Published in final edited form as:

J Cancer Surviv. 2016 April ; 10(2): 280–290. doi:10.1007/s11764-015-0474-7.

Health behaviors, quality of life, and psychosocial health among survivors of adolescent and young adult cancers

Echo L. Warner¹, Gina E. Nam¹, Yingying Zhang², Molly McFadden², Jennifer Wright³, Holly Spraker-Perlman³, Anita Y. Kinney⁴, Kevin C. Oeffinger⁵, and Anne C. Kirchhoff^{1,3}

Echo L. Warner: echo.warner@hci.utah.edu

¹Cancer Control and Population Sciences Research Program, Huntsman Cancer Institute, 2000 Circle of Hope, Rm 4125, Salt Lake City, UT 84112, USA

²Division of Epidemiology, Department of Internal Medicine, University of Utah, Salt Lake City, UT, USA

³Department of Pediatrics, University of Utah, Salt Lake City, UT, USA

⁴Department of Internal Medicine and University of New Mexico Cancer Center, University of New Mexico, 1 University Blvd NE, Albuquerque, NM, USA

⁵Department of Medicine and Pediatrics, Memorial Sloan-Kettering Cancer Center, New York, NY, USA

Abstract

Purpose—Survivors of adolescent and young adult (AYA) cancer may engage in unhealthy lifestyles (e.g., smoking), potentially heightening their risk for long-term health problems. We assessed health behaviors and constructs including quality of life (QOL) and psychosocial well-being among survivors of AYA cancer compared to the general population.

Methods—We used 2009 Behavioral Risk Factor Surveillance System data to evaluate health behaviors for survivors of AYA cancer compared to AYAs without cancer. Multivariable regressions assessed health behaviors (smoking, binge drinking, physical inactivity, and low fruit/vegetable intake) by sex and age between AYA survivors and controls, and among survivors to determine the effects of demographic, QOL, psychosocial, and cancer factors on behaviors.

Results—A greater proportion of female survivors of AYA cancer smoked than controls (currently aged 20–39: 27 vs. 14.3%, respectively; currently aged 40–64: 29.3 vs. 18.4%, respectively). Generally, survivors and controls were non-adherent to national health behavior guidelines. Uninsured survivors were at greater risk of smoking vs. insured (females, Relative Risk (RR)=1.64, 95 % confidence interval (CI) 1.43–1.90; males, RR=2.62, 95 % CI 1.71–4.02). Poor social/emotional support was associated with smoking (RR= 1.26, 95 % CI 1.07–1.48) among female survivors and was associated with low fruit/vegetable intake among male (RR= 1.12, 95 % CI 1.01–1.23) and female (RR=1.12, 95 % CI 1.05–1.19) survivors. Female survivors >10 years

Correspondence to: Echo L. Warner, echo.warner@hci.utah.edu.

Electronic supplementary material The online version of this article (doi:10.1007/s11764-015-0474-7) contains supplementary material, which is available to authorized users.

Conflict of interest The authors declare that they have no conflict of interest.

from diagnosis had higher risk of smoking (RR=1.26–1.91, all $p<0.01$) than survivors 5–10 years from diagnosis.

Conclusions—Unhealthy lifestyle behaviors are common in survivors of AYA cancer.

Implications for Cancer Survivors—AYA survivors require health behavior support.

Keywords

Quality of life; Adolescent and young adult; Smoking; Diet; Binge drinking; Exercise

Nearly 70,000 adolescents and young adults (AYA) aged 15 to 39 are diagnosed with cancer each year [1]. Approximately 10,000 die from cancer annually in this age range [2]. For AYAs with cancer, the diagnosis arrives at a complex time during development. AYA is a period of transitions to college, work, marriage, and parenthood, as well as substantial physical and psychosocial changes [3]. At the same time, AYAs exhibit increases in risky behaviors and decreases in physical activity [3, 4]. A cancer diagnosis during this age period may cause disruptions in key periods of physical, social, and psychological development, potentially leading to diminished quality of life (QOL) following treatment [5, 6].

In 2012, the National Comprehensive Cancer Network released clinical practice guidelines that specifically focus on the management of risky health behaviors for AYAs with cancer [7]. However, little is known about modifiable health behaviors such as smoking, alcohol use, physical activity, and low fruit/vegetable intake among survivors of AYA cancers. While some studies report that survivors of AYA cancer have a higher incidence of smoking than the general population [5], others suggest survivors are less likely to smoke [8]. Also, the majority of survivors of AYA cancer may not be adherent to national guidelines on fruit/vegetable intake and physical activity [5, 8]. These modifiable health behaviors may affect an AYA's risk for subsequent chronic health problems including second cancers [9].

Using national data from the Behavioral Risk Factor Surveillance System (BRFSS), we report on health behaviors (current smoking, binge drinking, low physical activity, and low fruit/vegetable intake) among survivors of AYA cancer diagnosed ages 15 to 39 compared to AYAs without a cancer history. As survivors of AYA cancer experience poorer QOL compared to those without cancer [5, 6, 10], we extend on an earlier BRFSS report on AYAs with cancer [5] to investigate the link between health behaviors and QOL, as well as other important factors such as psychosocial health. Our analyses also provide an account of health behaviors among AYAs diagnosed throughout the full age range of 15 to 39 years, as the 30 to 39 age range has not always been included in earlier studies. We hypothesized that survivors of AYA cancer would be less likely to meet national recommendations for modifiable health behaviors compared to controls, and that these differences would persist across age. We also hypothesized that certain survivors (i.e., those with poor QOL, low levels of social/emotional support, or further from diagnosis) would have poorer health behavior adherence and investigated these differences by sex.

Methods

Conducted annually, BRFSS is a nationally representative computer-assisted survey implemented in the USA, Puerto Rico, Guam, and the Virgin Islands (www.cdc.gov/brfss). BRFSS uses random-digit telephone dialing methods to sample non-institutionalized adults aged 18 years. A total of 432,607 individuals participated in the 2009 BRFSS for a response rate of 53 % [11]. Secondary data analyses of publicly available data are considered exempt by the University of Utah Institutional Review Board.

