health-related behaviors in a variety of ways, the participants reporting increased, decreased, or no change in their level of engagement with health behaviors did not necessarily align with their assigned profile cluster. An important consideration is that the quantitative survey focused primarily on intrapersonal and interpersonal factors while the qualitative findings may have implicitly addressed perceptions of risk behaviors within a cultural context. The embedded reflection of sociocultural influences in interview responses may account for some of the discrepancy in qualitative findings and cluster assignment. It is impossible to distinguish the influence of cancer on health behavior outcomes from their social and cultural context for each participant in the interview data. Furthermore, the ecologic approach of the TTI allows for the complexity of multiple streams of influence to characterize exposures and outcomes. Ultimately our findings that were consistent with the literature for quantitative data but the qualitative data show less consistency.

Additionally, the qualitative interviews assessed participants' perspectives of their interactions with healthcare providers regarding health behaviors. Previous studies from the same cancer center as this cohort show that healthcare providers perceive that they are able to identify high-risk groups and provide targeted messaging to support improved health behaviors and the unique psychosocial needs of this patient population (Berg, Stratton, Esiashvili, Mertens, 2015). However, our qualitative findings show that young adult cancer survivors perceive provider guidance on health behaviors to be generic, rather than tailored to their specific needs. For example, a high-risk participant highlighted that her provider emphasized moderation as an overall strategy when engaging in risky health behaviors instead of targeting her specific behavioral risk areas. Our quantitative findings corroborate this disparity. Specifically, provider interactions were not significant across cluster comparisons despite the dramatically different risk profiles of the patients that emerged from the cluster analysis. This disparity in provider versus patient perceptions is an area that requires further exploration and offers an opportunity for training healthcare providers or additional care coordination support in addressing specific health needs of this vulnerable population and intervention programming in a clinic setting.

Implications and future directions

There are gaps in the current structure of care delivery for young adult cancer survivors as they transition from cancer treatment to follow up care (Hutchinson, 2013). At a health systems and policy level, there is opportunity to better define the role of providers in addressing health promotion during follow up care. Despite longstanding recommendations for survivorship care plans from the Institute of Medicine (Stovall et al., 2005), a recent study showed that a large representative sample of primary care providers reported relatively low knowledge of follow up care screening guidelines and self-reported discomfort in treating medically complex cancer survivor patients (Suh et al., 2014). In addition to improving the health of cancer survivors, there are substantial direct and indirect economic benefits to a cohesive survivorship care and health promotion strategy that hinges on improving the long-term health and economic productivity of this population (Guy et al., 2014). There is evident need for highly targeted and theory-driven health promotion intervention programs to bridge the gap between cancer care, survivorship, and long term follow up that can provide guidance for providers and support for patients. Thus, innovative health promotion program delivery approaches may be appropriate for this population. For example, web-based platforms are acceptable among young adult cancer survivors and are feasible to implement once a web-based health promotion program has been developed (Nagler, Puleo, Sprunck-Harrild, & Emmons, 2012). The findings from this study provide initial guidance on opportunities for targeted health promotion interventions to risk profiles of young adult cancer survivors.

This study uses a cluster analysis technique in a novel application for identifying multiple-risk behavior profiles of cancer survivors and is a major contribution to the literature. Previous studies have used cluster analysis to assess health behaviors of college students and tobacco users (Berg et al., 2011; Berg et al., 2010; Suragh, Berg, & Nehl, 2013). Additionally, a similar methodology was used to assess multiple health behaviors and was guided by the Theory of Triadic Influence (Lippke et al., 2012). Identifying health behaviors profiles is a relatively new approach in the field of public health but has been documented thoroughly in the field of social marketing and business advertising. Other researchers have documented the utility of this approach in developing targeted health behavior messaging that is targeted toward health behavior profiles, or “market segments” (Berg et al., 2010; Suragh et al., 2013). Thus, targeting multiple-risk behavior profiles rather than isolated health behavior change is a promising strategy for intervention development. This theory driven, analytic procedure is useful for the field of research and practice for improving the health of young adult cancer survivors.

The Theory of Triadic Influence is an appropriate theory to drive future research among this population as it accounts for multiple streams of influence and takes an ecologic perspective (Flay et al., 2009), and has been used alongside both health behavior outcomes and cluster analysis techniques (Lippke et al., 2012). Additionally the TTI can be used to guide future public health practice. The ecologic perspective allows for programs to intervene at intrapersonal, interpersonal, and sociocultural and environmental levels. This may be particularly useful for young adult cancer survivors are their relationships and social environments are rapidly changing.

