

Trends and Cancer-Specific Patterns of Physical Activity, Sleep Duration, and Daily Sitting Time Among US Cancer Survivors, 1997-2018

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Abstract

Background

Physical activity, sufficient sleep, and limiting sedentary time may improve cancer survivorship.

Methods

Utilizing US nationally representative samples from the National Health Interview Survey (NHIS) 1997-2018 and the National Health and Nutrition Examination Survey (NHANES) 2007-2018, this study investigated the trends of meeting physical activity guidelines (PAG), insufficient sleep duration, and sitting time in US cancer survivors (n=58,527) and non-cancer adults (n=640,109).

Results

From 1997-2018, the prevalence of meeting PAG was consistently lower in cancer survivors than in non-cancer adults. Among cancer survivors, the prevalence of meeting PAG increased from 34.9% (95% CI, 33.1-36.8) to 46.5 (95% CI, 45.0-48.1) for aerobic (≥ 150 minutes/week at moderate-intensity or 75 minutes/week at vigorous-intensity), from 13.9 (95% CI, 12.8-15.1) to 23.1 (95%, 21.8-24.4) for muscle-strengthening (≥ 2 days/week) activities, and from 9.5 (95% CI, 8.4-10.7) to 17.9 (95% CI, 16.7-19.1) for both combined (all P for trend $< .001$). From 2004 to 2018, the prevalence of insufficient sleep duration (< 7 h/d) increased from 28.4% (95% CI, 26.3-30.5) to 30.8% (95% CI, 29.3-32.2) ($P_{\text{trend}}=0.004$). Daily sitting time increased from 6.09 h/d (95% CI, 5.71-6.46) in 2007-2008 to 7.36 h/d (95% CI, 7.05-7.68) in 2013-2014 and attenuated to 6.20 h/d (95% CI, 5.74-6.65) in 2017-2018. The pattern of physical activity, sleep, and sitting time varied by sex, race/ethnicity, BMI, cancer type, and time since cancer diagnosis.

Conclusions

More than half of US cancer survivors did not meet PAG and a large proportion had insufficient sleep duration and prolonged sitting time.

Introduction

The growing population of US cancer survivors is expected to reach 26 million in the US by 2040 [1]. Cancer survivors experience impaired quality of life and increased risks of comorbidities, cancer recurrence and death [1-4]. With an initial mission in 2016 to accelerate the progress against cancer, the Cancer Moonshot was reignited by President Biden in early 2022 to highlight new goals: “reduce the cancer death rate by half within 25 years and improve the lives of people with cancer and cancer survivors”. Upon the completion of cancer treatment, modifying 24-hour lifestyle behavior is often the best strategy to improve outcomes for cancer survivors [5-12]. National [6, 9] and international agencies and professional organizations (e.g. American Society of Clinical Oncology, American College of Sports Medicine) [5, 13, 14] released lifestyle behavior guidelines for cancer survivors. In its first report in 2006, the American Cancer Society (ACS) encouraged cancer survivors to be physically active [15]. In its second report in 2012, ACS provided quantified physical activity recommendations (≥ 150 minutes/week of moderate-intensity or 75 minutes/week of vigorous-intensity aerobic physical activity, and muscle-strengthening activities on 2+ days/week) [16]. Recognizing lifestyle exposures may affect cancer survivors differently depending on cancer types, ACS added cancer-specific recommendations in their 2022 report [5]. Despite the evolution of national cancer survivorship guidelines on physical activity over time, to the best of our knowledge, no previous studies have evaluated the temporal trend in physical activity among cancer survivors at the population level.

Sleep and sedentary behaviors, the major components of 24-hour movement behaviors, are emerging factors affecting cancer survivorship. Environmental, social, and occupational cues in modern society have led to irregular sleep and restricted sleep duration, which adversely affect health outcomes [17, 18]. Cancer survivors experience persistent sleep problems (e.g., short sleep duration) further due to cancer and cancer treatment [11] and may

reduce cancer survival [12, 19]. Meanwhile, sedentary behavior, particularly prolonged sitting, is highly prevalent among cancer survivors and associated with worsened all-cause, cancer-specific and non-cancer mortality [10, 20]. While quantitative guidelines are yet to be developed, to date, population level data on patterns and correlates of sleep duration and sedentary time in cancer survivor are limited.

To address these knowledge gaps, this study aims to evaluate the overall trend and cancer-specific prevalence of physical activity, sleep duration, and sitting time using nationally representative samples of US cancer survivors and non-cancer adults. Understanding cancer-specific patterns of these behaviors is critical for developing precision interventions to improve long-term survivorship across cancer types.

Methods

This serial, cross-sectional analysis used data from nationally representative samples from the National Health Interview Survey (NHIS) and National Health and Nutrition Examination Survey (NHANES), that were designed to monitor the health and risk factors of the US population [10, 20]. Both NHIS and NHANES protocols were approved by the National Center for Health Statistics ethics review board, and informed consent was obtained from all participants.

Study Population

Participants in NHIS and NHANES completed in-person interviews and NHANES participants additionally underwent a set of physical examinations. Data on physical activity (1997-2018) and sleep duration (2004-2018) were available in 22 cycles and 15 cycles of NHIS, respectively, and data on daily sitting time were available in 6 cycles of NHANES (2007-2018). Data on sociodemographic characteristics, lifestyle factors and long-term conditions (Detailed in **Supplementary Methods**) among cancer survivors and non-cancer adults aged ≥ 20 years were extracted from corresponding study cycles of NHIS and NHANES.

Diagnosis of Cancer

Data on cancer diagnosis and cancer type were collected during the in-person interview, including cancer type(s) with up to three diagnoses and age at each diagnosis [10, 21].

Participants were asked, “Have you ever been told by a doctor or other health professional that you had cancer or a malignancy of any kind?” Individuals who responded “Yes” were defined as cancer survivors and then asked, “What kind of cancer was it?” and “How old were you when this cancer was first diagnosed?”. Years since the first cancer diagnosis were calculated as the difference between current age and age at first diagnosis.

Leisure-Time Physical Activity, Sleep Duration, and Daily Sitting Time

Leisure-time physical activity (LTPA) and sleep duration were self-reported in NHIS during the in-person interview. NHIS participants were asked to report their moderate-and vigorous-intensity LTPA, the frequency (per day, week, month, or year) and the duration of LTPA sessions (minutes or hours). Total LTPA was estimated as minutes of moderate-intensity activities plus twice the minutes of vigorous-intensity activities [10]. In addition, NHIS participants reported specific LTPA to increase muscle strength (e.g., lifting weights, doing calisthenics). Based on the *2018 Physical Activity Guidelines (PAG) for Americans* [6] and *American Cancer Society Guidelines on Diet and Activity for Cancer Survivors 2022* [5], participants with LTPA of ≥ 150 minutes/week were defined as meeting the aerobic PAG and those with muscle-strengthening activities of ≥ 2 days/week were defined as meeting the muscle-strengthening PAG. NHIS participants self-reported sleep duration during the in-person interview via: “on average, how many hours of sleep do you get in a 24-hour period?” Fewer than 7 hours/day was defined as insufficient sleep duration [17, 22, 23].

Daily sitting time was self-reported during NHANES in-person interview using the Global Physical Activity Questionnaire [24]. Participants were asked, “On a typical day, how much time

do you usually spend sitting at school, at home, getting to and from places, or with friends, including time spent sitting at a desk, traveling in a car or bus, reading, playing cards, watching television, or using a computer?”. Prolonged sitting was defined as sitting ≥ 6 h/d in accordance with recent studies [10, 25, 26].

Measurements of LTPA, sleep duration, and daily sitting time were consistent across the analyzed study cycles.

Sociodemographic Characteristics, Lifestyle Factors, and Long-term Conditions

Sociodemographic characteristics, lifestyle factors, and long-term conditions were self-reported or measured, including sex, race and ethnicity, educational attainment, family poverty income ratio [10], body mass index (BMI), smoking status, and the history of cardiovascular disease (CVD) and diabetes mellitus (**Supplementary Methods**).

Statistical Analysis

All analyses were conducted following the NHIS and NHANES analytic guidelines and accounted for the complex survey design to ensure nationally representative estimates [10, 20]. Statistical tests were two-sided and statistical significance was set at $P < 0.05$. Every two NHIS yearly cycles were combined into a single two-year cycle with recalculated sample weights to align with the NHANES two-year cycle. Data analyses were performed from January 1 to April 1, 2022, using Stata, version 17.0 (StataCorp LLC).

First, trend analyses were conducted to evaluate the changes in patterns of LTPA, sleep duration, and daily sitting time over time in both cancer survivors and non-cancer adults (sample sizes detailed in **Supplementary Table 1-2**). Trends in prevalence of meeting the aerobic LTPA guidelines were calculated (**Supplementary Methods**) and visually illustrated by sex, race/ethnicity, BMI, and time since cancer diagnosis. Second, all study cycles were aggregated into one single dataset for NHIS and NHANES, respectively, to evaluate the patterns of LTPA,

sleep duration, and daily sitting time by cancer types (**Supplementary Table 3**) and sociodemographic, lifestyle factors and long-term conditions (**Supplementary Table 4**). Multivariable (MV) logistic regressions to evaluate the patterns in LTPA, insufficient sleep duration, and prolonged sitting were adjusted for age, sex, race/ethnicity, education level, family poverty income ratio, body mass index, smoking status, history of diabetes, cardiovascular diseases, number of cancer types, age at cancer diagnosis, and time since cancer diagnosis. MV linear regressions were employed to evaluate the trends in sleep duration and daily sitting time, respectively, as continuous variables. Sensitivity analyses were conducted by excluding cancer survivors within 0-1 year since cancer diagnosis by cancer types.

