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Prevalence of healthy behaviors among cancer survivors in the United States: How far have we come?

Hannah Arem^{1,2}, Scherezade K. Mama³, Xuejing Duan⁴, Julia H. Rowland⁵, Keith M. Bellizzi⁶, Diane K. Ehlers⁷

¹GW Milken Institute School of Public Health, Department of Epidemiology, Washington DC, 20052

²GW Cancer Center, Washington DC, 20052

³Department of Kinesiology, College of Health and Human Development, The Pennsylvania State University, 268J Recreation Building, University Park, PA 16801

⁴GW Milken Institute School of Public Health, Department of Biostatistics, Washington DC, 20052

⁵Smith Center for Healing and the Arts

⁶Human Development and Family Sciences, University of Connecticut

⁷University of Nebraska Medical Center

Abstract

Background: The 16.9 million cancer survivors in the U.S. are at increased risk for comorbidities and recurrence. However, this risk may be attenuated by a healthy lifestyle. This study describes health behaviors by cancer history to inform behavior change priorities.

Methods: We analyzed 2013–2017 data from the National Health Interview Survey (NHIS). There were 164,692 adults, of whom 12,648 reported a cancer history. We calculated prevalence of smoking, physical activity (PA), alcohol consumption, body mass index (BMI), and sleep duration by cancer history, age, and cancer site. We conducted logistic regression to determine odds of meeting lifestyle recommendations by cancer history.

Results: Overall, those with a cancer history were less likely to report current smoking (14.1% vs 16.8%) and moderate/heavy drinking (18.8 vs 21.9%) than those without a cancer history. However, a lower percentage of cancer survivors met PA guidelines (14.2 vs 21.1%) or reported a healthy BMI (31.6 vs 34.7%) compared to those without a cancer history. Cancer survivors were more likely to report excessive sleep (6.8% vs 3.6%). In adjusted logistic regression survivors were more likely to meet recommendations on smoking, PA, and BMI but were less likely to meet alcohol recommendations; meeting sleep recommendations did not differ by cancer history.

Corresponding Author: **Hannah Arem, PhD**, hannaharem@gwu.edu, 950 New Hampshire Avenue NW, 5th Floor Suite, Washington, D.C. 20052, Phone: 202-994-4676.

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Conclusions: While cancer survivors had lower prevalence of smoking and moderate/heavy drinking, they also had lower prevalence of PA, healthy BMI, and reported longer sleep duration. Regression analyses suggested survivors only showed poorer behaviors for alcohol.

Impact: Targeted health promotion interventions among cancer survivors are needed.

Keywords

cancer survivorship; health behaviors; physical activity; alcohol; body mass index; sleep

Introduction:

The number of cancer survivors in the U.S. is 16.9 million at present and is expected to reach 21.7 million by 2029¹². An estimated 67% of cancer survivors are surviving five or more years after diagnosis¹. These survivors are at increased risk for cancer recurrence and second primary cancers, as well as many physical (e.g. peripheral neuropathy, insomnia, pain) and psychosocial symptoms (e.g. depression, emotional distress), among other treatment side effects that adversely impact quality of life²³.

Over the past few decades research on health behaviors among cancer survivors has grown significantly⁴⁵. One recent mortality study suggested that modifiable lifestyle behaviors could prevent 48% of cancer deaths among women and 44% in men.⁶ The growing body of evidence on the benefits of a healthy lifestyle has also led the National Comprehensive Cancer Network (NCCN),⁷ American Society of Clinical Oncology (ASCO)^{8–10}, and the American Cancer Society (ACS)¹¹ to publish and promote guidelines recommending smoking cessation, limiting alcohol consumption, increasing physical activity, and maintaining a healthy body weight to mitigate the detrimental effects of treatment and lower cancer recurrence and mortality. These lifestyle recommendations are supported by multiple expert reports on specific behaviors and cancer risk and survivorship.¹²¹³ Additionally, NCCN encourages screening for treatment side effects (e.g. fatigue, insomnia) and providing cancer survivors with lifestyle recommendations.¹⁴ While not explicitly a recommendation at present, sleep is an emerging area of research related to cancer risk and survivorship as impaired sleep is a common side effect of cancer diagnosis and treatment and can have significant health consequences.^{15–17}

Cancer diagnosis is often promoted as a “teachable moment”, where behavior change might be motivated by a desire to combat risk of recurrence or other complications.¹⁸ However, before promoting specific behavior change it is necessary to better understand the prevalence of health behaviors among cancer survivors. Previous studies using the Behavioral Risk Factor Surveillance System (BRFSS) nationally representative data from 2009,¹⁹ ACS’s 2008 study of Cancer Survivors II,²⁰ and the National Health Interview Survey (NHIS) dataset from 1998–2001²¹ suggest that a significant percentage of cancer survivors do not meet guidelines on smoking (8–17%), physical activity (53–71%), alcohol consumption (16.3%), or maintaining a healthy body mass index (60%). Over the past two decades there have been shifts in both policy (e.g. additional taxes on cigarettes, smoke and tobacco-free policies, etc.)²², and research funding (e.g. increases in lifestyle intervention research for cancer survivors)²³ that we hypothesize should impact these health behaviors. We thus set

out to update nationally representative figures on prevalence of select health behaviors to understand whether we have made progress since the benchmark 2005 NHIS paper²¹, updating relevant lifestyle recommendations and adding analyses for sleep. We thus 1) analyzed prevalence of meeting guidelines on smoking, alcohol consumption, physical activity, body mass index (BMI), and sleep duration overall and by cancer site and age, and 2) conducted logistic regression to understand odds of meeting these recommendations by cancer history.