Our mixed methods findings have implications for research. First, future research should explore the effects of cancer on health-related behaviors compared to the effects of life changes and transitioning to adulthood. Our findings show that health behavior profiles of young adult cancer survivors are significantly associated with a variety of life-stage factors as shown in the bivariate analysis of sociodemographic and psychosocial characteristics. Specifically, a finding from our analysis shows that the years since diagnosis were significantly different across cluster assignments. For example, the Collegiate Low Risk cluster was the closest to their cancer diagnosis while the Post-Collegiate Moderate Risk group was furthest from their diagnosis with Transitioning High Engagers falling between. A longitudinal assessment of young adult cancer survivors as they transition through young adult life stages is needed to understand the effects of progression through young adulthood compared to the impact of cancer treatment on future health behaviors.

Additionally, future research should investigate the utility of this analytic approach among larger cohorts of young adult cancer survivors, and among particularly vulnerable cancer survivor sub-groups by cancer type. Cluster analysis methods and the novel application in the field of cancer survivorship is useful for building holistic profiles that assess multiple risk factors simultaneously. The k-means cluster analysis procedure allowed for unique profiles to emerge from the data that compensate for multiple risk factors simultaneously. This is a particularly important approach given that health-behaviors in a young adult population may be highly variable or skewed, thus reducing the explanatory power of means and simple regression testing. There is emerging evidence in the literature using this technique when examining health behaviors and alongside the Theory of Triadic Influence (Lippke et al., 2012) and assessing the composite health behavior and risk profiles of college students (Berg et al., 2011; Berg et al., 2010; Suragh et al., 2013), but there is limited evidence for the use of cluster analysis techniques in cancer survivorship literature. These results suggest that considering unique health-related behaviors alongside sociodemographic and psychosocial factors may provide further insight into opportunities for intervention and survivorship programming. Thus, our approach is innovative and contributes significantly to the literature.

Additionally, our findings have implications for practice. Young adult cancer survivors have unique health behavior and psychosocial profiles that are both different from the general population, and have differential clustering within their population. Adapting and targeting survivorship treatment plans to the unique health behavior profiles, life-stage, and psychosocial factors (including mental health status) is key for survivorship populations. Survivorship care plans need to be both adaptive to the unique needs of cancer survivors and also responsive to the changing needs of cancer survivors during life changes and transitions through young adulthood. Literature shows that interventions can change the health behaviors (e.g., smoking) of cancer survivors but also demonstrates the need for targeted approaches given the unique needs of patients and survivors (de Moor, Elder, & Emmons, 2008). For example, web-based platforms for health behavior interventions have been shown to be acceptable among young adult cancer survivors and provide an opportunity for targeted interventions based on unique profiles (Nagler et al., 2012). Our findings should be used to assess cancer survivors and develop responsive, adaptive, and targeted health promotion interventions. The feasibility of this approach should be assessed through both research and programmatic methods using translational strategies.

There are opportunities for targeted survivorship programming based on these health behavior profiles. Participants in the Transitioning High Risk group are the highest risk and have high engagement in health-related behaviors with higher mental health symptoms. They are a particularly vulnerable group that clinical providers and survivorship programs should target for health promotion and health education. The Collegiate Low Risk group has the lowest levels of engaging in health-related behaviors and lowest levels of mental health symptoms. Our evidence shows that there is additional guidance needed for providers to identify at risk patients and provide specific guidance and intervention on these behaviors. There is an opportunity for intervention among this group to maintain low engagement in risky behaviors and promote healthy behaviors. Affirming healthy practices during a time where they are currently maintained may mitigate the adoption of more risky behaviors as this group transitions into the post-collegiate environment and moves further away from their diagnosis.

Our qualitative findings provide further guidance on health promotion intervention planning for young adult cancer survivor populations. Through these in-depth interviews, participants discussed a variety of preferred communication channels and the need for intervention messages to come from a provider or program with expertise. Regarding intervention strategies, they requested a source of information for daily engagement, as well as access to the most emerging information regarding healthy practices for young adult cancer survivors. Additionally, they listed specific community resources like access to a gym member ship for reduced or no cost as a way to address environmental barriers to engaging in health promoting behaviors.