Participants

We limited our sample to the $N=424,592$ US participants. Individuals with cancer were identified from the question, “Have you ever been told by a doctor, nurse, or other health professional that you had cancer?” The test-retest reliability for this question is high ($k=0.91$) [12]. Participants indicating a cancer history were asked the age at diagnosis of their first primary cancer. We excluded those with a cancer diagnosis aged <15 or 40 years ($N=48,134$). Additional exclusions included the following: missing cancer information ($N=24,974$), unknown diagnosis age or current age ($N=6231$), and diagnosis of non-melanoma skin cancer ($N=2119$). Those who were less than 5 years from diagnosis were also excluded ($N=756$). Based on our inclusion criteria, there were $N=7619$ participants with cancer diagnosed aged 15 to 39 and $N=334,759$ controls with no cancer history.

Measures

Health behavior outcome measures—Current smoking was defined as those smoking some/every day vs. those who did not currently smoke. Binge drinking was categorized for males as having 5 drinks/females as having 4 drinks on one occasion vs. those who drank alcohol less frequently [13]. Using the validated BRFSS physical activity measure [14], we defined low moderate leisure-time physical activity as <30 min/day for 5 days per week vs. 30 min/day for 5 days per week [15]. Low fruit/vegetable intake was grouped as <5 fruits or vegetables per day vs. meeting recommendations of 5 servings of fruits and vegetables per day per Center for Disease Control (CDC) guidelines [16].

Demographic and cancer—Demographic factors included sex (female vs. male), age at survey (20–29, 30–39, 40–64, 65), race (non-Hispanic White, non-Hispanic Black, Hispanic/Latino, non-Hispanic other race, non-Hispanic multiracial), and health insurance status (insured vs. uninsured). Among survivors, cancer factors included diagnoses such as breast, thyroid, melanoma, colorectal, Hodgkin’s, non-Hodgkin’s, testicular, bone, brain, leukemia, cervical, ovarian, endometrial, and other cancers (i.e., stomach, bladder, pancreatic, esophageal, and lung), number of cancer diagnoses (1 vs. 2), age at diagnosis (15–20, 21–29, 30–39), and years since diagnosis (5–10, 11–20, 21–29, 30).

Quality of life and psychosocial health—QOL measures were from the CDC Health-Related QOL measures that included self-reported poor general health status (fair/poor health vs. good/very good health) and 15 days per month of poor physical or mental health vs. <15 days per month of poor physical or mental health, for both [17]. Psychosocial health measures included poor social/emotional support (sometime/rarely/never receiving adequate

social/emotional support vs. always/usually receiving adequate social/emotional support) and poor life satisfaction (dissatisfied/very dissatisfied vs. very satisfied/satisfied).

Statistical analysis

Descriptive statistics of raw counts and BRFSS survey design weight-adjusted proportions were calculated for demographic, QOL, and psychosocial health factors categorized by sex for survivors of AYA cancer and controls. For survivors, raw counts and BRFSS weight-adjusted proportions were calculated for the cancer diagnosis, number of cancer diagnoses, age at diagnosis, and years since diagnosis.

Statistical analyses considered the four dichotomous unhealthy behavioral outcomes described previously. We estimated adjusted percentages of subjects with unhealthy behaviors by sex after adjustment for age (as a continuous variable within each age group) and race for each of six groups defined by age category (20–39, 40–64, 65 years) and cohort (cancer survivors and controls). The adjusted percentages were estimated by fitting separate logistic regression models relating the unhealthy behaviors to sex within each of the indicated groups with covariate adjustment for age and race, using the method of marginal standardization [18], while taking into account the complex survey sampling design.

Multivariable Poisson regression analyses were applied among the cancer survivors to jointly relate each behavior to the following predictor variables: age at survey category, race/ethnicity, health insurance, health status, days per month of poor physical health, days per month of poor mental health, level of social/emotional support, and life satisfaction. We also ran similar models for the controls to evaluate whether predictors of health behaviors differed from the predictors that were significant in the survivor models.

Last, among survivors, Poisson regressions were used to relate each health behavior outcome to cancer diagnosis, age at diagnosis, and years since diagnosis while controlling for age (as a continuous variable) and race, with separate models fit for each outcome and predictor variable. The Poisson regression analyses were performed separately for males and females, utilized robust standard errors while accounting for the complex survey sampling design [19], and are reported as relative risks (RR) with 95 % confidence intervals (CI). All data were analyzed using appropriate procedures in SAS 9.4 or Stata 13 (SAS Institute, Cary, NC; StataCorp. 2013. *Stata Statistical Software: Release 13*. College Station, TX: StataCorp LP). *p* values were two-sided, with *p*<0.05 considered significant.

Results

Demographics, cancer characteristics, QOL, and psychosocial health

The majority of participants were 40 to 64 years old with more survivors in this age group for both females (survivors 60.8 % vs. controls 45.4 %) and males (66.7 % vs. 48.0 %; Table 1). Most participants were non-Hispanic, White. Overall, more than 80 % of participants had some form of health insurance. Common cancer diagnoses for female survivors included cervical (38.4 %), breast (13.3 %), ovarian (8.5 %), and melanoma (8.5 %), and for males, melanoma (23.1 %), testicular (14.6 %), and Hodgkin's lymphoma (7.2 %).

In adjusted models, female survivors had poorer QOL and psychosocial health than female controls (Fig. 1), ranging from 31.3 % reporting fair/poor general health vs. 15.4 % of female controls, and 27.0 % reporting poor social/emotional support vs. 20.5 % of female controls. Male survivors had poorer health and more days of physical and mental impairment than male controls, but did not differ from controls on social/emotional support or life satisfaction.

Health behaviors among AYA cancer survivors and controls

In adjusted percentages in Table 2, more female survivors smoked than female controls with 27 % (95 % CI 20.7–33.3) aged 20 to 39 smoking compared to 14.3 % (95 % CI 13.2–15.3) of controls ($p<0.001$); there was a similar difference among those aged 40 to 64. Fewer male survivors aged 40–64 (15.2 %, 95 % CI 10.1–20.3 vs. 22.3, 95 % CI 21.4–23.3) reported binge drinking than controls ($p<0.05$).