Materials and Methods:

The NHIS is a continuous cross-sectional household interview survey that uses a probability design to generate a representative sampling of U.S. households and non-institutionalized adults. Interviewers are employed and trained by the U.S. Census Bureau staff using procedures outlined by the National Center for Health Statistics. Among households selected for survey one sample adult aged 18 years or older completes the interview. We combined datasets from 2013–2017. From 2006–2015 the NHIS design included oversampling of African American, Hispanic, and Asian individuals. The sampling plan changed in 2016 to account for changes in distribution of the U.S. population; the new sampling plan eliminated oversampling of race/ethnicity groups at the household level, except among those aged 65 or older. Detailed information on questionnaires and methods are available online from the National Center for Health Statistics.²⁴ We used the Sample Adult File, which collects information on demographic characteristics, health history, and lifestyle behaviors. The final response rate for the Sample Adult File was 61.2% for 2013, 58.9% for 2014, 55.2% for 2015, 54.3% for 2016 and 53.0% for 2017.

Participants.

There were 164,692 adults in our combined sample. Cancer was self-reported from the question “Have you ever been told by a doctor or health professional that you had cancer or a malignancy of any kind?” Those who responded yes specified what kind of cancer and were given opportunities to report first, second, third, or more cancer sites, leading to identification of 16,514 cases. Individuals who reported only non-melanoma skin cancer (n=2,706) or skin cancer unknown type (n=1092) were excluded from analyses. Individuals whose response to the question about cancer history were coded as refused, not ascertained, or don’t know (n=71) were also excluded from analyses. Some individuals reported unknown skin cancer and another cancer type and thus were kept in the dataset as a primary case of the other cancer type. These exclusions were not mutually exclusive (e.g. individuals could have fallen into multiple categories). In the combined dataset from 2013–2017 we thus included 12,648 individuals with a self-reported history of cancer and 147,971 individuals with no reported cancer history.

Measures.

We categorized demographic and health information as follows: age at questionnaire (18- <40, 40- <65, 65+ years), sex (male, female), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, other), education (< high school, high school graduate, some college, Bachelor’s degree or greater), family income (< \$45,000, \$20,000-\$45,000, <

\$20,000), health insurance coverage over prior 12 months (yes, no), functional limitations (limited in any way, not limited), and self-reported health status (excellent, very good, good, fair, poor). We created categories for missing responses. Age at first cancer diagnosis was used for those who reported multiple cancers. Time since diagnosis in years was calculated by subtracting reported age at diagnosis from age at interview. However, some individuals reported years since diagnosis rather than age at diagnosis (e.g. reported breast cancer diagnosis at age 1). Therefore, for cancer sites where <5% of diagnoses are among individuals under age 20 (using 2012–2016 Surveillance Epidemiology and End Results data) we assumed that the age at diagnosis was incorrectly reported as time since cancer diagnosis (n=452).

Health behaviors

Smoking.—We categorized participants into groups of never (< 100 lifetime cigarettes), former, or current smokers. Current smokers were further categorized by smoking frequency (every day or some days). In logistic regression we collapsed categories into non-smoker (meeting guidelines) vs current smoker.

Alcohol consumption.—NHIS collates self-reported alcohol consumption as: “lifetime abstainer”, “former”, “current infrequent”, “current light”, “current moderate”, and “current heavy” based on whether and when an individual drank, and how much.²⁵ There is a robust body of literature documenting associations between alcohol intake and risk of breast, liver, colon and rectal cancer, and some head and neck cancers.¹¹²⁶²⁷ Some evidence suggests that even 5–14.9 grams alcohol per day (<1 drink) is associated with an elevated cancer risk among women²⁸ and the International Agency for Research on Cancer (IARC) has classified alcohol as a carcinogen. Professional societies such as ACS suggest that women consume no more than one drink/day and that men consume no more than 2 drinks/day. Only limited research exists on risks of alcohol consumption among cancer survivors. Given the differences in these recommendations in relation to cancer risk, to allow readers to see more detailed categories we included all the NHIS-collated categories in our prevalence estimates. We combined the moderate and heavy groups to assign the high-risk behavior in regression analyses as both ACS and IARC consider these groups high-risk, while there is still more controversy around risks of light drinking. We also did not select former drinkers as the referent group due to the possibility of reverse causation (i.e. individuals may stop drinking due to poor health) and never drinkers may have other differences in characteristics that were not captured in our data. We categorized meeting guidelines as those who did not report moderate/heavy drinking.

Physical activity.—Participants reported weekly frequency and duration of moderate- and vigorous-intensity activities. We calculated total weekly physical activity by adding weekly minutes of moderate-intensity activities in bouts 10 minutes to 2x the minutes of vigorous-intensity activities in bouts 10 minutes, as during data collection questions were phrased using a minimum of 10-minute bouts to reflect common practice for defining moderate- to vigorous intensity activity during the time of data collection (2013–2017).²⁹ We categorized participants according to the 2008 U.S. Physical Activity Guidelines²⁹ (also recommended for cancer survivors³⁰) as inactive (none), insufficiently active (>0 but <150 min /week), or

sufficiently active (150+ min/week). Strength-based physical activity was categorized into <2 times/week (does not meet recommendations) or 2+ times /week (meets recommendations). We then created a composite for meets both aerobic and strength guidelines, meets aerobic only, meets strength only, insufficient activity for either aerobic and strength, and inactive (neither strength nor aerobic). Meeting guidelines was the group who reported sufficient aerobic and strength exercise.

Body mass index (BMI).—BMI was calculated in kg/m² using self-reported height and weight. We categorized BMI into the following categories: 15-<18.5, 18.5-<25, 25-<30, 30-<35, and 35+ kg/m². We then further categorized individuals into maintained a normal body weight (18.5-<25), overweight (25-<30) or obese (30+ kg/m²). Those with a BMI <15 or >60 were categorized as missing. Those with a BMI of 18.5-<25 were categorized as meeting guidelines.

Sleep.—Participants reported hours of sleep in a 24-hour period (30 minutes-24 hours). We categorized daily hours of sleep as <5, 5-<7, 7-8, >8-9, or 9+ based on previous literature showing increased risks of mortality at either end of a U-shaped curve. National Sleep Foundation guidelines in 2015 recommended 7-9 hours of sleep for adults age 18-64 and 7-8 hour of sleep for adults age 65+. ³¹ We thus categorized individuals into meeting these guidelines or not by age group.