Results

Trends in Leisure-Time Physical Activity

A total of 55,180 cancer survivors and 608,891 non-cancer adults provided information on LTPA in NHIS across cycles from 1997-1998 to 2017-2018. From 1997-1998 to 2017-2018, the prevalence of meeting PAG was consistently lower in cancer survivors than in non-cancer adults (**Table 1-2 and Figure 1**). Among cancer survivors, the prevalence of meeting PAG increased for aerobic LTPA (34.9% [95% CI, 33.1 to 36.8] to 46.5 [95% CI, 45.0 to 48.1]), muscle-strengthening activities (13.9 [95% CI, 12.8 to 15.1] to 23.1 [95%, 21.8 to 24.4]), and both combined (9.5 [95% CI, 8.4 to 10.7] to 17.9 [95% CI, 16.7 to 19.1]) (all *P* for trend <.001) (**Table 1**). The prevalence of meeting PAG increased in all population subgroups defined by sex, race/ethnicity, BMI, and time since cancer diagnosis (**Figure 2**) and remain statistically significant after adjusting for sociodemographic, lifestyle factors and long-term conditions (**Supplementary Table 5**). Racial/ethnic disparities were noted by a higher prevalence of meeting PAG in 1997 with a greater increase through 2018 (*P* for interaction=0.04) in Non-Hispanic Whites (35.8% to 48.1%) comparing to Non-Hispanic Blacks (24.4% to 29.4%) (**Table 3, Supplementary Table 6**). In the multivariable adjusted model, cancer survivors with low

socioeconomic status, low education attainment and those who were older, female, racial/ethnic minorities, current smokers, living with obesity, diabetes, CVD, and multiple cancers were less likely to report meeting the PAG (**Table 4, Supplementary Table 7**, all $p < .05$). Additionally, cancer survivors who were diagnosed with cancer at 15-39 years or had a longer time since their first cancer diagnosis were more likely to meet the PAG.

Cancer-Specific Patterns of Leisure-Time Physical Activity

Among common cancer types, the prevalence of meeting aerobic and muscle-strengthening PAG was 35.7% (95% CI, 34.5 to 36.9) and 16.5% (95% CI, 15.6 to 17.5) in breast, and 43.0% (95% CI, 41.5 to 44.5) and 18.3% (95% CI, 17.1 to 19.4) in prostate cancer survivors (**Table 5**). The prevalence of meeting aerobic PAG was lower in survivors with cancers of the upper aerodigestive (e.g., pharynx, 28.7% [95% CI, 23.9 to 33.4]), digestive system (e.g., liver, 19.7% [95% CI, 14.8 to 24.6]), respiratory system (e.g., lung, 20.9% [95% CI, 18.6 to 23.3]), and bone (24.7% [95% CI, 19.7 to 29.6]). Results were similar after excluding survivors with <1 year since cancer diagnosis (**Supplementary Table 8**).

Trends in Sleep Duration

Data on sleep duration were available for 39,242 cancer survivors and 395,160 non-cancer adults. From 2004 to 2018, despite decreased trends in sleep duration in both groups, cancer survivors consistently had longer sleep duration than non-cancer adults (**Table 1-2 and Figure 1**). For cancer survivors, the sleep duration decreased from 7.28 (95% CI, 7.21 to 7.35) to 7.22 (95% CI, 7.17 to 7.27) h/d (P for trend < 0.06 [95% CI, -0.15 to 0.02]). Meanwhile, the prevalence of insufficient sleep duration (<7 hours/day) significantly increased from 28.4% (95% CI, 26.3 to 30.5) to 30.8% (95% CI, 29.3 to 32.2) (P for trend = 0.004, difference, 2.4% [95% CI, -0.2 to 4.9]) (**Table 1, Supplementary Table 4**). Female survivors had a shorter sleep duration (7.20 [95% CI, 7.17 to 7.22] vs. 7.39 [95% CI, 7.36 to 7.42] h/d; β , -0.11 [95% CI, -0.15 to -0.06]) and a

higher prevalence of insufficient sleep duration (31.8% [95% CI, 31.0 to 32.5] vs. 26.0% [95% CI, 25.1 to 26.8]; OR, 1.19 [95% CI, 1.12 to 1.26]) than male survivors (**Tables 3-4**). Compared to Non-Hispanic Whites (7.30 hours/day [95% CI, 7.28 to 7.33]; 28.0% [95% CI, 27.4 to 28.6]), Non-Hispanic Blacks (7.18 hours/day [95% CI, 7.10 to 7.26]; 37.2% [95% CI, 35.1 to 39.3]), Hispanic (7.13 hours/day [95% CI, 7.05 to 7.21]; 35.9% [95% CI, 33.4 to 38.4]), and other (7.05 hours/day [95% CI, 6.92 to 7.18]; 39.3% [95% CI, 35.5 to 43.0]) reported shorter and higher prevalence of insufficient sleep duration. Additionally, survivors who were current smokers, with obesity or low socioeconomic status, and diagnosed with cancer between 15-39 years were more likely to report shorter and insufficient sleep durations (all $P < 0.05$).

Cancer-Specific Patterns of Sleep Duration

By cancer type (**Table 5**), survivors with cancers of the female reproductive system had the shortest sleep duration (e.g., cervix, 6.81 hours/day [95% CI, 6.73 to 6.89]; ovary, 6.91 hours/day [95% CI, 6.78 to 7.04]) and highest prevalence of insufficient sleep duration (e.g., cervix, 44.8% [95% CI, 42.4 to 47.2]; ovary, 41.6 [95% CI, 37.6 to 45.6]). Among common cancers, the prevalence of insufficient sleep duration was 28.4% (95% CI, 27.1 to 29.7) for breast, 23.6% (95%, 22.1 to 25.1) for prostate, 27.4% (95% CI, 24.4 to 30.5) for lung, and 29.1% (95% CI, 26.8 to 31.4) for colon cancers.

Trends in Daily Sitting Time

A total of 3,347 cancer survivors and 31,218 non-cancer adults had information on daily sitting time in NHANES 2007-2018. Cancer survivors had more sitting time than non-cancer adults over time (**Figure 1**). For cancer survivors, daily sitting time increased from 6.09 hours/day (95% CI, 5.71 to 6.46) in 2007-2008 to 7.36 hours/day (95% CI, 7.05 to 7.68) in 2013-2014 and attenuated to 6.20 h/d (95% CI, 5.74 to 6.65) in 2017-2018 (**Table 1**). Female and male survivors reported 6.48 (95% CI, 6.29 to 6.68) and 6.87 (95% CI, 6.62 to 7.11) hours daily sitting

time, respectively. Hispanics reported a shorter daily sitting time (4.98 hours/day [95% CI, 4.66 to 5.31]) and a lower prevalence (38.4 95% CI, 32.9 to 43.8]) of prolonged sitting time (>6 hours/day) than other racial/ethnic groups. Furthermore, prolonged sitting time was observed in survivors with obesity and those living with diabetes and CVD, had multiple cancer diagnoses and a longer time since cancer diagnosis (**Tables 3-4**).

Cancer-Specific Patterns of Daily Sitting Time

By cancer type (**Table 5**), survivors of pancreas (9.13, [95% CI, 6.19 to 12.1]), bone (8.24, [95% CI, 6.13 to 10.4]), and blood (7.87, [95% CI, 5.52 to 10.2]) cancers reported longest sitting (hours/day). Among common cancers, the prevalence of prolonged sitting time (>6 hours/day) was 58.0% (95% CI, 52.1 to 63.9) for breast, 58.3% (95%, 52.5 to 64.1) for prostate, 71.6% (95% CI, 59.0 to 84.1) for lung, 64.2% (95% CI, 56.6 to 71.8) for colon cancers.

Discussion

In the US cancer survivor population, despite an increasing trend in the prevalence of meeting PAG from 1997 to 2018, only half of survivors met the aerobic PAG and 1/4 met the muscle-strengthening PAG by 2018, and these numbers were lower than in non-cancer adults. Racial/ethnic disparities were noted with a constantly lower, and lesser increased, prevalence of meeting PAG in Non-Hispanic Blacks than Non-Hispanic Whites. The prevalence of insufficient sleep duration increased from 2014 to 2018, now affecting approximately 30% of cancer survivors. Prolonged sitting was highly prevalent with over 50% of cancer survivors spending ≥ 6 hours/day sitting from 2007 through 2018. Of note, patterns of LTPA, sleep and sitting in US cancer survivors differed with unfavorable levels observed among females, Non-Hispanic Blacks, and survivors with higher BMI and shorter time since cancer diagnosis and varied with considerably between cancer types.

To our knowledge, this study is the first to examine the trends and prevalence of LTPA, sleep duration, and daily sitting time in nationally representative samples of cancer survivors.