Furthermore, our findings show the potential importance of life stage and age as young adult survivors transition from collegiate young adulthood to post-collegiate young adulthood. During this transition, they may be particularly vulnerable and at elevated risk of engaging in a host of health-related behaviors. Long term survivorship plans for young adult survivors should consider the longitudinal changes in young adult cancer survivors regarding their health behaviors, psychosocial characteristics, life stage, and distance from cancer. Cancer survivorship program goals are twofold; early detection of late effects of cancer therapy, and patient education for preventative health measures (Landier, 2007; Landier et al., 2004). This research suggests that there is opportunity for programming and intervention particularly with regard to targeted and responsive patient education.

Limitations and Strengths

There are several limitations to the study that should be considered. First, this was a small sample (n=104), limiting the overall power of the study and ability to conduct subsample analyses. Next, the cross-sectional design of survey and interview data collection allows only for correlational inference, and limits any conclusions regarding causality. This limitation is particularly important to consider given that the health behavior cluster profiles also corresponded with temporally related, life stage factors. In addition, the sample was drawn exclusively from one southeastern cancer center, which limits external generalizability to other parts of the country or to other groups of young adult cancer survivors. Additionally, the mean sociodemographic characteristics among the qualitative interview sub-sample sample were slightly different from the sample obtained for the quantitative survey. The qualitative interview sub-sample was slightly younger; more female; more non-Hispanic and white; and had fewer years since their cancer diagnosis. While the differences in the survey sample and qualitative interview sub-sample were minimal, this still limits the interpretive power of the qualitative findings to the internal study population of young adult cancer survivors.

There were a couple of limitations related to measurement of key variables. First, self-reported survey responses may be biased or inaccurate. Some measurement bias due to social desirability is likely and should be considered when assessing internal validity as well as interpreting or generalizing findings to young adult cancer survivors at large. Next, we did not assess body mass index, which would have been informative given the assessments regarding related health behaviors (i.e., physical activity and nutrition), healthcare provider interactions addressing weight in the clinical encounters, and as a proximal indicator of general health status. In addition, our dichotomous categorization of the health risk behavior variables reduces analytic power. However, dichotomization was appropriate given the homogenous and relatively small sample.

While the Theory of Triadic Influence drove the study and instrument design and analytic method, this study has limited focus on sociocultural or environment level variables. Rather, the study focused primarily on intrapersonal and interpersonal streams of influence. Social support may serve as a proximal indicator of the sociocultural environment; however, our findings for this variable were null. There were constraints in our ability to assess a full scope of sociocultural influences. All study participants were recruited from records at a southeastern cancer center however participants' current geographic environments at the time of the study were dispersed. Geographic dispersion combined with small sample size meant that we were unable to standardize and assess variables related to place and built environments. While the quantitative survey did not assess sociocultural influences specifically, the qualitative interviews allowed for participants to reflect on their health behaviors and experiences with healthcare providers within their larger social context. The role of sociocultural influences related to participants' interactions with providers and health systems began to emerge in the key informant interviews but deserves focused attention in future studies. An important sociocultural factor to consider for future research is the influence of healthcare access on young adult cancer survivors. Healthcare access for this vulnerable population should include primary care, specialty care, support services, as well as access to survivorship care. Contextualizing clustered health behavior profiles within sociocultural and environment characteristics will allow researchers to further assess multi-level and ecological influences and health promoting interventions.

Despite several limitations, this study had several strengths. First, the research aims and analytic approach were theory-driven and were informed by the Theory of Triadic Influence. The

TTI is well documented in substance use, health behaviors, and adolescent and young adult populations and therefore the application of this theory among a new population is justified and appropriate (Flay et al., 2009; Sussman et al., 2009). The TTI supports the assessment of multiple streams of influence across intrapersonal and interpersonal levels, which were assessed in this study via individual health behaviors, sociodemographic factors, cancer treatment related factors, and psychosocial factors.

Another major strength of the study was the mixed methods approach and the use of qualitative data collected from a sub-sample of the total survey population. The mixed methods approach allows for the unique profiles of young adult cancer survivors to be examined in depth and allows for nuanced details to be captured beyond the capacity of a survey. Additionally, this study shows success using a novel analytic approach in characterizing young adult cancer survivors across health behaviors and psychosocial factors. The cluster analysis approach has substantial implications for both research and practice, particularly for targeted health promotion during survivorship care.