Data analysis

NHIS data are collected using a complex sample design involving stratification, clustering, and multi-stage sampling. ³² Person-level weights are adjusted according to a quarterly post-stratification by age/sex/race/ethnicity classes based on population estimates produced by the U.S. Census Bureau in order to provide national estimates. All reported Ns are unweighted and percentages are weighted. The R package “survey” was used to account for complex survey procedures. Weights were divided by five to account for combining five years of data. Since the five years of data fell into different sample design periods (design periods 2013-2015 and 2016-2017), as instructed by NHIS data analysis guidelines, we modified the stratum variable for the sample period of 2016-2017 by adding multiples of 1000 before combining with the 2013-2015 strata. ³³ We used descriptive statistics and chi-squared tests to compare sample characteristics and behaviors by cancer history. We also generated prevalence estimates by cancer site to better determine the public health burden among specific groups. We used logistic regression to examine odds of meeting guidelines, creating three models: Model 1 adjusted for variables deemed important *a priori*, Model 2 adjusted for additional Table 1 variables that were significantly associated with cancer history, and Model 3 mutually adjusting for other lifestyle recommendations. Results of fully adjusted Model 3 are presented in the text. As the previous NHIS study showed differences in health behaviors by age, we set out *a priori* to look at differences in selected behaviors by age. Thus, we conducted logistic regression analyses stratified by age category and tested for multiplicative interaction. To compare our prevalence rates with previously published NHIS prevalence rates we used a z-test based on published weighted prevalence and standard errors. R (Version 3.6.0) was used to conduct descriptive statistics, chi-squared tests and regression models. Python (Pandas, Python 3) was used for data management.

Results

Population

Cancer survivors were on average 65.6 years old (standard deviation 14.4), compared to 48.1 years old (standard deviation 18.0) among those with no cancer history. In Table 1 we reported that compared to those with no cancer history, cancer survivors were more likely to be female (61% vs 54%), non-Hispanic white (82% vs 66%), report functional limitations (67% vs 35%), and were less likely to report excellent health status (12% vs 28%) (all p-values <0.001). Table 2 shows distribution by sex and cancer type; Among women with a cancer history, 41% reported breast cancer, 12% reported cervical cancer, 7% reported colon cancer, 10% reported uterine cancer, 9% reported melanoma, 5% reported ovarian cancer, 5% reported cancers of the larynx, lung, or pharynx, 5% reported leukemia or lymphoma, and 6% reported other cancers. Among men with a cancer history, 46% reported prostate cancer, 12% colon cancer, 15% melanoma, 9% cancers of the larynx, lung, or pharynx, 9% leukemia or lymphoma, and 9% other cancers. Average years since diagnosis varied among women (range: 6.6 years [larynx, lung and pharynx] to 19.1 years [cervix]) and men (range: 7.3 years [larynx, lung, and pharynx] to 10 years [leukemia/lymphoma]).

Prevalence estimates

Smoking.—Compared to individuals without a cancer history overall, a lower percentage of those with a cancer history were never smokers (48% vs 62%) or current smokers (14% vs 17%) (Table 3). Still, among those ages 18–<40, 29% with a cancer history reported current smoking compared to 18% of those without a cancer history.

Alcohol.—Moderate alcohol drinking was reported by 14% of those with a cancer history vs. 16%, among those without a cancer history and heavy drinking was reported by 5.1% and 5.6%, respectively. By age group, a lower percentage of those 18–<40 with a history of cancer reported heavy drinking compared to those without a history of cancer, although among survivors age 65+ a higher percentage reported moderate or heavy drinking compared to those with no cancer history.

Physical Activity.—Only 24% of those with a cancer history met the aerobic physical activity guidelines compared to 28% of those with no cancer history; among those with a history of cancer, 39% reported no physical activity at all, which was higher than those without a cancer history (31.2%). Only 14% of those with a cancer history met physical activity guidelines for aerobic and strength-based exercise (compared to 21% of those without a cancer history, with a declining percentage of cancer survivors meeting guidelines as age increased (22% among those age 18–<40 and 12% among those age 65+).

Body mass index.—Overweight or obesity was reported by 66.3% of cancer survivors, compared to 63.6% of those with no cancer history. The greatest differences by cancer history were observed for those who were obese class 2: among survivors age 18–<40, there was a 16.1% compared to 10.7% among those with no cancer history.

Sleep.—We found similar percentages of individuals reporting <5 hours of sleep per night (4% among those with a cancer history and 3% among those with no cancer history). However, among individuals age 18–<40 with a history of cancer 7.9% reported <5 hours of sleep per night compared to 2.5% of those 18–<40 without a cancer history. For long sleep duration, 7% of those with a cancer history reported >9 hours/day compared to 4% of those without a cancer history.

We also examined differences in prevalence of meeting lifestyle recommendations by cancer site (Table 4). Lung/larynx/pharynx and gynecologic cancer survivors had the highest percentages of individuals reporting current smoking (18.6% and 26.2% respectively). Current smoking among gynecologic cancer survivors was driven by a 35.4% prevalence among cervical cancer survivors, compared to 21.9% for ovarian and 18.8% for uterine cancer survivors (data shown in text only). Heavy alcohol consumption was highest among lung/larynx/pharynx cancer survivors (6.8%), while moderate drinking was highest among prostate cancer survivors (22.2%). For physical activity, 15% of leukemia/lymphoma survivors and 14.8% of prostate cancer survivors reported meeting the guidelines compared to only 7.1% of lung/larynx/pharynx survivors. The percentage of those meeting the BMI guidelines ranged from 29.2% (prostate) to 39.3% (lung/larynx/pharynx). For sleep duration the percentage meeting guidelines ranged from 50.2% (gynecologic) to 63.1% (prostate).