Given the alarming trends in sedentary lifestyle dating back to the industrial revolution, evidence on physical activity and health benefits have quickly accumulated in past decades. US health agencies and national organizations, since the 1990s [27], started recommending LTPA to the general population and individuals with heart diseases. Recommending physical activity to cancer survivors has occurred more recently with general recommendations in the 2008 first edition PAG for Americans and was followed by its second edition in 2018 [6]. Meanwhile, ACS recommend cancer survivors with long-term disease-free living or stable disease to meet the PAG for Americans [5]. In the US general population, recent data indicated an increased in meeting aerobic PAG since 1997 to 2018 (54.2%) [28]. Our study revealed that the prevalence of meeting aerobic PAG among US cancer survivors also increased but remained lower than the general population. The prevalence of meeting PAG for muscle-strengthening activities and combined aerobic and muscle-strengthening activities increased from 1997 to 2018, albeit extremely low among cancer survivors. Indeed research evidence indicated clinically meaningful benefits of muscle-strengthening activities [29], however cancer survivors experience unique barriers and require exercise programs designed with consideration of cancer treatment side-effects, such as cachexia, fatigue, pain [30, 31], and long-term muscle weakness [32].

Short sleep duration and prolonged sitting became prevalent in modern society and may impair health [17, 20]. Short sleep duration is a common sleep problem among long-term cancer survivors [11], but its temporal trend was unclear in the cancer survivor population. The present study revealed that sleep duration decreased in US cancer survivors from 1997 to 2018 and 1/3 survivors reported short sleep durations. National sleep guidelines recommend that healthy adults need at least 7 hours of sleep per night [33]; no specific recommendations are available for cancer survivors. Benchmark of sleep duration estimated in the present study will support future research and guidelines development for US cancer survivors.

The 2018 PAG for Americans, for the first time, highlighted the health risks associated with sedentary behaviors and recommended moving more and sitting less to improve health [6].

One recent nationally representative cohort study found that a substantial portion of cancer survivors did not meet PAG and sat at least 6 hours/day, and that sitting time was associated with heightened all-cause and cancer-specific mortality risks [10]. The present study revealed that daily sitting time increased since 2007 and over half of cancer survivors sat at least 6 hours/day, which placed them at excess mortality risks. Our data support developing interventions targeting sedentary behavior and specify quantitative recommendations for cancer survivors.

Notable racial/ethnic disparities were observed with Non-Hispanic Blacks and Hispanics being less likely to meet PAG and more likely to have insufficient sleep than Non-Hispanic Whites. Consistent with previous studies, several sociodemographic and lifestyle correlates were identified for LTPA and sleep duration, including educational attainment, family income, BMI, smoking history, and comorbidities [10, 17, 34, 35].

The 2022 ACS guidelines for cancer survivors aimed to provide cancer-specific recommendations on lifestyle behaviors and summarized evidence by cancer types [5]. Most evidence were generated from previous studies conducted in common cancers (breast, colorectal, prostate) [36, 37]. Our estimates demonstrated low levels of LTPA in survivors of liver, lung, and bone cancers, high prevalence of short sleep duration survivors of cancer of the female reproductive system, and prolonged sitting among survivors of pancreas, bone and blood cancers, highlighting the high-risk subpopulations for future studies.

Strengths and Limitations

A clear strength was analyzing over 20 years' data from nationally representative samples of US cancer survivors, which allowed the population-level evaluation of temporal trends in patterns of LTPA, sleep, and sitting. This study also had some limitations. First, measurement errors may exist in self-reported LTPA, sleep duration, and daily sitting time; however, these assessments have been widely used in epidemiologic studies and were unlikely to affect the findings on the

secular trends over time. Second, the data on LTPA and sleep duration and data on daily sitting time came from different studies. Nevertheless, both NHIS and NHANES were designed to provide US nationally representative samples. Of note, the estimated populations of cancer survivors from NHIS and NHANES were similar and aligned with the estimation from the US cancer statistics [1]. Despite this, the sample sizes for the less common cancers were relatively small, in particular for sitting time analyses. Lastly, NHIS and NHANES did not collect data on clinical information (e.g., cancer stages and treatment status), hence we were not able to investigate how these factors may affect physical activity, sleep duration and daily sitting time [38].

Conclusion

More than half of US cancer survivors did not meet PAG even though the prevalence of meeting PAG for aerobic and muscle-strengthening activities both increased from 1997-2018.

Meanwhile, a considerable proportion of cancer survivors had insufficient sleep duration and prolonged sitting time. The patterns of LTPA, sleep duration, and daily sitting time varied across different cancer types.

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Table 1. Trends in Physical Activity, Sleep Duration, and Daily Sitting Time Among US Adult Cancer Survivors, NHIS 1997-2018 and NHANES 2007-2018^a

Years	Meeting Physical Activity Guidelines, % (95% CI) ^b			Sleep Duration ^c		Total Daily Sitting ^d	
	<i>Aerobic</i>	<i>Strength</i>	<i>Combined</i>	<i>h/d</i>	<i><7 h/d, % (95% CI)</i>	<i>h/d</i>	<i>≥6 h/d, % (95% CI)</i>
1997-1998	34.9 (33.1 to 36.8)	13.9 (12.8 to 15.1)	9.5 (8.4 to 10.7)				
1999-2000	35.9 (34.2 to 37.5)	13.7 (12.5 to 15.0)	10.7 (9.5 to 11.8)				
2001-2002	37.6 (35.9 to 39.2)	16.3 (15.1 to 17.5)	12.3 (11.2 to 13.4)				
2003-2004	36.8 (35.1 to 38.4)	15.7 (14.5 to 16.9)	12.1 (11.0 to 13.3)	7.28 (7.21 to 7.35)	28.4 (26.3 to 30.5)		
2005-2006	36.5 (34.7 to 38.3)	16.1 (14.8 to 17.4)	11.9 (10.7 to 13.1)	7.35 (7.29 to 7.41)	28.8 (27.2 to 30.4)		
2007-2008	38.0 (36.1 to 39.9)	17.4 (15.9 to 18.9)	12.9 (11.6 to 14.3)	7.33 (7.26 to 7.39)	27.8 (26.0 to 29.6)	6.04 (5.69 to 6.40)	50.3 (45.1 to 55.5)
2009-2010	40.6 (38.9 to 42.4)	20.1 (18.7 to 21.5)	15.4 (14.1 to 16.7)	7.33 (7.28 to 7.39)	28.8 (27.2 to 30.4)	6.53 (6.22 to 6.83)	57.6 (52.9 to 62.3)
2011-2012	42.4 (40.8 to 44.0)	20.3 (19.1 to 21.6)	16.6 (15.4 to 17.8)	7.32 (7.27 to 7.37)	28.1 (26.7 to 29.4)	6.55 (6.14 to 6.97)	57.1 (50.9 to 63.2)
2013-2014	41.4 (39.7 to 43.1)	20.1 (18.7 to 21.4)	15.5 (14.3 to 16.8)	7.24 (7.18 to 7.30)	30.4 (28.8 to 32.0)	7.43 (7.11 to 7.75)	72.3 (67.6 to 77.0)
2015-2016	43.9 (42.3 to 45.5)	20.6 (19.3 to 21.9)	16.8 (15.6 to 18.0)	7.23 (7.18 to 7.28)	29.8 (28.4 to 31.3)	6.79 (6.44 to 7.14)	58.4 (52.9 to 64.0)
2017-2018	46.5 (45.0 to 48.1)	23.1 (21.8 to 24.4)	17.9 (16.7 to 19.1)	7.22 (7.17 to 7.27)	30.8 (29.3 to 32.2)	6.39 (5.94 to 6.84)	52.7 (46.5 to 58.8)
<i>P</i> for Trend ^e	<.001	<.001	<.001	<.001	0.004	0.091	0.412
2017-2018 vs 1st ^f	11.6 (9.2 to 14)	9.2 (7.4 to 10.9)	8.4 (6.7 to 10.1)	-0.06 (-0.15 to 0.02)	2.4 (-0.2 to 4.9)	0.35 (-0.22 to 0.93)	2.42 (-5.63 to 10.5)

^aWeighted estimates and 95% CIs were estimated for each cycle. All estimates were weighted to be nationally representative

^bData on physical activity were available from NHIS 1997-2018.

^cData on sleep duration were available from NHIS 2004-2018.

^dData on total daily sitting time were available from NHANES 2005-2018

^e*P* for trend were calculated using linear regression that included the 2-year cycle as a continuous variable.

^fAn increase corresponds to difference above zero.

Table 2. Trends in Physical Activity, Sleep Duration, and Daily Sitting Time Among US Non-Cancer Adults, NHIS 1997-2018 and NHANES 2005-2018^a