ACKNOWELDGMENTS

This work was supported by the Georgia Cancer Coalition (PI: Berg), the National Cancer Institute (PI: Berg; 5K07CA139114), the Emory Egleston Children's Research Center (PI: Esiashvili), and the Winship Cancer Institute Kennedy Survivorship Award (PI: Berg).

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Table 1. Participant characteristics and health behaviors

Variable	Total N (%) or M (SD) N=104	Transitioning High Engagers N (%) or M (SD) N=25	Post-Collegiate Moderate Engagers N (%) or M (SD) N=39	Collegiate Low Engagers N (%) or M (SD) N=40	p-value
Sociodemographics					
Age (SD)	22.13 (3.18)	22.12 (2.52)	24.08 (3.36)	20.23 (2.06)	<0.001
Gender (%)					
Male	53 (51.0)	17 (68.0)	12 (30.8)	24 (60.0)	0.005
Female	51 (49.0)	8 (32.0)	27 (69.2)	16 (40.0)	
Ethnicity (%)					
Hispanic or Latino	5 (4.8)	2 (8.0)	1 (2.6)	2 (5.0)	0.610
Not Hispanic or Latino	99 (95.2)	23 (92.0)	38 (97.4)	38 (95.0)	
Race [a] (%)					
White	82 (78.8)	18 (72.0)	33 (84.6)	31 (77.5)	0.378
Black	21 (20.2)	6 (24.0)	6 (15.4)	9 (22.5)	
Other	1 (1.0)	1 (4.0)	0 (0.0)	0 (0.0)	
Relationship status (%)					
Married/living with partner	19 (18.3)	3 (12.0)	11 (28.2)	5 (12.5)	0.127
Other	85 (81.7)	22 (88.0)	28 (71.8)	35 (87.5)	
Employment status [a] (%)					
Employed part- or full-time	35 (34.0)	9 (37.5)	20 (51.3)	6 (15.0)	0.012
Student	52 (50.5)	13 (54.2)	14 (35.9)	25 (62.5)	
Other	16 (15.5)	2 (8.3)	5 (12.8)	9 (22.5)	
Parental education [a] (%)					
< Bachelor’s degree	45 (43.3)	13 (52.0)	15 (38.5)	17 (42.5)	0.562
≥Bachelor’s degree	59 (56.7)	12 (48.0)	24 (61.5)	23 (57.5)	
Health-Related Factors					
Health care coverage (%)					

Private - Parent’s	58 (55.8)	15 (60.0)	19 (48.7)	24 (60.0)	0.012
Public	13 (12.5)	1 (4.0)	2 (5.1)	10 (25.0)	
No health insurance	10 (9.6)	3 (12.0)	4 (10.3)	3 (7.5)	
Private - Other	23 (22.1)	6 (24.0)	14 (35.9)	3 (7.5)	
Years since diagnosis (SD)	8.34 (5.71)	7.08 (4.39)	11.08 (6.78)	6.45 (4.15)	<0.001
Health Behaviors					
Current alcohol use (%)	62 (59.6)	25 (100.0)	37 (94.9)	0 (0.0)	<0.001
Current binge drinking (%)	23 (22.1)	19 (76.0)	4 (10.3)	0 (0.0)	<0.001
Current tobacco use (%)	20 (19.2)	15 (60.0)	3 (7.7)	2 (5.0)	<0.001
Current marijuana use (%)	12 (11.5)	10 (40.0)	2 (5.1)	0 (0.0)	<0.001
≥5 days of aerobic PA (%)	52 (50.0)	20 (80.0)	11 (28.2)	21 (52.5)	<0.001
≥2 days of strength training (%)	31 (29.8)	12 (48.0)	6 (15.4)	13 (32.5)	0.019
≥5 servings FV per day (%)	43 (41.3)	10 (40.0)	21 (53.8)	12 (30.0)	0.098
Number sex partners past year (SD)	0.59 (0.49)	0.84 (0.37)	0.72 (0.46)	0.30 (0.46)	<0.001