Adjusted analysis

Using logistic regression (Table 5), we examined odds of meeting lifestyle guidelines by cancer history. In adjusted models (Model 3) cancer survivors were 1.13 times more likely to be non-smokers compared to those without a cancer history (OR=1.13, 95% CI 1.06–1.21), but were less likely to meet guidelines on moderate to heavy alcohol consumption than those with no cancer history (OR=0.93, 95% CI 0.88–0.99). Survivors had a 14% higher odds of meeting the physical activity guidelines than those with no cancer history (OR=1.14, 95% CI 1.07–1.22) and were 7% more likely to maintain a healthy BMI (OR=1.07; 95% CI 1.01–1.12). We found no significant difference in meeting sleep guidelines by cancer history (OR=1.01, 95% CI 0.97–1.06).

We found statistically significant interaction by age for multiple lifestyle factors (Table 6): survivors age 18–<40 were 31% less likely to be non-smokers than those age 18–<40 with no cancer history (95% CI 0.55–0.87), while survivors age 40–<65 and 65+ had a 21% and 35% higher odds of reporting not smoking (95% CIs 1.09–1.34 and 1.20–1.51, respectively, p-interaction <0.001) compared to those of the same age with no cancer history. Survivors age 18–<40 were more likely to refrain from moderate/heavy alcohol use (OR=1.32, 1.02–1.71), but survivors age 65 or older were 14% less likely to refrain from moderate/heavy alcohol use (95% CI 0.79–0.94, p-interaction 0.002) compared to age-specific groups with no cancer history. P-interaction values were not significantly different by age for physical activity or maintaining and healthy BMI. Cancer survivors age 18–<40 were less likely to meet sleep guidelines than those of the same age group with no cancer history (OR=0.73, 95% CI 0.60–0.89), while in older age groups there was no significant association between cancer history and meeting sleep guidelines (p-interaction <0.001).

Discussion

Our observed prevalence rates suggest that there is an overall need to implement health promotion interventions, and that these interventions are particularly needed among cancer survivors who have higher health risks. Health promotion priorities also differ by age and cancer site. For instance, smoking rates were highest among younger individuals, and were particularly elevated among gynecologic cancer survivors, while older cancer survivors reported the lowest rates of meeting physical activity guidelines.

In adjusted analyses we observed that cancer survivors had a higher odds of meeting guidelines for smoking, physical activity, and BMI, but were less likely to meet guidelines for alcohol consumption, and were no different than those with no cancer history for sleep duration. Adjusted analyses by age suggested a higher odds of smoking and sleep in survivors age 18–<40, and moderate/heavy alcohol use among older survivors compared to those with no cancer history. Both prevalence estimates and regression analyses contribute to our understanding of public health priorities.

We also set out to compare our results with the 1998–2001 NHIS analyses to chart progress in the cancer survivor population over time.²¹ From the prior to the current time period those with a cancer history who reported smoking declined from 20.2% to 14.1% ($p<0.001$). Similar to our findings, a publication of 2009 BRFSS data reported that 15% of cancer survivors were current cigarette smokers.¹⁹ While prevalence has declined and observed odds ratios suggest that cancer survivors are less likely to smoke than non-cancer controls, public health efforts remain necessary to target smoking cessation both among cancer patients, in particular among younger survivors and those with gynecologic cancers (particularly cervical cancer survivors), who still had an alarmingly high smoking prevalence in the present study.^{34,35}

In contrast to the improvement seen in smoking prevalence among survivors, the percentage of moderate to heavy drinkers showed a statistically significant increase from 16.3% to 18.8% ($p<0.001$) from the prior to the present NHIS study, a trend that seemed to be driven by those aged 40–<65 (increase 17.0% to 20.3%) and age 65+ (increase 15.2% to 18.0%). Alcohol consumption has negative health consequences, not only in relation to breast cancer risk¹⁰, but also for cancers of the oral cavity, larynx, and pharynx, esophageal squamous cell carcinoma, liver, and colon or rectum¹⁰. There is also some evidence of increased risk of new primary cancers of these cancer sites with increased alcohol intake among those who have a cancer diagnosis¹¹. These observations led the International Agency for Research on Cancer to classify alcohol as a group 1 carcinogen.³⁶ A recent study of alcohol intake among cancer survivors in the NHIS found the highest rates of heavy drinking among ovarian (7.9%), melanoma (7.1%), and cervical cancer survivors (6.1%),³⁷ suggesting that alcohol consumption may be a critical ongoing health behavior to target, particularly among those groups with higher consumption. Alcohol consumption was also the only health recommendation that cancer survivors were less likely to meet than those with no cancer history in logistic regression analyses.

In the 1998–2001 NHIS data 29.6% of survivors met aerobic physical activity guidelines of 150 minutes of moderate-intensity or 60 minutes of vigorous-intensity activity weekly. When we combine the 14.2% in the present study who met both strength and aerobic guidelines with the 24.2% who met aerobic physical activity guidelines (total 38.4%) it appears that a greater percentage of survivors meet aerobic guidelines at present ($p<0.001$). A previous study comparing the proportion of older adults meeting physical activity guidelines using the 2011–2012 National Health and Nutrition Examination Survey (NHANES), and 2013 NHIS and BRFSS data found that more people reported meeting the aerobic physical activity guidelines in BRFSS (44.3%), while 27.5% met guidelines in NHANES and 35.8% in NHIS³⁸. These differences in physical activity reporting by survey could be due to the survey technique (i.e. telephone vs in-person) or timeframe of physical activity (i.e. prior 30 days vs one year) but overall suggest results similar to ours. Despite significant improvements in prevalence of meeting guidelines since 2001, the 17.3% of cancer survivors who currently report insufficient activity and 39.2% who report no physical activity are critical target populations, as physical activity can mitigate many of the late and long term side effects of diagnosis and treatment; Physical activity has also been associated with lower cancer³⁹ and mortality⁴⁰ risk in both the general population and in cancer survivors^{41,42}. A recent roundtable convened by the American College of Sports Medicine led to publication of more targeted physical activity goals by cancer site, suggesting that even with functional limitations, avoiding inactivity where possible yields some health benefits.¹³ Exercise programs for cancer survivors may have to accommodate issues such as lymphedema, ostomy, neuropathy, or fatigue, but these considerations do not contraindicate exercise.¹³

In the previous NHIS study 21.9% of cancer survivors reported obesity, whereas in our analysis 30.2% of survivors reported obesity ($p<0.001$). These findings are in concordance with other population-based studies that have shown rising trends in obesity prevalence in the cancer survivor population⁴³.