Years	Meeting Physical Activity Guidelines, % (95% CI) ^b			Sleep Duration ^c		Total Daily Sitting ^d	
	Aerobic	Strength	Combined	h/d	<7 h/d, % (95% CI)	h/d	≥6 h/d, % (95% CI)
1997-1998	42.4 (41.3 to 42.4)	16.7 (10.8 to 16.7)	15.9 (15.1 to 15.9)				
1999-2000	42.7 (41.8 to 42.7)	17.4 (11.3 to 17.4)	15.8 (15.1 to 15.8)				
2001-2002	44.1 (43.1 to 44.1)	17.7 (12.0 to 17.7)	17.5 (16.8 to 17.5)				
2003-2004	43.4 (42.5 to 43.4)	20.7 (11.7 to 20.7)	17.2 (16.5 to 17.2)	7.19 (7.15 to 7.19)	29.3 (28.0 to 29.3)		
2005-2006	42.1 (41.0 to 42.1)	15.8 (9.5 to 15.8)	17.0 (16.2 to 17.0)	7.18 (7.15 to 7.18)	29.2 (28.2 to 29.2)		
2007-2008	43.4 (42.2 to 43.4)	18.8 (12.0 to 18.8)	18.1 (17.2 to 18.1)	7.19 (7.16 to 7.19)	28.3 (27.2 to 28.3)	5.63 (5.39 to 5.63)	44.0 (40.5 to 44.0)
2009-2010	48.1 (46.9 to 48.1)	25.5 (17.6 to 25.5)	20.4 (19.5 to 20.4)	7.20 (7.17 to 7.2)	29.1 (28.1 to 29.1)	5.76 (5.54 to 5.76)	46.7 (43.5 to 46.7)
2011-2012	50.1 (49.1 to 50.1)	21.3 (14.8 to 21.3)	21.2 (20.3 to 21.2)	7.18 (7.15 to 7.18)	29.6 (28.7 to 29.6)	6.42 (6.16 to 6.42)	55.0 (51.2 to 55.0)
2013-2014	50.6 (49.5 to 50.6)	18.2 (12.1 to 18.2)	21.5 (20.7 to 21.5)	7.14 (7.11 to 7.14)	31.3 (30.3 to 31.3)	7.19 (6.97 to 7.19)	66.8 (63.6 to 66.8)
2015-2016	51.7 (50.6 to 51.7)	18.9 (12.7 to 18.9)	22.4 (21.4 to 22.4)	7.08 (7.05 to 7.08)	32.8 (31.7 to 32.8)	6.64 (6.39 to 6.64)	58.0 (54.2 to 58.0)
2017-2018	54.6 (53.4 to 54.6)	26.1 (18.8 to 26.1)	24.5 (23.5 to 24.5)	7.07 (7.04 to 7.07)	33.3 (32.2 to 33.3)	5.94 (5.66 to 5.94)	48.5 (44.2 to 48.5)
<i>P</i> for Trend ^e	<.001	<.001	<.001	<.001	<.001	<.001	<.001
2017-2018 vs 1st ^f	12.1 (11.4 to 12.9)	8.3 (7.7 to 9.0)	8.5 (7.8 to 9.1)			0.28 (0.10 to 0.47)	4.10 (1.35 to 6.84)

^aWeighted estimates and 95% CIs were estimated for each cycle. All estimates were weighted to be nationally representative

^bData on physical activity were available from NHIS 1997-2018.

^cData on sleep duration were available from NHIS 2004-2018.

^dData on total daily sitting time were available from NHANES 2005-2018

^e*P* for trend were calculated using linear regression that included the 2-year cycle as a continuous variable.

^fA increase corresponds to difference above zero.

Table 3. Patterns of Physical Activity, Sleep Duration, and Daily Sitting Time Among US Cancer Survivors by Sociodemographic, Lifestyle and Cancer History^a

Characteristics	Meeting Physical Activity Guidelines, % (95% CI) ^b			Sleep Duration ^c		Daily Sitting Time ^d	
	Aerobic	Strength	Combined	h/d	<7h/d, % (95% CI)	h/d	≥6 h/d, % (95% CI)
All	40.3 (39.8 to 40.8)	18.5 (18.1 to 18.9)	14.4 (14.0 to 14.8)	7.28 (7.26 to 7.30)	29.3 (28.7 to 29.8)	6.65 (6.50 to 6.81)	58.4 (56.1 to 60.7)
Age, y							
<65	46.4 (45.6 to 47.2)	21.3 (20.7 to 21.9)	17.9 (17.3 to 18.5)	6.98 (6.96 to 7.01)	35.3 (34.4 to 36.2)	6.67 (6.41 to 6.93)	56.7 (53.1 to 60.3)
≥65	34.4 (33.7 to 35.0)	15.8 (15.3 to 16.3)	11.0 (10.5 to 11.4)	7.57 (7.54 to 7.59)	23.4 (22.8 to 24.1)	6.64 (6.47 to 6.81)	60.0 (57.2 to 62.8)
Sex							
Male	44.2 (43.4 to 45.1)	20.0 (19.3 to 20.6)	15.9 (15.3 to 16.6)	7.39 (7.36 to 7.42)	26.0 (25.1 to 26.8)	6.87 (6.62 to 7.11)	61.4 (58.1 to 64.7)
Female	37.4 (36.7 to 38.0)	17.4 (16.9 to 18)	13.3 (12.8 to 13.7)	7.20 (7.17 to 7.22)	31.8 (31.0 to 32.5)	6.48 (6.29 to 6.68)	56.0 (53.0 to 59.1)
Race/Ethnicity							
Non-Hispanic White	41.6 (41.0 to 42.2)	19.2 (18.8 to 19.7)	15.0 (14.6 to 15.5)	7.30 (7.28 to 7.33)	28.0 (27.4 to 28.6)	6.77 (6.60 to 6.95)	59.7 (57.1 to 62.2)
Non-Hispanic Black	26.8 (25.1 to 28.5)	12.5 (11.3 to 13.8)	8.4 (7.3 to 9.4)	7.18 (7.10 to 7.26)	37.2 (35.1 to 39.3)	6.50 (6.16 to 6.84)	57.1 (52.3 to 61.9)
Hispanic	33.5 (31.3 to 35.7)	13.9 (12.3 to 15.5)	10.8 (9.3 to 12.4)	7.13 (7.05 to 7.21)	35.9 (33.4 to 38.4)	4.98 (4.66 to 5.31)	38.4 (32.9 to 43.8)
Non-Hispanic Other	39.5 (36.1 to 42.9)	16.2 (13.7 to 18.8)	12.8 (10.4 to 15.2)	7.05 (6.92 to 7.18)	39.3 (35.5 to 43.0)	6.48 (5.89 to 7.08)	59.7 (49.3 to 70.1)
Educational level							
<High school	20.8 (19.7 to 21.8)	6.8 (6.2 to 7.5)	3.9 (3.4 to 4.4)	7.49 (7.42 to 7.56)	31.9 (30.4 to 33.5)	6.02 (5.71 to 6.32)	51.4 (46.7 to 56.2)
High school	31.2 (30.3 to 32.1)	12.1 (11.4 to 12.7)	8.1 (7.5 to 8.7)	7.31 (7.26 to 7.35)	30.7 (29.6 to 31.8)	6.18 (5.86 to 6.50)	52.3 (47.4 to 57.1)
>High school	49.9 (49.1 to 50.6)	24.8 (24.2 to 25.4)	20.2 (19.6 to 20.8)	7.22 (7.20 to 7.25)	28.0 (27.2 to 28.7)	6.92 (6.72 to 7.11)	61.6 (58.7 to 64.5)
Family Poverty Ratio							
<1.5	25.6 (24.5 to 26.6)	10.0 (9.4 to 10.7)	6.3 (5.7 to 6.9)	7.16 (7.10 to 7.21)	37.6 (36.3 to 38.9)	6.48 (6.20 to 6.75)	56.8 (52.8 to 60.9)
1.5-<3.5	33.6 (32.9 to 34.4)	14.4 (13.9 to 15)	10.1 (9.6 to 10.6)	7.37 (7.34 to 7.41)	29.1 (28.3 to 30.0)	6.41 (6.17 to 6.66)	55.9 (52.4 to 59.4)
≥3.5	53.4 (52.5 to 54.3)	26.4 (25.6 to 27.1)	22.2 (21.5 to 22.9)	7.25 (7.22 to 7.28)	25.9 (25.0 to 26.8)	6.92 (6.67 to 7.17)	61.1 (57.3 to 64.9)
Body mass index, kg/m ²							
<25	44.0 (43.1 to 44.9)	22.5 (21.7 to 23.2)	17.9 (17.2 to 18.6)	7.38 (7.35 to 7.42)	26.8 (25.8 to 27.7)	6.18 (5.91 to 6.45)	53.2 (48.8 to 57.7)
25 - <30	43.6 (42.7 to 44.5)	19.3 (18.6 to 20.0)	15.3 (14.6 to 15.9)	7.29 (7.26 to 7.32)	27.5 (26.6 to 28.5)	6.38 (6.11 to 6.65)	54.5 (50.5 to 58.6)
≥30	31.9 (30.9 to 32.8)	12.8 (12.2 to 13.5)	9.1 (8.5 to 9.7)	7.16 (7.12 to 7.19)	34.0 (32.9 to 35.1)	7.21 (6.94 to 7.48)	65.4 (61.8 to 69.1)
Smoking status							
Never smoker	42.8 (42.1 to 43.6)	20.8 (20.2 to 21.4)	16.6 (16.0 to 17.2)	7.27 (7.24 to 7.30)	28.2 (27.3 to 29.0)	6.72 (6.50 to 6.94)	59.4 (56.0 to 62.7)
Former smoker	40.9 (40.1 to 41.7)	18.9 (18.2 to 19.6)	14.4 (13.8 to 15.0)	7.42 (7.38 to 7.45)	26.3 (25.4 to 27.2)	6.74 (6.48 to 7.00)	60.0 (56.3 to 63.7)
Current smoker	31.4 (30.1 to 32.6)	10.9 (10.1 to 11.7)	7.6 (6.9 to 8.3)	6.97 (6.91 to 7.02)	40.5 (38.9 to 42.2)	6.24 (5.85 to 6.63)	51.6 (45.8 to 57.4)
Diabetes mellitus							
No	42.5 (41.9 to 43.1)	19.7 (19.3 to 20.2)	15.7 (15.3 to 16.1)	7.26 (7.24 to 7.28)	28.8 (28.1 to 29.4)	6.58 (6.40 to 6.75)	57.5 (54.9 to 60.0)
Yes	28.0 (26.8 to 29.2)	11.8 (11.0 to 12.7)	7.3 (6.6 to 8.0)	7.39 (7.33 to 7.45)	31.8 (30.4 to 33.2)	6.98 (6.64 to 7.32)	62.4 (57.8 to 67.0)
Cardiovascular diseases							