Demographics, QOL, and psychosocial health factors associated with health behaviors

In Table 3, multivariable relative risks revealed that smoking was 34–72 % less common across all age groups of female survivors compared to those aged 20 to 29 ($p<0.001$). Black and Hispanic/Latino survivors smoked 52–62 % less often than White survivors, whereas multiracial survivors smoked more (RR=1.74, 95 % CI 1.40–2.16, $p<0.001$). Being uninsured (RR=1.64, 95 % CI 1.43–1.90, $p<0.001$), reporting fair/poor general health (RR=1.24, 95 % CI 1.05–1.48, $p=0.01$), having 15 days of poor mental health per month (RR=1.22, 95 % CI 1.05–1.44, $p=0.01$), and having inadequate social/emotional support (RR=1.26, 95 % CI 1.07–1.48, $p=0.004$) were all associated with smoking.

Binge drinking was more common among younger female survivors. Black survivors (RR=0.32, 95% CI 0.14–0.68, $p=0.003$) and survivors in poor general health (RR=0.66, 95 % CI 0.42–1.00, $p=0.05$) tended to binge drink less often than non-Hispanic, White survivors and those in good health, respectively. Black survivors reported lower physical activity levels (RR=1.32, 95 % CI 1.19–1.46, $p<0.001$) than White survivors. Fair/poor general health (RR=1.12, 95 % CI 1.03–1.23, $p=0.008$), 15 days of poor physical health per month (RR=1.12, 95 % CI 1.02–1.24, $p=0.01$), and low social/emotional support (RR=1.08, 95 % CI 1.00–1.18, $p=0.05$) were associated with lower levels of physical activity. Poor social/emotional support was the only factor associated with low fruit/vegetable intake among female survivors.

In Table 4, both smoking and binge drinking decreased across age for male survivors. Uninsured male survivors had 2.62 times (95 % CI 1.71–4.02, $p<0.001$) higher risk of smoking than male survivors with health insurance. Compared to non-Hispanic, White survivors, binge drinking was lower for Black (RR=0.04, 95 % CI 0.00–0.40, $p=0.005$) and Hispanic/Latino survivors (RR=0.20, 95 % CI 0.05–0.79, $p=0.02$). Male survivors with low social/emotional support (RR=1.12, 95 % CI 1.01–1.23, $p=0.02$) ate fewer fruits and vegetables per day than their counterparts.

We ran the same models among controls (Appendix). Similar demographic, QOL, and psychosocial variables were significantly associated with health behavior as in the survivor models. In addition, other factors such as life satisfaction, which were not statistically

significant in the survivors models, were associated with the controls' health behavior adherence.

Cancer-related factors associated with health behaviors

In Table 5, compared to cervical cancer, female survivors of all other cancer diagnoses were less likely to smoke ($p = 0.01$). Female survivors who were in the oldest group at diagnosis (30 to 39 years) smoked less than those aged 15 to 20 years at diagnosis ($RR=0.78$, 95 % CI 0.64–0.96, $p=0.02$). Yet, female survivors were more likely to smoke the further they were from diagnosis. Binge drinking was lower among female survivors with colorectal ($RR=0.11$, 95 % CI 0.03–0.36, $p<0.001$), Hodgkin's ($RR=0.08$, 95 % CI 0.03–0.26, $p<0.001$), and ovarian cancers ($RR=0.51$, 95 % CI 0.27–0.93, $p=0.03$). Female survivors of breast ($RR=0.85$, 95 % CI 0.78–0.94, $p=0.001$) and melanoma ($RR=0.85$, 95 % CI 0.76–0.94, $p=0.001$) were less likely to report low fruit/vegetable intake compared to cervical cancer survivors.

Male survivors who were 11 to 20 years from diagnosis had lower risk of smoking compared to those 5 to 10 years from diagnosis ($RR=0.57$, 95 % CI 0.32–1.00, $p=0.05$). Participants with a history of colorectal cancer ($RR=1.44$, 95 % CI 1.05–1.98, $p=0.02$ vs. melanoma) and those further from diagnosis (21 to 29 years: $RR=1.34$, 95 % CI 1.01–1.77, $p=0.04$; and 30 years: $RR=1.55$, 95 % CI 1.10–2.18, $p=0.01$ vs. 5 to 10 years) were less likely to meet physical activity recommendations.

Discussion

Tobacco use, excessive alcohol consumption, low levels of physical activity, and low fruit/vegetable intake are key behaviors related to chronic disease and mortality in the USA [20]. Studies that evaluate survivors of AYA cancers' adherence to healthy behavior guidelines are important for identifying intervention targets to improve their long-term survival and reduce their risk of second cancers [21]. Our results identify several areas of concern for this population. Survivors of AYA cancer smoke at levels greater than the general population, and in particular, many female survivors smoke in the decades following their cancer therapy. However, while we hypothesized that survivors would be less likely than the general population to meet national recommendations for other health behaviors, both physical activity adherence and fruit/vegetable consumption, while low, are largely comparable to the general population.

To our best knowledge, no studies exist regarding smoking cessation interventions specific to survivors of AYA cancer. However, interventions using in-person or web-based strategies have been successful at engaging childhood cancer survivors in smoking cessation [22] and may be appropriate for AYA survivors. Not surprisingly, being uninsured was related to smoking among both female and male survivors and controls. In the general population, the uninsured are significantly less likely to receive smoking cessation counseling from a physician, but this issue has not been studied explicitly among AYA survivors [23]. Moreover, similar to the general population [23], healthcare providers may be missing key opportunities to provide smoking cessation counseling to AYA cancer survivors [24] due to lack of time and focus on managing other health conditions. The Patient Protection and

Affordable Care Act includes smoking cessation counseling as an essential preventive service [25], meaning that survivors who are in need of smoking cessation services can potentially benefit from this new coverage.