Table 2. Psychosocial characteristics

Variable	**Total N (%) or M (SD) N=104**	**Transitioning High Engagers N (%) or M (SD) N=25**	**Post-Collegiate Moderate Engagers N (%) or M (SD) N=39**	**Collegiate Low Engagers N (%) or M (SD) N=40**	**p-value**
Psychosocial Factors					
Significant depressive symptoms, PHQ-9[a] (%)	21 (20.4)	9 (37.5)	5 (12.8)	7 (17.5)	0.052
POMS, tension-anxiety (SD)	4.78 (5.02)	7.24 (5.34)	4.92 (4.87)	3.10 (4.38)	0.004
POMS, depression-dejection (SD)	4.36 (5.05)	6.76 (5.14)	3.97 (5.15)	3.23 (4.47)	0.018
POMS, anger-hostility (SD)	5.33 (5.04)	7.04 (5.60)	4.56 (4.98)	5.00 (5.04)	0.139
POMS, fatigue-inertia (SD)	8.13 (5.99)	10.84 (6.34)	7.33 (5.71)	7.22 (5.66)	0.033
POMS, vigor-activity (SD)	10.61 (5.51)	10.36 (5.66)	10.08 (5.32)	11.28 (5.67)	0.611
POMS, confusion-bewilderment (SD)	4.15 (4.81)	6.44 (5.48)	3.54 (4.22)	3.33 (4.58)	0.022
Social support, MSPSS (SD)	68.72 (15.72)	66.12 (16.31)	69.26 (16.79)	69.83 (14.43)	0.633

Provider discussed during last clinic visit (%)					
Alcohol use	59 (56.7)	17 (68.0)	25 (64.1)	17 (42.5)	0.065
Smoking	61 (58.7)	16 (64.0)	27 (69.2)	18 (45.0)	0.075
Illicit drug use	48 (46.2)	11 (44.0)	22 (56.4)	15 (37.5)	0.234
Weight	69 (66.3)	15 (60.0)	28 (71.8)	26 (65.0)	0.606
Physical activity	74 (71.2)	15 (60.0)	31 (79.5)	28 (70.0)	0.239
Nutrition	73 (70.2)	16 (64.0)	31 (79.5)	26 (65.0)	0.275
Mental health	50 (48.1)	12 (48.0)	20 (51.3)	18 (45.0)	0.855
Social support	40 (38.5)	5 (20.0)	15 (38.5)	20 (50.0)	0.054

[a] Totals not equaling 104 due to missing data.

Table 3. Thematic Analysis and Sample Quotations

Theme	**Gender, Cluster Assignment**	**Sample Quote**
Impact of cancer on health-related behaviors		
Substance Use		
Better	Male, Collegiate Low Risk	Also I remember…they gave me IV Ativan. It's an anti-depressant. I don't remember exactly what it is. Some people take it to help them get to sleep, and that had a depressing effect on my system like being drunk or something….That really had a tremendous effect upon me in terms of mind-altering substances. Because of that, I still don't drink caffeine regularly at all. I barely drink alcohol at all, and I don't use any mind-altering substances or drugs, marijuana or anything like that because I remember that experience. It had a pretty profound effect. I don't know if it was necessarily scary. I realized that I really didn't like not being fully capable to do whatever I wanted to do and not being able to account for myself and what kind of state I was in.
	Male, Collegiate Low Risk	Now that I've been through chemotherapy and been through all of that, I know what it's like to feel very crappy and not feel like myself and feel very unhealthy as a result of something I really had no control over. There is nothing that I could have done while I was going through chemotherapy that would have made me feel like myself again. When you're being administered that type of drug, there's not much you can do. So now I make sure that I take the time to keep myself feeling good because I know what it's like to not feel good at all, and I don't like it.
	Female, Transitioning High Risk	I guess I just saw all the stuff that could happen with cancer and I don't want to do anything that could increase my risk of getting it. I don't want to go through that again.
No difference	Female, Transitioning High Risk	I don't think [having cancer] really did [impact substance use]. Well, just for that six weeks or whatever it was, but after that, you know, I got back into my old way of doing things, and the way I live my life now doesn't have much to do with, you know, cancer.
	Female, Transitioning High Risk	[Having cancer] should impact it by me saying 'just absolutely not,' but it's… you know, I've dabbled in a couple different things, and everything's been easy for me to put aside