No	44.1 (43.4 to 44.7)	20.2 (19.7 to 20.7)	16.4 (15.9 to 16.8)	7.22 (7.20 to 7.25)	28.8 (28.1 to 29.5)	6.57 (6.39 to 6.75)	57.0 (54.4 to 59.6)
Yes	31.4 (30.5 to 32.3)	14.5 (13.9 to 15.2)	9.8 (9.2 to 10.4)	7.41 (7.37 to 7.46)	30.3 (29.3 to 31.3)	6.99 (6.69 to 7.29)	64.2 (59.7 to 68.7)
Number of cancer types							
1	41.0 (40.4 to 41.5)	18.8 (18.3 to 19.2)	14.7 (14.3 to 15.1)	7.26 (7.24 to 7.28)	29.3 (28.7 to 29.9)	6.62 (6.45 to 6.78)	57.6 (55.2 to 60.0)
≥2	35.9 (34.4 to 37.4)	17.0 (15.9 to 18.1)	12.1 (11.1 to 13.1)	7.41 (7.34 to 7.48)	28.9 (27.3 to 30.5)	6.95 (6.54 to 7.37)	65.5 (58.8 to 72.2)
Age at cancer diagnosis, y							
≥40	39.4 (38.8 to 40.0)	17.7 (17.2 to 18.1)	13.5 (13.1 to 13.9)	7.38 (7.35 to 7.40)	26.6 (26.0 to 27.3)	6.74 (6.56 to 6.92)	59.9 (57.3 to 62.6)
15-39	45.0 (43.9 to 46.2)	22.1 (21.2 to 23.1)	18.3 (17.4 to 19.2)	6.93 (6.89 to 6.98)	38.5 (37.2 to 39.9)	6.31 (5.94 to 6.68)	53.9 (48.4 to 59.4)
0-14	35.2 (31.2 to 39.1)	16.8 (13.9 to 19.8)	12.4 (9.9 to 14.9)	7.21 (7.06 to 7.36)	32.7 (28.4 to 37.0)	6.34 (5.03 to 7.65)	50.8 (29.4 to 72.2)
Time since cancer diagnosis, y							
0-1	38.5 (37.1 to 39.9)	16.6 (15.6 to 17.6)	12.9 (12.0 to 13.8)	7.33 (7.27 to 7.38)	29.1 (27.6 to 30.6)	7.02 (6.51 to 7.54)	60.3 (54.2 to 66.4)
2-5	42.4 (41.3 to 43.4)	19.4 (18.6 to 20.2)	15.7 (14.9 to 16.4)	7.26 (7.22 to 7.30)	29.0 (27.9 to 30.2)	6.63 (6.30 to 6.95)	58.6 (53.6 to 63.6)
6-10	42.4 (41.2 to 43.6)	19.2 (18.3 to 20.1)	15.1 (14.2 to 15.9)	7.30 (7.26 to 7.34)	27.9 (26.7 to 29.1)	6.74 (6.45 to 7.02)	58.5 (54.2 to 62.7)
11-15	41.8 (40.3 to 43.2)	19.4 (18.2 to 20.6)	15.1 (14.0 to 16.2)	7.28 (7.22 to 7.33)	29.4 (27.8 to 30.9)	6.56 (6.15 to 6.96)	56.0 (49.8 to 62.2)
≥16	37.6 (36.6 to 38.6)	18.1 (17.3 to 18.9)	13.5 (12.8 to 14.2)	7.25 (7.21 to 7.29)	30.6 (29.5 to 31.7)	6.38 (6.11 to 6.66)	58.2 (53.4 to 62.9)

^aWeighted estimates and 95% CIs were estimated for each cycle. All estimates were weighted to be nationally representative

^bData on physical activity were available from NHIS 1997-2018.

^cData on sleep duration were available from NHIS 2004-2018.

^dData on total daily sitting time were available from NHANES 2005-2018

Table 4. Regression Models of Physical Activity, Sleep Duration, and Daily Sitting Time Among US Cancer Survivors, Adjusting for Sociodemographic and Lifestyle Characteristics, NHIS 1997-2018 and NHANES 2005-2018^a

Patient Characteristics	Meeting Physical Activity Guidelines, OR (95% CI) ^b			Sleep Duration ^c		Daily Sitting Time ^d	
	Aerobic	Strength	Combined	h/d, β (95% CI)	<7h/d, OR (95% CI)	h/d, β (95% CI)	≥ 6 h/d, OR (95% CI)
Age, y							
<65	1 [reference]	1 [reference]	1 [reference]	0 [reference]	1 [reference]	0 [reference]	1 [reference]
≥ 65	0.70 (0.67 to 0.74)	0.82 (0.77 to 0.88)	0.71 (0.66 to 0.77)	0.44 (0.39 to 0.48)	0.61 (0.57 to 0.66)	-0.12 (-0.52 to 0.28)	1.06 (0.81 to 1.38)
Sex							
Male	1 [reference]	1 [reference]	1 [reference]	0 [reference]	1 [reference]	0 [reference]	1 [reference]
Female	0.72 (0.68 to 0.76)	0.82 (0.77 to 0.87)	0.75 (0.70 to 0.80)	-0.11 (-0.15 to -0.06)	1.19 (1.12 to 1.26)	-0.28 (-0.63 to 0.07)	0.85 (0.68 to 1.06)
Race/Ethnicity							
Non-Hispanic White	1 [reference]	1 [reference]	1 [reference]	0 [reference]	1 [reference]	0 [reference]	1 [reference]
Non-Hispanic Black	0.67 (0.61 to 0.74)	0.84 (0.74 to 0.95)	0.75 (0.64 to 0.88)	-0.07 (-0.15 to 0.02)	1.29 (1.16 to 1.43)	-0.3 (-0.71 to 0.11)	0.89 (0.69 to 1.14)
Hispanic	0.91 (0.81 to 1.01)	0.88 (0.76 to 1.02)	0.93 (0.78 to 1.11)	-0.13 (-0.21 to -0.04)	1.21 (1.08 to 1.37)	-1.67 (-2.1 to -1.23)	0.45 (0.33 to 0.61)
Non-Hispanic Other	0.89 (0.76 to 1.05)	0.75 (0.61 to 0.91)	0.77 (0.61 to 0.97)	-0.20 (-0.33 to -0.07)	1.60 (1.36 to 1.90)	0.03 (-0.68 to 0.75)	1.15 (0.70 to 1.89)
Educational level							
<High school	1 [reference]	1 [reference]	1 [reference]	0 [reference]	1 [reference]	0 [reference]	1 [reference]
High school	1.40 (1.29 to 1.52)	1.56 (1.38 to 1.76)	1.65 (1.41 to 1.93)	-0.19 (-0.27 to -0.10)	1.03 (0.94 to 1.13)	-0.06 (-0.53 to 0.42)	0.90 (0.66 to 1.21)
>High school	2.40 (2.22 to 2.59)	2.92 (2.61 to 3.28)	3.47 (3.00 to 4.01)	-0.25 (-0.33 to -0.17)	0.97 (0.89 to 1.06)	0.69 (0.25 to 1.13)	1.39 (1.05 to 1.83)
Family poverty income ratio							
<1.5	1 [reference]	1 [reference]	1 [reference]	0 [reference]	1 [reference]	0 [reference]	1 [reference]
1.5- <3.5	1.21 (1.13 to 1.29)	1.20 (1.10 to 1.32)	1.30 (1.16 to 1.46)	0.15 (0.08 to 0.21)	0.80 (0.74 to 0.86)	-0.33 (-0.72 to 0.07)	0.84 (0.65 to 1.09)
≥ 3.5	1.93 (1.80 to 2.08)	1.84 (1.68 to 2.02)	2.20 (1.96 to 2.46)	0.13 (0.06 to 0.19)	0.68 (0.63 to 0.74)	0.01 (-0.44 to 0.46)	0.94 (0.70 to 1.26)
Body mass index, kg/m ²							
<25	1 [reference]	1 [reference]	1 [reference]	0 [reference]	1 [reference]	0 [reference]	1 [reference]
25 - <30	0.93 (0.88 to 0.99)	0.78 (0.74 to 0.84)	0.78 (0.73 to 0.84)	-0.14 (-0.19 to -0.10)	1.12 (1.04 to 1.20)	0.26 (-0.13 to 0.65)	1.05 (0.81 to 1.36)
≥ 30	0.61 (0.57 to 0.65)	0.52 (0.48 to 0.56)	0.48 (0.43 to 0.52)	-0.23 (-0.28 to -0.17)	1.35 (1.26 to 1.45)	1.08 (0.69 to 1.47)	1.70 (1.30 to 2.21)
Smoking status							
Never smoker	1 [reference]	1 [reference]	1 [reference]	0 [reference]	1 [reference]	0 [reference]	1 [reference]
Former smoker	1.00 (0.95 to 1.05)	0.97 (0.92 to 1.04)	0.96 (0.90 to 1.03)	0.04 (0 to 0.08)	1.00 (0.94 to 1.07)	-0.05 (-0.42 to 0.31)	0.97 (0.77 to 1.22)
Current smoker	0.63 (0.59 to 0.68)	0.51 (0.46 to 0.56)	0.45 (0.40 to 0.51)	-0.21 (-0.27 to -0.14)	1.44 (1.33 to 1.57)	-0.20 (-0.68 to 0.29)	0.89 (0.65 to 1.23)
Diabetes mellitus							
No	1 [reference]	1 [reference]	1 [reference]	0 [reference]	1 [reference]	0 [reference]	1 [reference]
Yes	0.75 (0.70 to 0.80)	0.79 (0.72 to 0.86)	0.67 (0.60 to 0.75)	0.07 (0 to 0.13)	1.11 (1.03 to 1.20)	0.18 (-0.22 to 0.58)	1.06 (0.82 to 1.37)
Cardiovascular diseases							
No	1 [reference]	1 [reference]	1 [reference]	0 [reference]	1 [reference]	0 [reference]	1 [reference]