A previous registry-based survey of $n=1,171$ cancer survivors reported longer sleep duration among male but not female breast cancer survivors⁴⁴. Various studies have also shown associations between sleep disruption among cancer survivors and detrimental health consequences for cardiometabolic and immune system health, neurobehavioral function, depression, fatigue, and quality of life^{45–48}. Studies in the general population have further demonstrated an association between both short and long sleep duration (versus average) and higher mortality risk⁴⁹. Our findings that sleep duration differed by age among those with a history of cancer (higher prevalence of long sleep duration among the older population and short sleep duration among those age 18–<40) should be further investigated. Future studies may also collect data on sleep quality in addition to duration. Additionally, known effective interventions such as cognitive behavioral therapy for insomnia should be more widely available to survivors.⁵⁰

Strengths of our study include the nationally representative non-institutionalized sample and multiple years of data. We were able to examine multiple health behaviors and demonstrate differences in prevalence by age and cancer site, providing targets for behavioral interventions to improve lifestyle. Still, there are limitations inherent to the NHIS data. All

NHIS data is self-reported, which may lead to social desirability bias in reporting or misclassification of cancer diagnosis or outcome. Additionally, we were unable to look at variables such as cancer treatment or diet (not included in surveys), current cancer status, or screening behaviors, as the 2014–2017 surveys only had questions on screening behaviors in the prior year (which could not be interpreted in light of current screening recommendations)⁵¹. The cross-sectional design also precludes looking at changes in health behaviors over time within individuals. We were further unable to examine pre-diagnosis behaviors or temporality of associations between health behaviors and cancer. NHIS also cannot generalize to those who are in nursing homes or other care facilities.

Research continues to show that meeting guidelines on smoking, physical activity, body weight, and alcohol consumption has numerous health benefits, particularly for a high-risk population like cancer survivors. Emerging research also suggests that sleep may be a key health target for survivors. The challenge is disseminating and delivering effective programs and services more broadly and encouraging healthcare providers to counsel cancer survivors about the need for a healthy lifestyle during and after cancer.^{52,53} Comparing our findings to those published 15 years ago, there has been some degree of success in reducing smoking rates, but specific groups still have alarmingly high smoking rates. Our data also suggest insufficient progress with regards to meeting physical activity guidelines and reducing moderate to heavy alcohol consumption. Research, advocacy, and policy may each be needed to further affect prevalence of these risk behaviors. Health researchers, oncologists, and other health care providers may utilize the data presented here to prioritize health behavior change in the cancer survivor and general population, with the goal of improving quality of life and multiple health outcomes.

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Demographic and Health Characteristics of the Adult Population in the National Health Interview Survey (NHIS) by Cancer History (2013–2017)^a

Table 1.

Characteristic	History of cancer		No history of cancer				p-value ^b	
	Total n	%	Age in years		Total n			
			18-<40	40-<65	65	% (SE)		18-<40
n	12648	810	4425	7413	147971	54739	62079	31153
Sex		% (SE) ^c	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)
Male	4918	39.0 (0.5)	26.9 (2.0)	34.5 (0.8)	43.0 (0.7)	47.9 (0.3)	48.3 (0.3)	39.5 (0.3)
Female	7730	61.0 (0.5)	73.1 (2.0)	65.5 (0.8)	57.0 (0.7)	52.1 (0.3)	51.7 (0.3)	60.5 (0.3)
Race/ethnicity								
White, non-Hispanic	10120	82.2 (0.5)	72.8 (1.9)	80.1 (0.7)	84.4 (0.6)	66.4 (0.4)	68.1 (0.4)	75.6 (0.5)
Black, non-Hispanic	1202	8.5 (0.3)	9.7 (1.4)	9.2 (0.5)	8.0 (0.4)	13.2 (0.2)	13.4 (0.3)	10.8 (0.3)
Hispanic	878	6.2 (0.3)	13.6 (1.3)	7.3 (0.5)	4.8 (0.3)	14.0 (0.3)	12.6 (0.3)	8.8 (0.3)
Non-Hispanic, other	448	3.1 (0.2)	3.9 (0.7)	3.5 (0.4)	2.8 (0.2)	6.3 (0.1)	7.6 (0.2)	4.8 (0.2)
Education								
< High school	1788	13.3 (0.4)	11.9 (1.3)	10.4 (0.5)	15.2 (0.5)	20.97	12.3 (0.2)	11.5 (0.2)
High school graduate	5767	44.8 (0.5)	48.2 (2.2)	42.8 (0.9)	45.6 (0.7)	66272	44.3 (0.3)	46.3 (0.4)
2- or 4- year college graduate	3556	29.2 (0.5)	32.6 (2.0)	34.2 (0.9)	25.7 (0.6)	44738	31.5 (0.2)	33.3 (0.3)
Bachelor's degree	1488	12.3 (0.4)	7.1 (1.1)	12.3 (0.6)	12.9 (0.5)	16051	11.5 (0.2)	13.1 (0.2)
Family income								
\$45,000	1515	12.8 (0.4)	20.2 (1.9)	26.0 (0.8)	3.9 (0.3)	30996	22.4 (0.2)	21.6 (0.3)
\$20,000-<\$45,000	1176	8.9 (0.3)	20.3 (1.6)	15.5 (0.6)	3.6 (0.3)	28533	19.0 (0.1)	25.0 (0.3)
< \$20,000	1186	8.9 (0.3)	25.2 (1.9)	11.4 (0.5)	5.7 (0.3)	23566	15.4 (0.2)	24.0 (0.3)
Functional limitations								
Limited in any way	8573	67.2 (0.6)	43.0 (2.2)	61.9 (0.9)	73.1 (0.7)	53844	35.4 (0.2)	16.7 (0.2)
Not limited	4033	32.4 (0.6)	56.5 (2.2)	37.9 (0.9)	26.5 (0.7)	94017	64.5 (0.2)	83.3 (0.2)
Health insurance coverage								
Covered	11856	94.0 (0.3)	76.3 (1.9)	88.5 (0.6)	99.3 (0.1)	122191	83.6 (0.2)	76.1 (0.3)
							83.4 (0.2)	98.2 (0.1)