Physical activity behaviors often formalize in adolescence and young adulthood [4], and a cancer diagnosis may be particularly disruptive to maintaining an active lifestyle. Younger cancer survivors are active at lower than recommended levels, and this continues after recovery [26, 27]. We found similar low activity levels for AYA survivors in our analysis, but not at levels markedly different than the general population. However, maintaining an active lifestyle is of critical importance for survivors to reduce their risk of chronic health problems, and our analyses suggest potential areas where survivors differ from the general population related to lack of exercise. For male survivors, none of the demographic, QOL, or psychosocial health factors significantly predicted low physical activity, but these factors were significant for controls. We found similar demographic and QOL predictors of inadequate physical activity among female survivors as female controls, such as poor general health, more physical limitations, and lower social and emotional support. Yet among female controls, older age (≥ 65 years), minority race/ethnicity, being uninsured and dissatisfied with life were associated with non-adherence to physical activity guidelines, whereas for survivors, only Black survivors were at risk.

We recommend that future studies should evaluate more comprehensive factors such as pain and stamina that are potentially associated with lack of exercise among AYA survivors, with particular focus on identifying issues among male survivors. In addition, whether exercise intervention studies designed for the general population could be tailored to survivors remains unclear despite the similarity we found among female survivors and controls for certain factors such as social support, and this is an important area for future investigation. Research to promote and sustain physical activity for AYA cancer survivors from diagnosis through survivorship should consider creative solutions to keep survivors engaged such as internet-based physical activity interventions that have shown high feasibility and acceptability in young survivors, with moderate improvements in both physical activity and psychosocial outcomes [28].

In addition, the importance of social support related to health behaviors cannot be understated for AYAs regardless of their cancer history, for whom peer and intimate partner relationships are central [3]. Between 20 and 23 % of the AYA controls in our sample reported inadequate social and emotional support, compared to 27 % of female and 25 % of male survivors. Although survivors and controls did not differ largely on social support, the cancer experience can be very isolating for AYAs [29] and peer support may provide a key way to design interventions targeted to survivors. Low support was associated with smoking, inactivity, and low fruit/vegetable intake for female survivors, and this was similar to controls. For males, low support was associated with not meeting fruit/vegetable intake recommendations, and for controls, with smoking, inadequate physical activity, and low fruit/vegetable intake. As BRFSS only includes one general marker of social support, we suggest that future studies generate more detailed data on issues such as social isolation during treatment and survivorship and how these factors are associated with health behaviors over time for AYA survivors. Rabin et al. conducted in-depth interviews with AYA cancer

survivors and found that while AYAs prioritized electronic social support interventions (e.g., an online forum) for their convenience, interventions that utilize phone or in-person meetings may be most effective at improving feelings of social engagement [30]. Thus, multi-mode health behavior interventions that consider optimal social support mechanisms may be essential to supporting AYA cancer survivors.

Several cancer-related factors are important in identifying survivors at high risk for non-adherence, especially among women. Female survivors further from diagnosis were more likely to smoke, whereas male survivors may be less physically active over time. Meaning that, similar to cancer survivors in general, health behavior support is needed in the long-term for all AYA survivors [31]. Cervical cancer was the most common female cancer diagnosis in our population. Similar to an adult-focused study that included a sub-population of AYAs [32], survivors of all other cancers were less likely to smoke than cervical cancer survivors. Male AYA survivors of colorectal cancer were less likely to meet physical activity recommendations. The reasons for these differences in health behaviors are not clear, although certain cancers may lead to barriers to exercise due to therapy (e.g., colorectal cancers with colostomy bags) or are associated with lack of insurance (e.g., cervical cancer).

Certain study limitations exist. The 2009 BRFSS was administered via landline telephones and to English- or English/Spanish-speaking participants only. Consequently, BRFSS underrepresents racial and ethnic minorities [33], and those who do not have landline telephones [34]. Individuals in cell phone-only households may differ in regards to other demographic factors (e.g., younger age, unmarried, unemployed, and Hispanic ethnicity), as well as in their health behaviors and insurance status [35, 36]. Future research assessing health behaviors among AYA cancer survivors including those with cell phones and landlines is needed [35, 36], as our estimates may be biased toward older, more socioeconomically stable, survivors.

In addition, the cancer subgroup analysis may be unstable, as participants with certain types of cancer are underrepresented compared to the others. BRFSS does not include information on cancer treatment or cancer stage at diagnosis. The high number of cervical cancers may be due to over-report of pre-cancerous lesions as cancer. Also, our estimates are based on survivors five or more years from diagnosis, meaning that our sample may overrepresent early stage cancers, cancers that are more responsive to treatment, or survivors with better health care access. Therefore, the sample may not be generalizable to the overall population of AYA survivors [37]. Lastly, because BRFSS is cross-sectional, we were unable to determine whether the causal link between smoking status and cancer influenced our results, as potentially more of the survivors could have had a history of smoking which affected their cancer risk.

In a nationally representative sample, we found that survivors of AYA cancers report smoking more than the general population. Social support should be considered when designing smoking cessation and other health-promoting interventions among AYA cancer survivors. Further research is needed to evaluate how development and coping post-treatment affect health behaviors in this unique cancer population. Health promotion interventions that target modifiable health behaviors and their correlates, such as social

support [30], are a priority for improving AYA cancer survivors' long-term health and reducing morbidity and mortality [21]. In addition, we found that many of the same demographic, QOL, and psychosocial factors were significantly associated with health behaviors among controls as with the survivor models. This potentially means that health behavior interventions developed within the general population to address behavior barriers, such as social support, could be successfully applied to the AYA survivor population and are an important area for future research. Additional research is needed to investigate implications of certain cancer diagnoses/treatments on lifestyle behaviors among the growing AYA cancer survivor population. Such research can inform targeted interventions to directly motivate better health behavior decisions among survivors of AYA cancers.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This study was funded by a National Cancer Institute R03 (1R03CA171585-01A1). Additional support for Dr. Kirchhoff comes from the Huntsman Cancer Institute and Huntsman Cancer Foundation.