Yes	0.74 (0.70 to 0.78)	0.86 (0.80 to 0.91)	0.77 (0.71 to 0.83)	0.04 (-0.01 to 0.08)	1.19 (1.12 to 1.27)	0.41 (0.03 to 0.79)	1.26 (0.98 to 1.62)
Number of cancer types							
1	1 [reference]	1 [reference]	1 [reference]	0 [reference]	1 [reference]	0 [reference]	1 [reference]
2	0.89 (0.82 to 0.96)	0.97 (0.88 to 1.06)	0.91 (0.81 to 1.01)	0.06 (-0.01 to 0.14)	1.05 (0.95 to 1.15)	0.11 (-0.37 to 0.59)	1.26 (0.88 to 1.81)
3	0.67 (0.52 to 0.85)	0.61 (0.47 to 0.78)	0.54 (0.39 to 0.75)	0.13 (-0.08 to 0.34)	1.05 (0.84 to 1.30)	1.14 (-0.01 to 2.28)	1.50 (0.70 to 3.19)
Age at cancer diagnosis, y							
≥40	1 [reference]	1 [reference]	1 [reference]	0 [reference]	1 [reference]	0 [reference]	1 [reference]
15-39	1.21 (1.13 to 1.30)	1.32 (1.21 to 1.43)	1.37 (1.25 to 1.50)	-0.14 (-0.20 to -0.09)	1.28 (1.18 to 1.39)	-0.15 (-0.66 to 0.35)	0.88 (0.64 to 1.21)
0-14	0.92 (0.75 to 1.13)	1.07 (0.84 to 1.36)	1.07 (0.82 to 1.38)	-0.01 (-0.17 to 0.15)	1.08 (0.88 to 1.33)	0.10 (-1.14 to 1.35)	0.83 (0.35 to 1.99)
Time since cancer diagnosis, y							
0-1	1 [reference]	1 [reference]	1 [reference]	0 [reference]	1 [reference]	0 [reference]	1 [reference]
2-5	1.18 (1.09 to 1.27)	1.21 (1.10 to 1.33)	1.27 (1.14 to 1.41)	-0.06 (-0.13 to 0)	1.00 (0.91 to 1.10)	-0.35 (-0.98 to 0.27)	0.98 (0.69 to 1.39)
6-10	1.19 (1.10 to 1.29)	1.19 (1.08 to 1.31)	1.20 (1.08 to 1.35)	-0.04 (-0.11 to 0.03)	0.95 (0.86 to 1.05)	-0.30 (-0.92 to 0.33)	0.95 (0.67 to 1.35)
11-15	1.15 (1.05 to 1.26)	1.18 (1.05 to 1.31)	1.18 (1.04 to 1.34)	-0.07 (-0.15 to 0)	1.03 (0.92 to 1.14)	-0.42 (-1.07 to 0.23)	0.87 (0.59 to 1.28)
≥16	1.04 (0.96 to 1.13)	1.11 (1.00 to 1.23)	1.08 (0.96 to 1.22)	-0.09 (-0.16 to -0.02)	1.01 (0.91 to 1.11)	-0.68 (-1.28 to -0.08)	0.90 (0.63 to 1.29)

^a All estimates were weighted to be nationally representative. The multivariable regression models were adjusted for age, sex, race/ethnicity, education level, family poverty income ratio, body mass index, smoking status, history of diabetes, cardiovascular diseases, number of cancer types, age at cancer diagnosis, and time since cancer diagnosis.

^bData on physical activity were available from NHIS 1997-2018.

^cData on sleep duration were available from NHIS 2004-2018.

^dData on total daily sitting time were available from NHANES 2005-2018

Table 5. Patterns of Physical Activity, Sleep Duration and Daily Sitting Time by Cancer Types Among US Adult Cancer Survivors, NHIS 1997-2018 and NHANES 2007-2018^a

Cancer Types	Meeting Physical Activity Guidelines, % (95% CI) ^b			Sleep Duration ^c		Daily Sitting Time ^d	
	Aerobic	Strength	Combined	h/d	<7h/d, % (95% CI)	h/d	≥6 h/d, % (95% CI)
All Types	40.3 (39.8 to 40.8)	18.5 (18.1 to 18.9)	14.4 (14.0 to 14.8)	7.28 (7.26 to 7.30)	29.3 (28.7 to 29.8)	6.65 (6.50 to 6.81)	58.4 (56.1 to 60.7)
Oral Cavity & Pharynx							
<i>Mouth/Tongue/Lips</i>	35.1 (28.0 to 42.1)	14.8 (9.0 to 20.5)	10.8 (5.5 to 16.0)	7.16 (6.78 to 7.54)	36.6 (27.7 to 45.4)	7.68 (5.47 to 9.89)	61.1 (24.5 to 97.8)
<i>Pharynx</i>	28.7 (23.9 to 33.4)	14.0 (10.3 to 17.6)	7.7 (5.1 to 10.4)	7.50 (7.27 to 7.73)	27.4 (21.8 to 33)	NA NA	NA NA
Digestive System							
<i>Esophagus</i>	26.6 (19.7 to 33.5)	9.8 (5.6 to 14.0)	6.2 (2.9 to 9.5)	7.46 (7.13 to 7.79)	30.8 (22.1 to 39.4)	7.65 (5.62 to 9.67)	68.0 (43.9 to 92.2)
<i>Stomach</i>	27.2 (21.9 to 32.4)	8.7 (5.5 to 11.9)	5.8 (3.0 to 8.5)	7.55 (7.16 to 7.93)	30.5 (24.3 to 36.7)	5.78 (4.60 to 6.97)	45.8 (20.6 to 70.9)
<i>Colon</i>	30.7 (28.7 to 32.7)	12.8 (11.5 to 14.2)	8.7 (7.5 to 9.9)	7.47 (7.37 to 7.56)	29.1 (26.8 to 31.4)	6.85 (6.16 to 7.55)	64.2 (56.6 to 71.8)
<i>Rectum</i>	29.0 (22.6 to 35.4)	14.9 (9.8 to 19.9)	9.3 (4.9 to 13.6)	7.21 (6.90 to 7.53)	34.5 (26.2 to 42.9)	5.52 (4.22 to 6.82)	44.0 (11.8 to 76.1)
<i>Liver</i>	19.7 (14.8 to 24.6)	12.1 (7.7 to 16.5)	6.1 (3.0 to 9.2)	7.42 (7.07 to 7.77)	36.2 (28.8 to 43.7)	7.68 (6.04 to 9.33)	73.7 (53.3 to 94.0)
<i>Gallbladder</i>	23.0 (6.5 to 39.5)	13.0 (0 to 28.1)	7.5 (0 to 21.7)	7.16 (6.17 to 8.14)	37.4 (16.8 to 58)	NA NA	NA NA
<i>Pancreas</i>	29.5 (22.3 to 36.7)	13.9 (8.3 to 19.5)	9.1 (4.7 to 13.5)	7.62 (7.14 to 8.11)	29.7 (21.7 to 37.7)	9.13 (6.19 to 12.1)	88.7 (72.2 to 100)
Respiratory System							
<i>Larynx/Trachea</i>	26.0 (17.8 to 34.3)	8.7 (3.8 to 13.7)	6.3 (1.7 to 10.9)	7.28 (6.91 to 7.65)	28.1 (17.8 to 38.4)	6.67 (4.24 to 9.10)	59.4 (26.2 to 92.6)
<i>Lung</i>	20.9 (18.6 to 23.3)	10.8 (8.9 to 12.7)	6.3 (4.8 to 7.8)	7.63 (7.48 to 7.77)	27.4 (24.4 to 30.5)	7.08 (6.25 to 7.90)	71.6 (59.0 to 84.1)
Musculoskeletal System							
<i>Bone</i>	24.7 (19.9 to 29.6)	16.1 (11.7 to 20.5)	10.4 (6.9 to 13.9)	7.64 (7.30 to 7.97)	34.6 (28.3 to 40.8)	8.24 (6.13 to 10.4)	69.4 (42.5 to 96.2)
<i>Soft Tissue</i>	38.0	16.8	13.5	7.18	31.0	NA	NA