Characteristic	History of cancer			Age in years			No history of cancer			Age in years			^b p-value	
	Total	n	% (SE) ^c	18-<40	40-<65	65	Total	n	% (SE)	18-<40	40-<65	65		
				% (SE)	% (SE)	% (SE)				% (SE)	% (SE)	% (SE)		
n	12648	810	4425	7413	147971	31153								
<i>Not covered</i>	301	2.2 (0.2)	8.0 (1.1)	4.2 (0.4)	0.4 (0.1)	6944	4.6 (0.1)	6.9 (0.1)	4.3 (0.1)	0.9 (0.1)				
Reported health status														<.001
<i>Excellent</i>	1492	12.3 (0.4)	18.9 (1.8)	12.8 (0.6)	11.2 (0.5)	40185	28.1 (0.2)	38.6 (0.3)	24.0 (0.2)	16.6 (0.3)				
<i>Very good</i>	3295	26.4 (0.5)	28.1 (2.1)	24.7 (0.8)	27.3 (0.6)	48279	33.1 (0.2)	34.7 (0.3)	32.6 (0.3)	31.0 (0.3)				
<i>Good</i>	4214	33.2 (0.5)	28.6 (1.9)	31.3 (0.9)	34.9 (0.6)	39584	26.1 (0.2)	21.1 (0.2)	28.0 (0.2)	32.1 (0.3)				
<i>Fair</i>	2600	20.0 (0.4)	17.7 (1.7)	21.1 (0.7)	19.5 (0.6)	15425	9.9 (0.1)	4.9 (0.1)	11.6 (0.2)	15.8 (0.3)				
<i>Poor</i>	1038	8.1 (0.3)	6.7 (1.0)	10.1 (0.5)	7.0 (0.3)	4448	2.8 (0.1)	0.7 (0.0)	3.9 (0.1)	4.6 (0.1)				

^a All reported Ns are unweighted and % are weighted

^b p-values are comparing the total columns by cancer history

^c Percentages may not add up to 100 due to rounding or missing data

Table 2.

Cancer sites and years since diagnosis, by sex in the Adult Population in the National Health Interview Survey (2013–2017)^a

Women	No of cases	%	SE	Average Years since diagnosis
Breast	2672	34.9	0.7	11.5
Cervix	834	10.2	0.4	18.6
Ovary	287	3.7	0.3	14.9
Colon	374	4.9	0.3	10.0
Uterus	559	7.2	0.3	16.9
Melanoma	525	7.0	0.3	10.9
Larynx, lung, pharynx	230	2.9	0.2	6.3
Leukemia, lymphoma	281	3.4	0.2	10.7
Multiple	810	10.7	0.4	13.2
Other	1158	15.1	0.5	9.3
Men				
Prostate	1709	34.2	0.8	8.2
Colon	369	7.2	0.4	9.6
Melanoma	489	10.3	0.5	9.2
Larynx, lung, pharynx	272	5.4	0.4	6.9
Leukemia, lymphoma	284	6.3	0.4	10.4
Multiple	564	11.3	0.5	9.6
Other	1231	25.4	0.7	8.8

^a All reported Ns are unweighted and % are weighted

Table 3.

Prevalence of Health Behaviors by Cancer History among the Adult Population in the National Health Interview Survey (2013–2017)^a