References

1. Adolescent and Young Adult Oncology Progress Review Group. [Accessed 5 June 2015] Closing the gap: research and care imperatives for adolescents and young adults with cancer. 2006. http://planning.cancer.gov/library/AYAO_PRG_Report_2006_FINAL.pdf
2. Ries, LAC.; Melbert, D.; Krapcho, M.; Stinchcomb, DG.; Howlader, N.; Mariotto, A., et al. SEER Cancer Statistics Review, 1975–2005. Bethesda, MD: National Cancer Institute; 2008. http://seer.cancer.gov/csr/1975_2005/ [Accessed 24 Sep 2014]
3. Arnett JJ. Emerging adulthood: a theory of development from the late teens through the twenties. *Am Psychol*. 2000; 55(5):469–480. [PubMed: 10842426]
4. Maggs, JL.; Schulenberg, J.; Hurrelmann, K. Developmental transitions during adolescence: health promotion implications. In: Schulenberg, J.; Maggs, JL.; Hurrelmann, K., editors. *Health risks and developmental transitions during adolescence*. 1st. Cambridge: The Press Syndicate of the University of Cambridge; 1997. p. 522-546.
5. Tai E, Buchanan N, Townsend J, Fairley T, Moore A, Richardson LC. Health status of adolescent and young adult cancer survivors. *Cancer*. 2012; 118(19):4884–4891. [PubMed: 22688896]
6. Smith AW, Parsons HM, Kent EE, Bellizzi K, Zebrack BJ, Keel G, et al. Unmet support service needs and health-related quality of life among adolescents and young adults with cancer: the AYA HOPE Study. *Front Oncol*. 2013; 3:75. [PubMed: 23580328]
7. Coccia PF, Altman J, Bhatia S, Borinstein SC, Flynn J, George S, et al. Adolescent and young adult oncology. Clinical practice guidelines in oncology. *J Natl Compr Canc Netw*. 2012; 10(9):1112–1150. [PubMed: 22956810]
8. Wada RK, Glaser DW, Bantum EO, Orimoto T, Steffen AD, Elia JL, et al. Hawaii's multiethnic adolescent and young adult survivors of childhood cancer: are their health behavior risks similar to state and national samples? *Hawaii J Med Public Health*. 2013; 72(11):380–385. [PubMed: 24251083]
9. Fairley TL, Hawk H, Pierre S. Health behaviors and quality of life of cancer survivors in Massachusetts, 2006: data use for comprehensive cancer control. *Prev Chronic Dis*. 2010; 7(1):A09. [PubMed: 20040224]
10. Kirchhoff AC, Spraker-Perlman H, McFadden M, Warner EL, Oeffinger K, Wright J, et al. Sociodemographic disparities in quality of life for adolescent and young adult cancer survivors. *J Adolesc Young Adult Oncol*. 2014; 3(2):66–74. [PubMed: 24940530]

11. Centers for Disease Control and Prevention. [Accessed 5 June 2015] Behavioral risk factor surveillance system 2009 summary data quality report. 2011. http://www.cdc.gov/brfss/annual_data/2009/pdf/2009_summary_data_quality_report.pdf
12. Kapp JM, Jackson-Thompson J, Petroski GF, Schootman M. Reliability of health-related quality-of-life indicators in cancer survivors from a population-based sample, 2005. BRFSS Public Health. 2009; 123(4):321–325. [PubMed: 19081117]
13. Wechsler H, Dowdall GW, Davenport A, Rimm EB. A gender-specific measure of binge drinking among college students. Am J Public Health. 1995; 85(7):982–985. [PubMed: 7604925]
14. Yore MM, Ham SA, Ainsworth BE, Kruger J, Reis JP, Kohl 3rd HW, et al. Reliability and validity of the instrument used in BRFSS to assess physical activity. Med Sci Sports Exerc. 2007; 39(8): 1267–1274. [PubMed: 17762359]
15. Children's Oncology Group. [Accessed 5 June 2015] Staying healthy through diet and physical activity. Long-term follow-up guidelines for survivors of childhood, adolescent, and young adult cancers. 2008. <http://www.survivorshipguidelines.org/pdf/DietandPhysicalactivity.pdf>
16. Centers for Disease Control and Prevention. [Accessed 5 June 2015] 5 a day works! Department of Health and Human Services. 2005. http://www.cdc.gov/nccdphp/dnpa/nutrition/health_professionals/programs/5aday_works.pdf
17. Centers for Disease Control and Prevention. [Accessed 5 June 2015] Measuring healthy days: population assessment of health-related quality of life. 2000. <http://www.cdc.gov/hrqol/pdfs/mhd.pdf>
18. Muller CJ, MacLehose RF. Estimating predicted probabilities from logistic regression: different methods correspond to different target populations. Int J Epidemiol. 2014; 43(3):962–970. [PubMed: 24603316]
19. Heeringa, SG.; West, BT.; Berglund, PA. Applied survey data analysis. New York: Chapman-Hall; 2010.
20. Ford ES, Zhao G, Tsai J, Li C. Low-risk lifestyle behaviors and all-cause mortality: findings from the National Health and Nutrition Examination Survey III Mortality Study. Am J Public Health. 2011; 101(10):1922–1929. [PubMed: 21852630]
21. Rabin C, Politi M. Need for health behavior interventions for young adult cancer survivors. Am J Health Behav. 2010; 34(1):70–76. [PubMed: 19663754]
22. Emmons KM, Puleo E, Park E, Gritz ER, Butterfield RM, Weeks JC, et al. Partnership for health-2, a web-based versus print smoking cessation intervention for childhood and young adult cancer survivors: randomized comparative effectiveness study. J Med Internet Res. 2013; 15(11):e218. [PubMed: 24195867]
23. Danesh D, Paskett ED, Ferketich AK. Disparities in receipt of advice to quit smoking from health care providers: 2010 National Health Interview Survey. Prev Chronic Dis. 2014; 11:E131. [PubMed: 25078568]
24. Emmons KM, Sprunck-Harrild K, Puleo E, de Moor J. Provider advice about smoking cessation and pharmacotherapy among cancer survivors who smoke: practice guidelines are not translating. Transl Behav Med. 2013; 3(2):211–217. [PubMed: 23894256]
25. Kaiser Family Foundation. [Accessed 7 Nov 2014] Preventive services covered by private health plans under the Affordable Care Act. 2014. <http://kff.org/health-reform/fact-sheet/preventive-services-covered-by-private-health-plans/>
26. Phillips-Salimi CR, Lommel K, Andrykowski MA. Physical and mental health status and health behaviors of childhood cancer survivors: findings from the 2009 BRFSS survey. Pediatr Blood Cancer. 2012; 58(6):964–970. [PubMed: 22012636]
27. Rabin C. Review of health behaviors and their correlates among young adult cancer survivors. J Behav Med. 2011; 34(1):41–52. [PubMed: 20683649]
28. Rabin C, Dunsiger S, Ness KK, Marcus BH. Internet-based physical activity intervention targeting young adult cancer survivors. J Adolesc Young Adult Oncol. 2011; 1(4):188–194. [PubMed: 23610737]
29. Abrams AN, Hazen EP, Penson RT. Psychosocial issues in adolescents with cancer. Cancer Treat Rev. 2007; 33(7):622–630. [PubMed: 17434265]