	(30.4 to 45.6)	(11.0 to 22.6)	(8.0 to 19.1)	(6.95 to 7.42)	(23.0 to 39.0)	N	NA
Skin							
<i>Melanoma</i>	48.2 (46.1 to 50.2)	22.7 (21.0 to 24.4)	18.8 (17.2 to 20.4)	7.25 (7.19 to 7.32)	26.8 (24.7 to 28.8)	6.78 (6.22 to 7.34)	62.1 (54.2 to 70.1)
<i>Skin Cancer (non-melanoma)</i>	50.7 (49.5 to 52.0)	25.2 (24.2 to 26.3)	20.6 (19.6 to 21.6)	7.28 (7.24 to 7.32)	25.3 (24.1 to 26.5)	6.64 (6.33 to 6.94)	58.6 (53.3 to 63.9)
<i>Skin Cancer (unknown kind)</i>	40.1 (38.3 to 41.9)	17.0 (15.7 to 18.3)	13.1 (11.9 to 14.3)	7.35 (7.28 to 7.42)	27.6 (25.7 to 29.5)	6.88 (6.42 to 7.33)	64.2 (57.2 to 71.3)
Breast	35.7 (34.5 to 36.9)	16.5 (15.6 to 17.5)	12.3 (11.5 to 13.1)	7.29 (7.24 to 7.33)	28.4 (27.1 to 29.7)	6.58 (6.24 to 6.93)	58.0 (52.1 to 63.9)
Reproductive System							
<i>Cervix</i>	39.7 (37.8 to 41.7)	17.9 (16.3 to 19.4)	13.8 (12.4 to 15.3)	6.81 (6.73 to 6.89)	44.8 (42.4 to 47.2)	6.35 (5.71 to 6.99)	54.9 (46.1 to 63.6)
<i>Uterus</i>	31.6 (29.4 to 33.8)	13.7 (12.1 to 15.3)	9.8 (8.3 to 11.2)	7.09 (6.98 to 7.19)	37.7 (34.8 to 40.5)	5.66 (5.12 to 6.20)	52.9 (41.9 to 63.9)
<i>Ovary</i>	35.1 (31.9 to 38.3)	16.1 (13.6 to 18.5)	12.3 (10.1 to 14.6)	6.91 (6.78 to 7.04)	41.6 (37.6 to 45.6)	6.98 (5.96 to 8.00)	64.5 (51.3 to 77.8)
<i>Prostate</i>	43.0 (41.5 to 44.5)	18.3 (17.1 to 19.4)	13.9 (12.8 to 15.0)	7.51 (7.45 to 7.57)	23.6 (22.1 to 25.1)	6.79 (6.38 to 7.19)	58.3 (52.5 to 64.1)
<i>Testis</i>	49.4 (43.3 to 55.4)	25.6 (20.7 to 30.5)	21.7 (16.9 to 26.4)	7.04 (6.81 to 7.27)	31.4 (24.6 to 38.2)	6.90 (4.78 to 9.03)	54.2 (22.4 to 86.1)
Urinary System							
<i>Bladder</i>	34.5 (31.4 to 37.7)	12.2 (10.2 to 14.2)	8.6 (6.8 to 10.3)	7.47 (7.31 to 7.62)	26.4 (23 to 29.8)	7.08 (6.26 to 7.91)	63.8 (51.7 to 75.9)
<i>Kidney</i>	30.4 (27.0 to 33.9)	12.9 (10.4 to 15.3)	8.8 (6.8 to 10.9)	7.34 (7.19 to 7.48)	30.1 (26 to 34.1)	6.94 (5.85 to 8.04)	57.4 (42.6 to 72.1)
Brain	30.3 (24.7 to 35.9)	17.6 (13.1 to 22.1)	14.8 (10.5 to 19.1)	7.79 (7.46 to 8.12)	26.4 (20.2 to 32.6)	6.09 (3.76 to 8.41)	47.1 (15.2 to 78.9)
Endocrine System							
<i>Thyroid</i>	44.0 (40.6 to 47.5)	20.9 (18.0 to 23.7)	17.1 (14.4 to 19.8)	7.01 (6.89 to 7.13)	36.0 (32.1 to 39.9)	5.79 (4.78 to 6.80)	43.5 (28.9 to 58.2)
<i>Lymphoma</i>	40.7 (37.7 to 43.7)	20.6 (18.2 to 23.1)	16.0 (13.8 to 18.3)	7.35 (7.23 to 7.47)	28.9 (25.8 to 32.1)	6.46 (5.43 to 7.49)	50.9 (36.8 to 65.0)
Blood							
<i>Leukemia</i>	36.0	17.1	13.4	7.41	28.8	7.14	58.6

	(31.4 to 40.7)	(13.2 to 21.0)	(9.8 to 17.1)	(7.23 to 7.60)	(23.8 to 33.8)	(5.85 to 8.43)	(39.3 to 77.9)
<i>Blood Cancer</i>	36.2	17.1	14.1	7.58	31.1	7.87	94.5
	(28.4 to 44.1)	(10.9 to 23.2)	(8.0 to 20.2)	(7.19 to 7.97)	(23.2 to 39)	(5.52 to 10.2)	(81 to 100)
Other	38.9	17.1	13.1	7.26	31.2	7.07	60.5
	(36.5 to 41.2)	(15.4 to 18.9)	(11.5 to 14.7)	(7.16 to 7.36)	(28.6 to 33.8)	(6.22 to 7.93)	(50.9 to 70.1)

^aWeighted estimates and 95% CIs were estimated for each cycle. All estimates were weighted to be nationally representative

^bData on physical activity were available from NHIS 1997-2018.

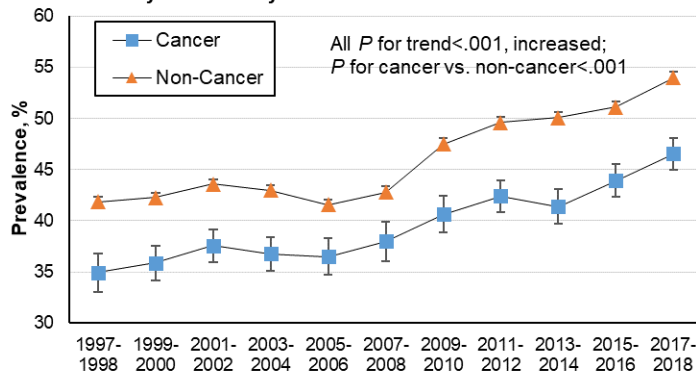
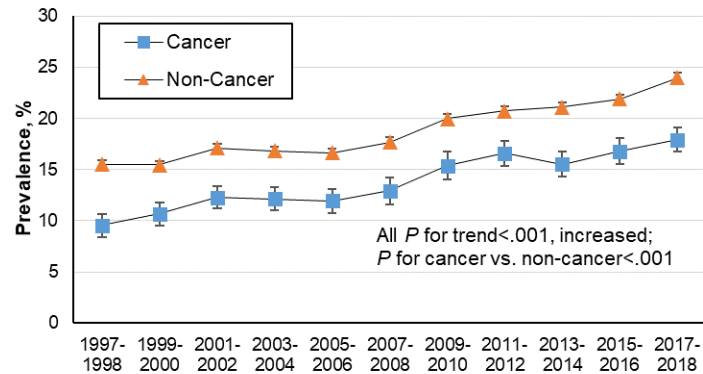
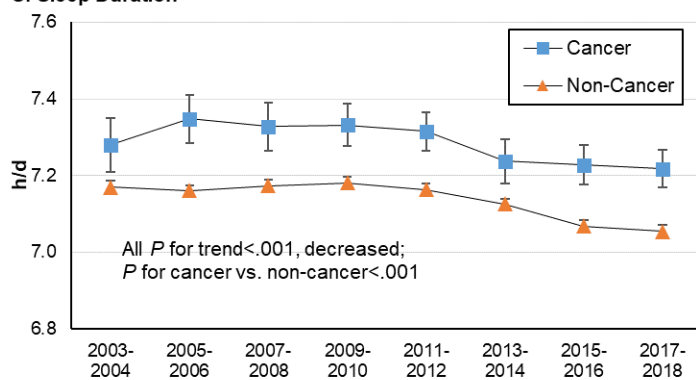
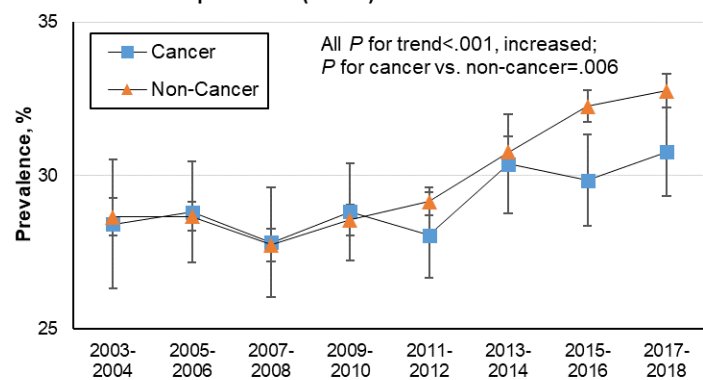
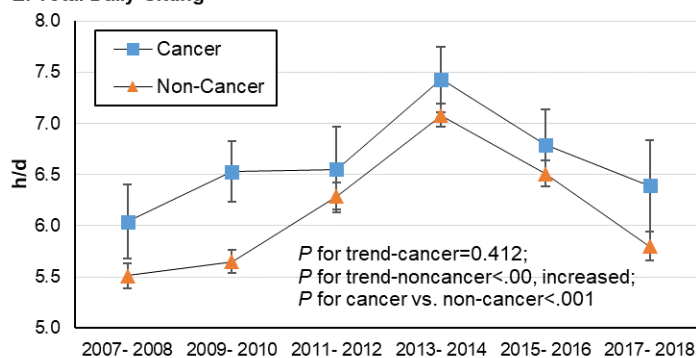
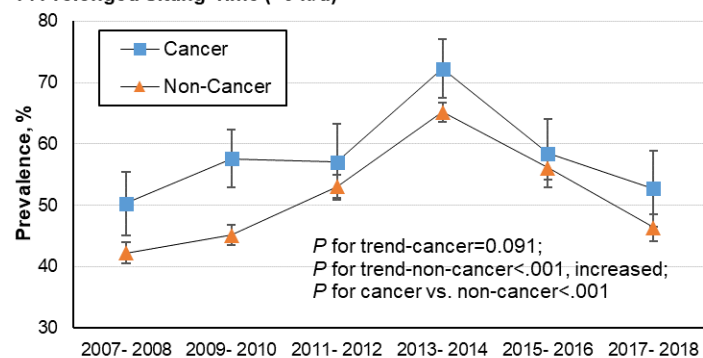
^cData on sleep duration were available from NHIS 2004-2018.