History of cancer				No history of cancer				p-value ^b		
Characteristic	Age in years			Age in years						
	Total n	Total % (SE)	18-<40 % (SE)	40-<65 % (SE)	65 % (SE)	Total n	Total % (SE)		18-<40 % (SE)	40-<65 % (SE)
Smoking status										
Current	1847	14.0 (0.4)	31.0 (1.9)	21.1 (0.7)	7.8 (0.4)	25116	16.7 (0.2)	17.6 (0.2)	19.3 (0.2)	9.6 (0.2)
Former	4715	37.7 (0.5)	12.8 (1.4)	30.3 (0.8)	45.0 (0.7)	32184	21.7 (0.2)	12.5 (0.2)	22.8 (0.2)	36.7 (0.3)
Never	6007	47.7 (0.6)	55.3 (2.0)	48.1 (0.8)	46.5 (0.7)	90102	61.3 (0.2)	69.5 (0.3)	57.5 (0.3)	53.3 (0.3)
Smoking frequency ^c										
Every day	1502	81.3 (1.1)	82.5 (2.7)	79.9 (1.6)	83.2 (1.9)	19103	75.8 (0.4)	69.8 (0.6)	79.6 (0.5)	81.3 (0.8)
Some days	345	18.7 (1.1)	17.5 (2.7)	20.1 (1.6)	16.8 (1.9)	6013	24.2 (0.4)	30.2 (0.6)	20.4 (0.5)	18.7 (0.8)
Alcohol drinking status										
Life-time abstainer	2270	17.3 (0.4)	12.3 (1.4)	12.9 (0.6)	20.5 (0.6)	29859	19.1 (0.2)	19.9 (0.3)	15.4 (0.2)	25.3 (0.4)
Former	3021	23.1 (0.4)	13.6 (1.5)	20.1 (0.7)	26.0 (0.6)	21291	13.8 (0.2)	6.7 (0.1)	15.3 (0.2)	24.3 (0.3)
Current Infrequent	1869	15.0 (0.4)	17.9 (1.6)	16.5 (0.7)	13.8 (0.5)	18584	12.4 (0.1)	10.9 (0.2)	13.5 (0.2)	12.9 (0.2)
Current Light	3005	24.5 (0.5)	36.4 (2.1)	29.0 (0.8)	20.4 (0.6)	44873	31.4 (0.2)	36.7 (0.3)	31.7 (0.2)	20.5 (0.3)
Current Moderate	1657	13.6 (0.4)	14.2 (1.5)	13.8 (0.7)	13.3 (0.5)	22746	16.0 (0.1)	18.1 (0.2)	16.2 (0.2)	11.5 (0.2)
Current Heavy	633	5.0 (0.2)	3.7 (0.8)	6.2 (0.4)	4.4 (0.3)	8024	5.5 (0.1)	5.9 (0.1)	6.0 (0.1)	3.9 (0.1)
Alcohol drinking days/week ^c										
<1	3441	48.0 (0.7)	59.6 (2.5)	48.3 (1.2)	46.0 (1.0)	44287	46.2 (0.2)	46.4 (0.4)	45.8 (0.3)	46.7 (0.5)
1-3	2344	32.5 (0.7)	33.0 (2.4)	37.3 (1.1)	28.8 (0.9)	37930	40.9 (0.2)	45.4 (0.3)	39.8 (0.3)	31.5 (0.4)
4-6	489	6.9 (0.4)	3.8 (1.0)	6.5 (0.6)	7.7 (0.5)	5729	6.1 (0.1)	5.4 (0.1)	6.6 (0.2)	6.9 (0.3)
7	913	12.5 (0.5)	3.6 (0.8)	7.9 (0.6)	17.5 (0.7)	6760	6.8 (0.1)	2.8 (0.1)	7.9 (0.2)	14.9 (0.4)
Physical activity guidelines met										
Both strength and aerobic	1718	14.2 (0.4)	22.0 (1.9)	17.0 (0.7)	11.6 (0.5)	29708	21.1 (0.2)	28.6 (0.3)	19.0 (0.2)	11.1 (0.2)
Aerobic only	3053	24.2 (0.5)	30.3 (1.9)	26.3 (0.7)	22.2 (0.6)	41436	27.8 (0.2)	29.8 (0.3)	28.0 (0.2)	23.9 (0.3)
Strength only	656	5.2 (0.2)	3.6 (0.8)	3.9 (0.4)	6.2 (0.3)	5895	4.1 (0.1)	3.5 (0.1)	4.0 (0.1)	5.2 (0.2)

Characteristic	History of cancer					No history of cancer					p-value ^b			
	Age in years					Age in years								
	Total n	Total	% (SE)	18-<40	40-<65	65	% (SE)	Total n	Total	% (SE)		18-<40	40-<65	65
Insufficient	2198	17.3 (0.4)	15.5 (1.6)	18.0 (0.7)	17.1 (0.5)	23695	15.8 (0.1)	14.2 (0.2)	16.8 (0.2)	16.8 (0.3)				
No physical activity reported	5023	39.2 (0.6)	28.5 (1.9)	34.9 (0.9)	42.9 (0.7)	47234	31.2 (0.3)	23.9 (0.3)	32.3 (0.3)	43.0 (0.5)				
Body-mass index														
Underweight	260	2.0 (0.2)	2.4 (0.6)	1.6 (0.2)	2.2 (0.2)	2470	1.7 (0.0)	2.2 (0.1)	1.0 (0.0)	1.9 (0.1)				
Normal	3812	30.5 (0.5)	35.9 (2.2)	27.9 (0.8)	31.4 (0.6)	48424	33.4 (0.2)	40.7 (0.3)	27.2 (0.2)	32.1 (0.3)				
Overweight	4272	33.8 (0.5)	27.5 (2.0)	30.9 (0.8)	36.2 (0.7)	48922	33.0 (0.2)	29.7 (0.3)	34.7 (0.2)	35.7 (0.3)				
Obese class 1	2365	18.5 (0.4)	14.9 (1.6)	19.5 (0.7)	18.4 (0.6)	25550	17.0 (0.1)	14.0 (0.2)	19.5 (0.2)	17.3 (0.3)				
Obese class 2	1513	11.7 (0.3)	15.5 (1.5)	15.9 (0.6)	8.7 (0.4)	17152	11.3 (0.1)	10.4 (0.2)	13.3 (0.2)	9.0 (0.2)				
Hours of sleep														
<5	489	3.8 (0.2)	7.7 (1.1)	4.9 (0.4)	2.8 (0.2)	4284	2.9 (0.1)	2.4 (0.1)	3.4 (0.1)	2.7 (0.1)				
5-7	3263	25.9 (0.4)	37.1 (2.1)	31.3 (0.8)	21.4 (0.5)	41768	28.3 (0.2)	28.6 (0.2)	30.9 (0.2)	22.3 (0.3)				
7-8	6876	54.5 (0.5)	44.4 (2.1)	52.4 (0.9)	56.9 (0.6)	85766	58.0 (0.2)	59.5 (0.3)	56.8 (0.2)	57.8 (0.4)				
>8-9	715	5.6 (0.2)	4.1 (0.9)	4.1 (0.3)	6.6 (0.3)	6103	4.0 (0.1)	3.8 (0.1)	2.9 (0.1)	6.7 (0.2)				
>9	872	6.5 (0.3)	3.4 (0.8)	4.1 (0.3)	8.3 (0.4)	5418	3.5 (0.1)	2.6 (0.1)	2.6 (0.1)	6.9 (0.2)				

^a All reported Ns are unweighted and % are weighted

^b p-values in the table are comparing those with a history of cancer to those without a history of cancer overall

^c Smoking and drinking frequency is described only for those who reported those behaviors at the time of questionnaire

Table 4.Adherence to lifestyle recommendations by cancer site among the Adult Population in the National Health Interview Survey (2013–2017)^a