30. Rabin C, Simpson N, Morrow K, Pinto B. Intervention format and delivery preferences among young adult cancer survivors. *Int J Behav Med*. 2013; 20(2):304–310. [PubMed: 22328444]
31. LeMasters TJ, Madhavan SS, Sambamoorthi U, Kurian S. Health behaviors among breast, prostate, and colorectal cancer survivors: a US population-based case-control study, with comparisons by cancer type and gender. *J Cancer Surviv*. 2014; 8(3):336–348. [PubMed: 24532045]
32. Coups EJ, Ostroff JS. A population-based estimate of the prevalence of behavioral risk factors among adult cancer survivors and noncancer controls. *Prev Med*. 2005; 40(6):702–711. [PubMed: 15850868]
33. Schneider KL, Clark MA, Rakowski W, Lapane KL. Evaluating the impact of non-response bias in the Behavioral Risk Factor Surveillance System (BRFSS). *J Epidemiol Community Health*. 2012; 66(4):290–295. [PubMed: 20961872]
34. Blumberg S, Ganesh N, Luke J, Gonzales G. Wireless substitution: state-level estimates from the National Health Interview Survey, 2012. *National Health Statistics Reports*. 2013:70.
35. Link MW, Battaglia MP, Frankel MR, Osborn L, Mokdad AH. Reaching the U.S. cell phone generation: comparison of cell phone survey results with an ongoing landline telephone survey. *Public Opin Q*. 2007; 71(5):814–839.
36. Tucker C, Brick JM, Meekins B. Household telephone service and usage patterns in the United States in 2004: implications for telephone samples. *Public Opin Q*. 2007; 71(1):3–22.
37. Underwood JM, Townsend JS, Stewart SL, Buchannan N, Ekwueme DU, Hawking NA. Surveillance of demographic characteristics and health behaviors among adult cancer survivors—behavioral risk factor surveillance system, United States, 2009. *MMWR Morb Mortal Wkly Rep*. 2012; 61:1–23.

Fig. 1.

Adjusted percentages and 95% CI of quality of life and psychosocial health among survivors of AYA cancer and controls by gender. Adjusted for continuous age and race/ethnicity

Author Manuscript

Author Manuscript

	Female			Male		
	AYA cancer survivors N=6441			Controls N=207,091		
	n	% ^a		n	% ^a	
Ovarian	519	8.5		—	—	
Endometrial	625	8.2		—	—	
Other ^c	686	10.9		—	—	
Number of cancer diagnoses						
1	5214	83.2		—	—	
2	1227	16.8		—	—	
Age at diagnosis, years						
15–20	665	15.4		—	—	
21–29	2516	38.8		—	—	
30–39	3260	45.8		—	—	
Years since diagnosis						
5–10	819	21.0		—	—	
11–20	1563	30.4		—	—	
21–29	1614	22.6		—	—	
30	2445	26.0		—	—	
AYA adolescent and young adult						

AYA adolescent and young adult

^aWeighted for BRFSS sampling

^bEstimates may be unstable due to small cell sizes (<50 participants) in certain subgroups

^cOther cancers: cancers reported by <1% of the sample, including stomach, bladder, pancreatic, esophageal, and lung. This category also includes cancer categorized by BRFSS as “other”

Adjusted percentages and 95 % CIs of non-adherence for health behaviors among survivors of AYA cancer and controls by sex and current age^a

Table 2

Females	Current ages 20–39				Current ages 40–64				Current ages >65			
	Female survivors	% ^a	95 % CI	Female controls	Female survivors	% ^a	95 % CI	Female controls	Female survivors	% ^a	95 % CI	Female controls
Current smoking	27.0 ^{**}	20.7–33.3	14.3	13.2–15.3	29.3 ^{**}	26.2–32.3	18.4	17.9–19.0	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>
Binge drinking	7.7	5.5–9.8	10.2	9.7–10.8	13.9	10.1–17.6	12.0	11.3–12.6	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>
Low physical activity	56.1	38.7–73.5	65.1	63.1–67.0	63.8	60.3–67.3	62.0	61.4–62.6	64.3	48.9–79.7	50.3	47.7–52.9
Low fruit/vegetable intake ^c	77.2	64.5–90.0	73.9	71.9–76.0	70.1	66.3–73.8	72.2	71.7–72.8	77.2	65.8–88.5	77.5	75.7–79.2
Males	Male survivors	% ^a	95 % CI	Male controls	Male survivors	% ^a	95 % CI	Male controls	Male survivors	% ^a	95 % CI	Male controls
Current smoking	26.6	13.0–40.2	19.5	18.1–20.9	18.6	13.8–23.5	20.9	20.2–21.7	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>
Binge drinking	12.6	6.0–19.2	20.3	19.2–21.4	15.2 [*]	10.1–20.3	22.3	21.4–23.3	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>
Low physical activity	60.3	36.5–84.1	65.1	63.0–67.1	61.7	55.9–67.5	64.8	64.0–65.5	56.3	38.7–73.9	45.7	43.2–8.2
Low fruit/vegetable intake ^c	88.6	78.8–98.3	80.7	79.0–82.5	77.8	72.8–82.9	81.8	81.2–82.4	82.8	72.6–92.9	84.7	83.4–86.0