		except the smoking. So that's just… it's my one crutch that I can't just seem to get a handle on.
	Male, Transitioning High Risk	I'm the typical college student. [Drinking alcohol] doesn't really bother me. I don't see the risk in it.
	Female, Transitioning High Risk	I know smoking is really bad for you and I know that it can cause cancer, but I picked it up anyways. It's kind of like it helps me with my stress.
	Female, Transitioning High Risk	I do smoke marijuana. My husband calls me a worry bee. I worry about everything and it helps me not worry about a lot, like keep a lot of things off my mind. I wouldn't say that cancer is the reason why I smoke. I wouldn't blame it on cancer.
Worse	Female, Transitioning High Risk	Well, I felt licensed to smoke pot. I smoked pot a lot. But it just kind of [laughs]. It's ridiculous, but cancer patients smoke pot, so I felt… I was fine with that.
	Male, Post-Collegiate Moderate Risk	Honestly, at first it was bad. It kind of made me want to drink, just because I felt like I was cheated out of my teenage years, so I had a couple of months where we partied, and then after that, I got my head on straight, and just played strong football and other things that kept me going.
	Male, Collegiate Low Risk	The risk of smoking and everything, they tell me it's not good for me but with the way that the steroids make me tic, the nicotine in there does calm my stress level down and it does help me. Yes, I know there's a risk of me getting another type of cancer. I've known it for a while…As some people say, I'm already on death row; I'm just waiting for the gavel of whatever God chooses to take me home. That's all I'm waiting for.
Physical Activity		
Better	Female, Transitioning High Risk	I know the times that I was in the hospital, like for two weeks or a week or whatever, I would get out and I'd feel so weak. I couldn't even bend over without assistance. That always makes me think, on days that I don't want to exercise, I'm like, 'Well, I actually have the ability to.' It feels wrong for me to just sit on my butt when I have muscular ability to do it. I think about the kids who are just lying in bed, getting all that medicine and they can't go exercise. It's kind of like motivation and I feel like I'm doing it for them. I don't know if that makes sense, but…

	Male, Collegiate Low Risk	It made me want to do more physical stuff, because I was a football player before treatment. I got diagnosed my freshman year, so I couldn't play high school football. Now that I'm off treatment I take every opportunity I can to get out and do something. I jog; I work out. I mess around with my friends and wrestle, stuff like that.
Delayed	Male, Post-Collegiate Moderate Risk	At first it limited my physical activities because at first my parents didn't want me to do things. I went to a private high school and because the administration viewed my health history, I don't think they really wanted me to be involved with sports, so I gravitated towards music and had fun with that. That created a situation where in college I just found music and art stuff. It hasn't been until after college that I explored exercise options and found some things that I really enjoy.
No difference	Female, Collegiate Low Risk	Even the year after I did my chemo, I was on dance line, because whenever I got sick, I was on dance line, so it didn't really keep me from doing anything. I did dance line; I think I did swim team like right after chemo, so it didn't really affect me that much at all. I really like to run.
Worse	Female, Transitioning High Risk	At the time when I had cancer, I had lost all of my muscle. I had to learn how to run again because I had been in bed a lot and couldn't do that. I actually had to learn how to run again, so I think I would be in better shape if I wouldn't have had cancer, or if I would have had somebody to exercise with me when I was younger after I had cancer or something because I lost all my muscles. I had a bunch of muscles because I was playing softball and doing weightlifting, but then when I got sick I had to stop, so I went down some.
Nutrition		
Better	Female, Transitioning High Risk	I eat a lot better since I had cancer. I would say my eating habits kind of changed. I don't want to eat too bad because I feel like I was blessed to be able to live through that, so I don't like to take advantage of it by eating crappy foods all the time. My family is pretty nutritious anyways. We always eat greens and fruits and stuff with our dinners.
	Male, Collegiate Low Risk	I think I would have to say I guess my diet got better. Then again, I was younger back then, so I did already tend to eat junk food, and stuff like that. Already, as I was getting older, I was getting out of that stage. But definitely now, it makes me watch my diet more than what I would, and kind of stay away from fast foods and things like that. I'm assuming, because since I've had it since fifteen, or fourteen, or however old. I don't know how to really answer that, but I guess it's made me keep more of an eye on things and watch what I put into my body, watch how I treat my body more than what I would have than if I didn't have the cancer, basically.