	Breast cancer		Prostate cancer		Lung, larynx, pharynx		Gynecologic		Colorectal		Leukemia/lymphoma	
	N	% (SE)	N	% (SE)	N	% (SE)	N	% (SE)	N	% (SE)	N	% (SE)
Current smoker												
Yes	297	9.2 (0.6)	190	10.0 (0.8)	149	18.6 (1.8)	542	26.2 (1.1)	130	10.9 (1.0)	92	11.8 (1.3)
No	2797	90.8 (0.6)	1777	90.0 (0.8)	594	81.4 (1.8)	1483	73.8 (1.1)	954	89.1 (1.0)	640	88.2 (1.3)
Alcohol use												
Life-time abstainer	746	23.4 (0.9)	235	11.1 (0.8)	121	16.1 (1.5)	355	17.7 (1.0)	232	21.4 (1.4)	138	18.7 (1.7)
Former	700	21.9 (0.9)	515	25.9 (1.2)	246	32.8 (2.1)	482	24.0 (1.1)	311	28.2 (1.6)	168	22.3 (1.8)
Current Infrequent	480	16.3 (0.8)	219	11.5 (0.9)	120	17.1 (1.7)	389	20.1 (1.1)	145	12.7 (1.2)	105	13.9 (1.5)
Current Light	706	23.8 (0.9)	472	24.5 (1.1)	125	16.5 (1.6)	518	25.2 (1.2)	210	20.4 (1.5)	184	26.1 (1.9)
Current Moderate	280	9.5 (0.6)	418	22.2 (1.1)	74	10.7 (1.3)	151	7.7 (0.8)	131	12.7 (1.2)	95	13.3 (1.5)
Current heavy	160	5.2 (0.5)	94	4.8 (0.6)	49	6.8 (1.1)	108	5.3 (0.6)	47	4.6 (0.8)	34	5.7 (1.1)
Meets PA guidelines												
Yes	406	13.9 (0.8)	282	14.8 (0.9)	60	7.1 (1.1)	255	13.5 (1.0)	108	10.9 (1.1)	99	15.0 (1.6)
No	2710	86.1 (0.8)	1697	85.2 (0.9)	687	92.9 (1.1)	1778	86.5 (1.0)	981	89.1 (1.1)	637	85.0 (1.6)
Maintains a healthy body mass index												
Yes	1025	35.0 (1.1)	552	29.2 (1.2)	286	39.3 (2.2)	577	29.1 (1.3)	289	29.6 (1.8)	233	33.7 (2.0)
No	1949	65.0 (1.1)	1402	70.8 (1.2)	443	60.7 (2.2)	1355	70.9 (1.3)	769	70.4 (1.8)	486	66.3 (2.0)
Meets sleep guidelines												
Yes	1818	61.1 (1.1)	1192	63.1 (1.3)	377	53.7 (2.1)	995	50.2 (1.3)	567	53.9 (1.8)	428	59.6 (2.2)
No	1186	38.9 (1.1)	723	36.9 (1.3)	337	46.3 (2.1)	970	49.8 (1.3)	483	46.1 (1.8)	287	40.4 (2.2)

^a All reported Ns are unweighted and % are weighted

Odds ratios and 95% confidence intervals for adherence to lifestyle recommendations for cancer survivors compared to those without a history of cancer among the Adult Population in the National Health Interview Survey (2013–2017)

Table 5.

	Model 1 ^a		Model 2 ^b		Model 3 ^c	
	OR	95% CI	OR	95% CI	OR	95% CI
Non- smoker						
No cancer history	1.00		1.00		1.00	
Cancer survivor	0.95	0.89–1.02	1.12	1.05–1.20	1.13	1.06–1.21
No Mod/Heavy Alcohol use						
No cancer history	1.00		1.00		1.00	
Cancer survivor	0.92	0.87–0.98	0.93	0.88–0.99	0.93	0.88–0.99
Meets Physical Activity guidelines						
No cancer history	1.00		1.00		1.00	
Cancer survivor	0.89	0.84–0.94	1.16	1.09–1.24	1.14	1.07–1.22
Maintains a healthy body mass index (BMI)						
No cancer history	1.00		1.00		1.00	
Cancer survivor	0.93	0.88–0.98	1.06	1.00–1.11	1.07	1.01–1.12
Meets sleep guidelines						
No cancer history	1.00		1.00		1.00	
Cancer survivor	0.87	0.83–0.91	1.02	0.97–1.06	1.01	0.98–1.08

^aModel 1 is adjusted for age, sex, and race/ethnicity.

^bModel 2 is adjusted for all Model 1 factors, as well as education, insurance status, functional limitations, and health status.

^cModel 3 is adjusted for all the Model 2 factors, as well as for meeting all other guidelines (smoking, physical activity, alcohol, BMI, and sleep)

Table 6.

Odds ratios and 95% confidence intervals (CIs) for adherence to lifestyle recommendations for cancer survivors compared to those without a history of cancer among the Adult Population in the National Health Interview Survey (2013–2017), stratified by age

Odds of meeting lifestyle guidelines	OR	95 % CI	p-interaction ^b
Non-smoker			<0.001
18–39 years	0.69	0.55–0.87	
40–64 years	1.21	1.09–1.34	
65+ years	1.35	1.20–1.51	
No Moderate/Heavy Alcohol use			0.022
18–39 years	1.32	1.02–1.71	
40–64 years	0.96	0.87–1.07	
65+ years	0.86	0.79–0.94	
Meets Physical Activity guidelines			0.575
18–39 years	1.04	0.82–1.32	
40–64 years	1.18	1.06–1.31	
65+ years	1.18	1.07–1.30	
Maintains a healthy body mass index (BMI)			0.092
18–39 years	0.93	0.75–1.16	
40–64 years	1.16	1.06–1.28	
65+ years	1.02	0.95–1.10	
Meets sleep guidelines			<0.001
18–39 years	0.73	0.60–0.89	
40–64 years	1.07	0.99–1.16	
65+ years	1.02	0.96–1.09	

^a Odds ratios are adjusted for age, sex, and race/ethnicity, education, insurance status, functional limitations, and health status, as well as for meeting all other guidelines (smoking, physical activity, alcohol, BMI, and sleep).

^b Wald test was used to generate p-values for interaction.