^a Adjusted for continuous age and race^b Unable to calculate due to small frequencies^c Less than 5 fruits/vegetables per day^{*} *p* value <0.05 (comparing survivors to controls for each age and sex group);^{**} *p* value <0.001 (comparing survivors to controls for each age and sex group)

Table 3

Multivariable relative risks and 95 % CIs of the impact of demographics, quality of life, and psychosocial factors on non-adherence to recommended health behaviors among female survivors

	Current smoking			Binge drinking			Low physical activity			Low fruit/vegetable intake ^a		
	RR	95 % CI	p value	RR	95 % CI	p value	RR	95 % CI	p value	RR	95 % CI	p value
Demographics												
Age at survey												
20–29	1			1			1			1		
30–39	0.66	0.51–0.84	<0.001	0.38	0.21–0.67	<0.001	0.96	0.77–1.22	0.77	1.10	0.91–1.32	0.33
40–64	0.56	0.45–0.71	<0.001	0.54	0.33–0.86	0.01	1.02	0.82–1.26	0.89	1.02	0.85–1.21	0.90
65	0.28	0.20–0.38	<0.001	0.12	0.06–0.22	<0.001	1.10	0.88–1.38	0.38	1.02	0.85–1.22	0.87
Race/ethnicity												
Non-Hispanic, White	1			1			1			1		
Non-Hispanic, Black	0.48	0.33–0.68	<0.001	0.32	0.14–0.68	0.003	1.32	1.19–1.46	<0.001	0.86	0.73–1.02	0.09
Hispanic/Latino	0.38	0.23–0.63	<0.001	1.44	0.76–2.70	0.27	1.06	0.87–1.31	0.52	0.94	0.79–1.11	0.44
Non-Hispanic, other race	1.08	0.73–1.58	0.70	0.68	0.31–1.47	0.32	1.08	0.91–1.26	0.40	0.92	0.78–1.08	0.30
Non-Hispanic, multiracial	1.74	1.40–2.16	<0.001	1.04	0.44–2.50	0.92	0.90	0.71–1.12	0.34	0.96	0.82–1.13	0.61
Health insurance												
Insured	1			1			1			1		
Uninsured	1.64	1.43–1.90	<0.001	1.42	0.98–2.04	0.06	1.02	0.93–1.14	0.60	1.04	0.97–1.14	0.26
Quality of life and psychosocial health												
Health status												
Excellent/very good/good	1			1			1			1		
Fair/poor general health	1.24	1.05–1.48	0.01	0.66	0.42–1.00	0.05	1.12	1.03–1.23	0.008	1.02	0.95–1.09	0.65
Days of poor physical health per month												
<15 days	1			1			1			1		
15 days	1.12	0.95–1.34	0.18	0.66	0.41–1.04	0.07	1.12	1.02–1.24	0.01	1.00	0.92–1.07	0.80
Days of poor mental health per month												
<15 days	1			1			1			1		
15 days	1.22	1.05–1.44	0.01	1.08	0.77–1.53	0.63	0.94	0.87–1.04	0.24	1.04	0.96–1.11	0.39
Social/emotional support												

	Current smoking			Binge drinking			Low physical activity			Low fruit/vegetable intake ^a		
	RR	95 % CI	p value	RR	95 % CI	p value	RR	95 % CI	p value	RR	95 % CI	p value
Always/usually	1			1			1			1		
Sometimes/rarely/never	1.26	1.07–1.48	0.004	1.08	0.73–1.58	0.72	1.08	1.00–1.18	0.05	1.12	1.05–1.19	<0.001
Life satisfaction												
Very satisfied/satisfied	1			1			1			1		
Very dissatisfied/dissatisfied	1.12	0.93–1.35	0.25	1.04	0.63–1.73	0.86	1.10	0.99–1.21	0.07	1.04	0.96–1.14	0.33

Relative risks generated from multivariable Poisson regression analyses

^aLess than 5 fruits/vegetables per day

Table 4

Multivariable relative risks and 95 % CIs of the impact of demographics, quality of life, and psychosocial factors on non-adherence to recommended health behaviors among male survivors

	Current smokin			Binge drinking			Low physical activity			Low fruit/vegetable intake ^a		
	RR	95 % CI	p value	RR	95 % CI	p value	RR	95 % CI	p value	RR	95 % CI	p value
Demographics												
Age at survey												
20–29	1			1			1			1		
30–39	0.82	0.35–1.86	0.62	0.76	0.25–2.39	0.65	0.86	0.47–1.54	0.60	1.12	0.80–1.55	0.52
40–64	0.38	0.17–0.80	0.01	0.40	0.13–1.25	0.12	0.82	0.47–1.41	0.47	0.98	0.71–1.35	0.88
65	0.32	0.13–0.76	0.009	0.30	0.09–1.01	0.05	0.80	0.46–1.39	0.43	0.98	0.70–1.37	0.89
Race/ethnicity												
Non-Hispanic, White	1			1			1			1		
Non-Hispanic, Black	2.04	0.84–4.95	0.12	0.04	0.00–0.40	0.005	0.98	0.57–1.66	0.92	1.06	0.92–1.22	0.44
Hispanic/Latino	1.20	0.66–2.14	0.56	0.20	0.05–0.79	0.02	1.38	0.99–1.90	0.06	1.02	0.84–1.23	0.85
Non-Hispanic, other race	1.30	0.59–2.90	0.51	1.08	0.21–5.59	0.93	1.14	0.76–1.69	0.54	1.00	0.83–1.20	0.99
Non-Hispanic, multiracial	0.60	0.19–1.84	0.37	1.40	0.50–3.87	0.53	0.88	0.53–1.49	0.66	0.76	0.45–1.25	0.27
Health insurance												
Insured	1			1			1			1		
Uninsured	2.62	1.71–4.02	<0.001	1.12	0.46–2.70	0.81	0.94	0.68–1.30	0.72	1.06	0.91–1.23	0.46
Quality of life and psychosocial health												
Health status												
Excellent/very good/good	1			1			1			1		
Fair/poor general health	1.10	0.63–1.91	0.75	0.86	0.40–1.83	0.69	1.14	0.91–1.41	0.27	0.86	0.76–0.99	0.04
Days of poor physical health per month												
<15 days	1			1			1			1		
15 days	0.88	0.46–1.74	0.73	1.08	0.48–2.42	0.86	1.14	0.88–1.48	0.31	1.12	0.97–1.27	0.12
Days of poor mental health per month												
<15 days	1			1			1			1		
15 days	1.76	0.92–3.39	0.09	0.88	0.38–2.04	0.76	0.88	0.61–1.25	0.45	1.00	0.85–1.16	0.94
Social/emotional support												