	Female, Collegiate Low Risk	It definitely makes me more aware of the benefits of nutrition and being able to focus on that as a way of promoting good health.
No difference	Female, Collegiate Low Risk	I don't eat as healthy as I should. They tell me that I definitely need to take a vitamin, because I'm just like the world's pickiest eater. I don't eat vegetables. I just started trying to eat some fruit and stuff like that.
Healthcare providers' interactions regarding health-related behaviors		
Substance Use		
Minimal or no assessment/intervention	Female, Transitioning High Risk	I don't remember them every saying nothing but I'm sure I have a higher risk of getting cancer than a normal person does with smoking.
	Male, Collegiate Low Risk	Due to my age, they haven't really discussed [smoking] much, and since I've indicated that in no possible way am I going to ever think about smoking, they haven't really gone into great detail about it.
	Female, Transitioning High Risk	I'm not a huge drinker, but I don't think it's ever been approached.
Assessment and intervention	Female, Post-Collegiate Moderate Risk	They would ask me did I smoke, and I told them no, and he was saying that you shouldn't smoke. He's like, 'your chances of getting lung cancer is a lot greater than any other person, so just don't do it.' He tried to scare me into it, but I don't smoke, so it doesn't really matter.
	Female, Post-Collegiate Moderate Risk	I think it's just the general talk you get. Don't smoke, don't drink and don't use illicit drugs.
	Female, Collegiate Low Risk	They asked me if I do marijuana. I said I didn't and they said 'good.' They didn't give any negative reasons to smoking marijuana or taking pills, but they didn't specifically take a point to mention hey, this isn't good for you.
Emphasizing moderation	Female, Transitioning High Risk	They probably just said moderation. They thought it was so funny because I turned 21 in July and I had liver problems previously and I was like, 'Would it be okay for me if I have some alcohol on my birthday?' They just thought it was so funny that I asked and I was like, 'Well, I don't want to mess everything up now that I'm healthy!' But they said just as long as

		I don't go binge drinking, which is fine and I didn't do that. They said one or two is fine, every once in a while.
	Female, Transitioning High Risk	I drink. Yeah, I'm a college student, but [my doctors] haven't… They said, 'Don't go crazy.' It really can't do anything, unless you're taking your [medication], if you're taking your medication with the alcohol.
Physical Activity and Nutrition		
Education	Female, Collegiate Low Risk	They've definitely emphasized the specifics like fruits and vegetables, and eating well and getting exercise, and a specific amount over a week and different things along those lines. They've definitely emphasized it.
	Female, Transitioning High Risk	They talk about that and how important it is to stay healthy. Right when I finished treatment, they were telling me that my bones were probably really weak and that it would be important to do weight bearing activities, so I run a lot. They talk about that a lot and ask me about that.
No opportunity because no recent clinic visits	Male, Collegiate Low Risk	[I've heard nothing about health-risk behaviors, physical activity or nutrition], and of course, there hasn't really been much of a context for that to come up because I haven't seen a doctor regularly in a while, and I didn't go through any exit counseling I suppose you could call it after I completed treatment because I stopped going to see the oncologist flat out.
Potential resources to address health-related behaviors		
Information and education through various reliable sources	Male, Collegiate Low Risk	Having a resource, whether it's a person on an online community, to help me make informed decisions and follow good practices for managing my health, like knowing good ways to exercise and use my time effectively to exercise, and exercise right so I don't hurt myself or do something stupid like that. Having resources that help me figure out how to incorporate healthier eating into my day-to-day life without impacting my time tremendously, like figuring out a good way to eat healthy without taking even more time to cook and prepare food. Having a good resource that I'm comforting using, consulting with, and helping incorporate healthier practices into my day-to-day life.
	Male, Transitioning High Risk	Just the talking to the doctor has been the most important thing for me. It's everything I expected and wanted, so it's been good.

	Female, Collegiate Low Risk	Health information keeps updating every day. One day tea leaves are good for you and the next day they're poison. Updated information on what is healthy and what is no longer considered healthy.
Other resources for addressing specific health behavior challenges	Female, Transitioning High Risk	Probably some kind of medication. I forget there's this new medicine that's out—that was new; it's not new anymore, something, I forget what it's called but I want to try it. It's some kind of medicine that you take for like so many days and you can still smoke on it but it makes you not want a cigarette. I don't remember what it's called. That would probably help me. I've tried chewing gum. I've tried the electric cigarettes, and it's just really hard.
	Male, Transitioning High Risk	Maybe having access to a gym membership that you wouldn't have to pay a monthly fee, or get a discounted monthly fee; that would definitely be really helpful, just because I'm not so motivated that I want to spend forty dollars a month to be able to go to a gym. In that case, I would rather just jog around the block or something. If I did have access to that kind of thing for free or for a discount, I might take advantage of that.