^dData on total daily sitting time were available from NHANES 2005-2018

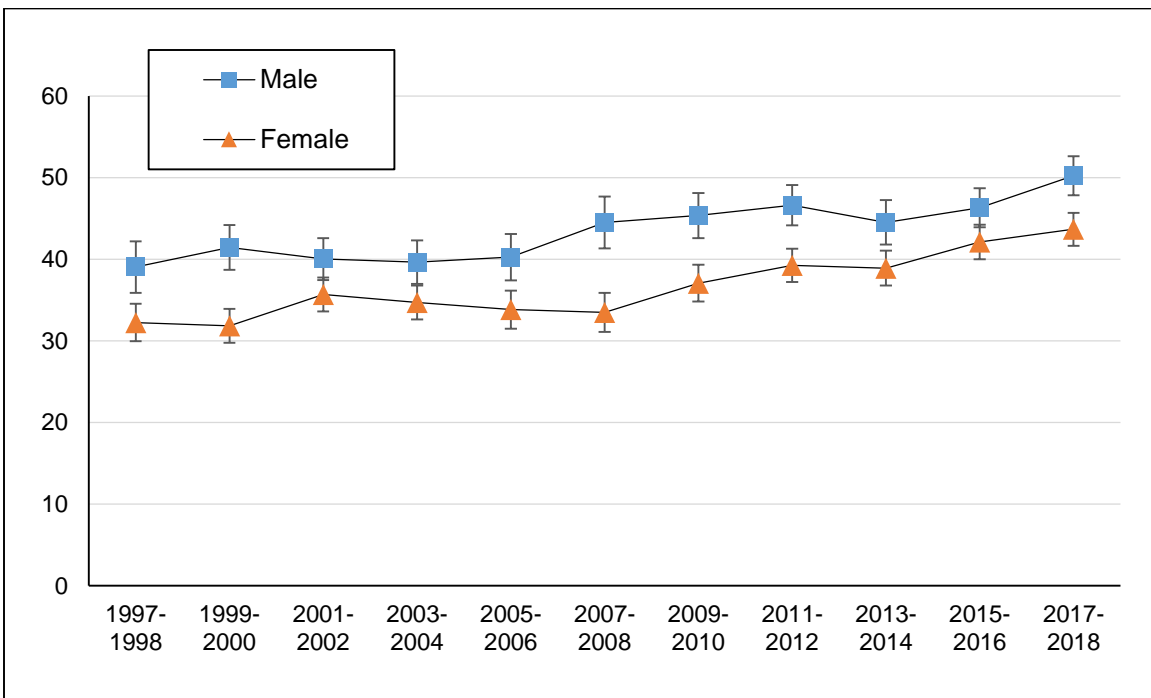
Figure 1. Trends in Physical Activity, Sleep Duration, and Daily Sitting Time Among US Cancer Survivors and Non-Cancer Adults, NHIS 1997-2018 and NHANES 2007-2018

Data were weighted to be nationally representative. Error bars indicate 95% CIs. NHIS, National Health Interview Survey. NHANES, National Health and Nutrition Examination Survey.

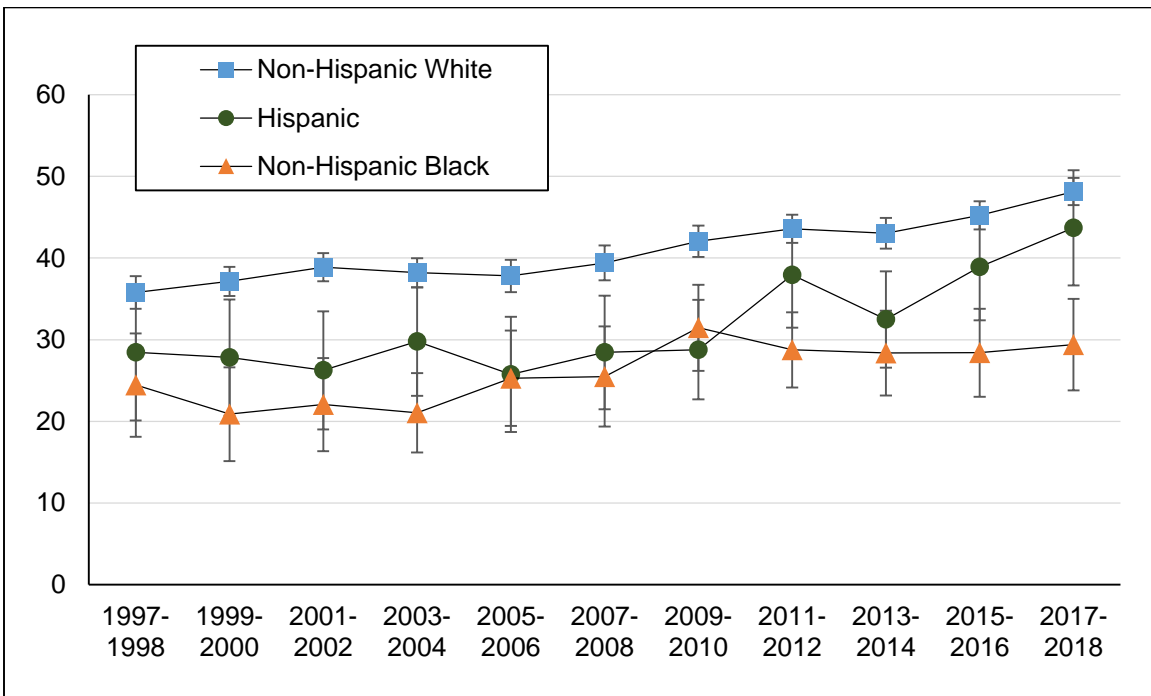
Figure 2. Trends in Prevalence of Meeting Aerobic Physical Activity Guidelines Among US Cancer Survivors, 1997-2018

A. Aerobic Physical Activity Guideline**B. Aerobic and Strength Physical Activity Guidelines****C. Sleep Duration****D. Insufficient Sleep Duration (<7 h/d)****E. Total Daily Sitting****F. Prolonged Sitting Time (>6 h/d)**

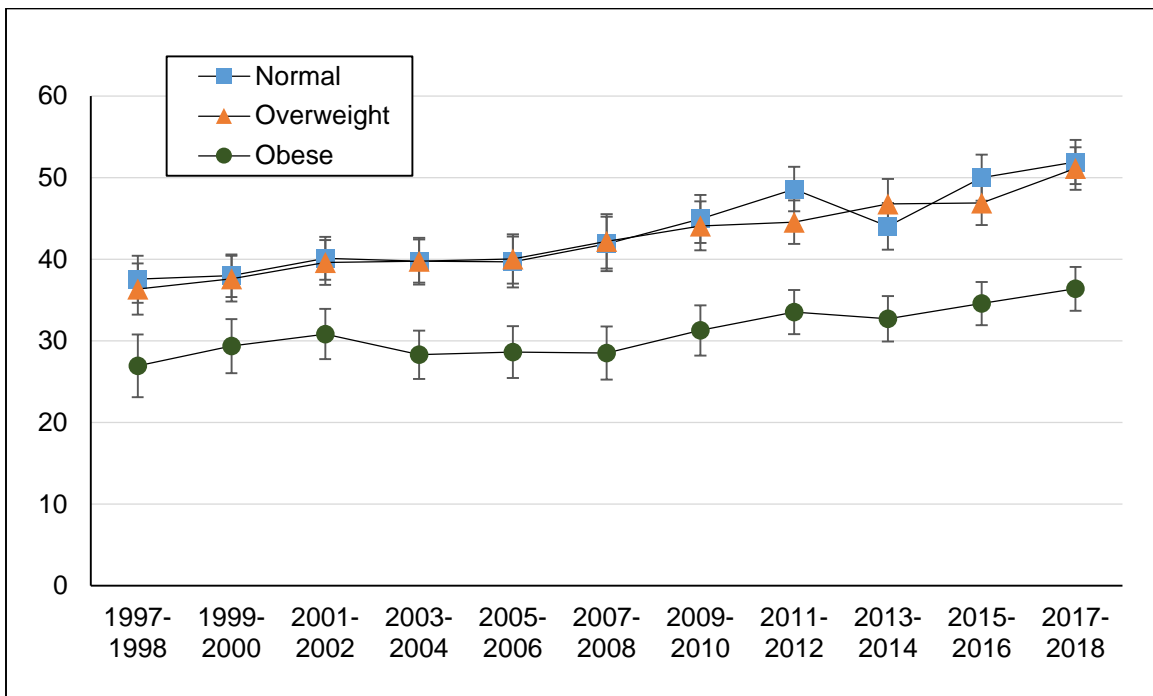
A. By Sex



B. By Race/Ethnicity



C. By Weight Status



D. By Time Since Cancer Diagnosis