	Current smoking			Binge drinking			Low physical activity			Low fruit/vegetable intake ^a		
	RR	95 % CI	p value	RR	95 % CI	p value	RR	95 % CI	p value	RR	95 % CI	p value
Always/usually	1			1			1			1		
Sometimes/rarely/never	1.00	0.62–1.59	0.98	1.26	0.68–2.34	0.46	1.04	0.85–1.28	0.68	1.12	1.01–1.23	0.02
Life satisfaction												
Very satisfied/satisfied	1			1			1			1		
Very dissatisfied/dissatisfied	1.76	0.96–3.25	0.07	1.56	0.63–3.88	0.33	1.18	0.85–1.62	0.33	1.04	0.92–1.18	0.49

Relative risks generated from multivariable Poisson regression analyses

^aLess than 5 fruits/vegetables per day

Multivariable relative risks and 95 % CIs of the impact of cancer-related factors on non-adherence to recommended health behaviors among survivors by sex

Table 5

	Current smoking			Binge drinking			Low physical activity			Low fruit/vegetable intake ^a		
	RR	95 % CI	p value	RR	95 % CI	p value	RR	95 % CI	p value	RR	95 % CI	p value
Female												
Original cancer diagnosis												
Cervical	1			1			1			1		
Breast	0.48	0.38–0.61	<0.001	0.69	0.41–1.18	0.18	0.98	0.89–1.08	0.68	0.85	0.78–0.94	0.001
Colorectal	0.27	0.14–0.52	<0.001	0.11	0.03–0.36	<0.001	1.12	0.94–1.33	0.20	0.98	0.85–1.14	0.80
Hodgkin's lymphoma	0.32	0.18–0.56	<0.001	0.08	0.03–0.26	<0.001	1.17	0.99–1.38	0.06	1.00	0.87–1.16	0.99
Melanoma	0.27	0.20–0.37	<0.001	0.74	0.46–1.20	0.22	0.92	0.81–1.05	0.22	0.85	0.76–0.94	0.001
Ovarian	0.74	0.58–0.93	0.01	0.51	0.27–0.93	0.03	0.90	0.78–1.05	0.18	0.95	0.85–1.05	0.29
Thyroid	0.20	0.13–0.30	<0.001	0.80	0.41–1.56	0.51	0.97	0.83–1.15	0.74	0.90	0.78–1.04	0.15
Age at diagnosis, years												
15–20	1			1			1			1		
21–29	1.05	0.87–1.26	0.62	0.85	0.55–1.33	0.48	0.94	0.84–1.05	0.29	0.99	0.90–1.08	0.78
30–39	0.78	0.64–0.96	0.02	0.95	0.59–1.53	0.85	0.93	0.83–1.05	0.23	0.93	0.85–1.02	0.15
Years since diagnosis												
5–10	1			1			1			1		
11–20	1.26	1.05–1.53	0.01	1.06	0.72–1.56	0.76	1.01	0.90–1.14	0.83	0.98	0.90–1.08	0.75
21–29	1.75	1.40–2.19	<0.001	1.57	0.95–2.61	0.08	1.02	0.89–1.16	0.80	1.08	0.97–1.20	0.15
30	1.91	1.41–2.57	<0.001	1.16	0.54–2.49	0.70	1.07	0.90–1.26	0.45	1.11	0.98–1.27	0.11
Male												
Original cancer diagnosis												
Melanoma	1			1			1			1		
Colorectal	1.02	0.21–4.91	0.98	1.06	0.41–2.77	0.90	1.44	1.05–1.98	0.02	1.12	0.98–1.29	0.10
Hodgkin's lymphoma	0.41	0.15–1.16	0.09	0.93	0.30–2.83	0.89	1.26	0.94–1.68	0.12	0.99	0.81–1.20	0.90
Non-Hodgkin's lymphoma	1.58	0.57–4.35	0.38	0.28	0.04–1.99	0.20	0.80	0.39–1.63	0.54	0.90	0.69–1.17	0.42
Testicular	0.88	0.42–1.81	0.72	0.86	0.43–1.71	0.66	1.19	0.93–1.53	0.17	1.04	0.92–1.19	0.52
Thyroid	0.56	0.18–1.77	0.33	1.31	0.46–3.71	0.61	1.20	0.91–1.59	0.19	0.87	0.67–1.14	0.32
Age at diagnosis, years												

	Current smoking			Binge drinking			Low physical activity			Low fruit/vegetable intake ^d		
	RR	95 % CI	p value	RR	95 % CI	p value	RR	95 % CI	p value	RR	95 % CI	p value
Female												
15–20	1			1			1			1		
21–29	1.20	0.60–2.37	0.61	0.99	0.47–2.09	0.98	0.88	0.69–1.13	0.32	0.99	0.87–1.13	0.90
30–39	1.19	0.56–2.50	0.65	0.77	0.37–1.59	0.48	0.80	0.62–1.02	0.08	0.97	0.85–1.10	0.59
Years since diagnosis												
5–10	1			1			1			1		
11–20	0.57	0.32–1.00	0.05	0.95	0.47–1.92	0.88	1.26	0.97–1.63	0.08	0.91	0.81–1.02	0.09
21–29	0.99	0.53–1.87	0.98	1.31	0.60–2.88	0.50	1.34	1.01–1.77	0.04	1.01	0.88–1.17	0.86
30	1.21	0.46–3.18	0.70	1.09	0.40–3.02	0.86	1.55	1.10–2.18	0.01	1.09	0.91–1.30	0.35

Relative risks generated from multivariable Poisson regression analyses adjusted for age and race/ethnicity

^aLess than 5 fruits/vegetables per day