

Research Article

Healthy Behavioral Choices and Adherence to Recommended Cancer Screening among US Adults: National Health Interview Survey 2005

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Abstract

Purpose: We investigated associations of healthy behaviors and cancer screening in a large sample from the US population.

Methods: This analysis used the data from 2005 National Health Interview Survey and included adults at age ≥ 18 years that completed the cancer questionnaires (15,995,240 cancer survivors and 201,590,979 respondents without cancer). Self-reported information on cancer history, healthy behaviors (body mass index [BMI], smoking, alcohol use, physical activity, fruit/vegetable consumption, and sunscreen use) was extracted from survey questionnaires. We examined associations of healthy behaviors and screening practices with survivorship status, overall and by gender.

Results: Overall, cancer survivors were more likely to be obese, to be current or former smokers, to use sunscreen regularly, and to follow recommended cancer screenings. Female cancer survivors were more likely to be former or current smokers as compared to their cancer-free counterparts (former: OR=1.43, 95%CI 1.22-1.69; current: OR=1.74, 95%CI 1.44-2.10), more likely to consume alcohol below the recommended limit (OR=1.20, 95%CI 1.01-1.43) and to follow recommended cancer screenings. Male cancer survivors were more likely to be former smokers (OR=1.24, 95%CI 1.03-1.50) and to have inadequate fruit/vegetable intake (OR=1.36, 95%CI 1.03-1.80).

Conclusion: Certain cancer survivor groups can benefit from tailored preventive services addressing concerns related to selected healthy behaviors and screening practices.

Keywords: Healthy behaviors; Screening practices; Population-based survey; Cancer survivors.

Abbreviations

BMI: Body Mass Index; CI: Confidence Interval; NHIS: National Health Interview Survey; OR: Odds Ratio; PSA: Prostate-Specific Antigen; US: United States

Introduction

According to the American Cancer Society, over 1.7 million new cancer cases are expected in 2014 [1]. Recent advances in cancer detection and treatment resulted in improved survival for many tumor sites which increased the prevalence of cancer survivors [2]. Cancer survivors have a greater risk of second primary cancers and other co-morbidities including obesity, cardiovascular disease and hypertension, osteoporosis, and diabetes [3-7]. Healthy lifestyle choices help to manage long-term health consequences of cancer, by controlling and preventing the incidence of these conditions [8-10]. Recommended healthy behaviors such as increased physical activity, proper nutrition, refraining from tobacco and alcohol use, maintaining a healthy weight, and adherence to recommended cancer screening guidelines have shown to reduce incidence of adverse health outcomes and to improve overall quality of life among cancer survivors [1,11-13].

Despite the potential benefits of healthy behaviors cancer survivors do not always adhere to these guidelines [13-15]. Further, the evidence on differences in healthy behaviors by gender is limited. We hypothesized that cancer survivors and respondents without a cancer history will differ with respect to selected healthy behaviors. The objective of this analysis was to describe the overall and gender-specific associations of healthy behaviors and adherence to recommended screening practices with cancer survivorship status in a population-based sample of US adults. Understanding these differences may help to develop tailored public health interventions to ensure long-term health benefits among cancer survivors.

Methods

Survey population and design

The National Health Interview Survey (NHIS) is a cross-sectional household survey administered to the non-institutionalized U.S. population by the National Center for Health Statistics of the Centers for Disease Control and Prevention to monitor the health of the U.S. population and to collect data for epidemiologic studies and policy analyses to address ongoing public health issues [16].

The survey utilizes a multistage probability sample design that

has been previously described in detail [16]. The NHIS questionnaire collects information on basic health and demographics (core questionnaire), healthcare access and utilization, health insurance, and income and assets, and on current health topics. The data are collected separately from adults and children in each family. The 2005 NHIS survey includes a supplement that covers a variety of cancer-related topics such as diet, physical activity, tobacco and alcohol use, and cancer screening.

Study population

This analysis uses 2005 NHIS data and is limited to adult participants (age 18 and older) who completed the cancer questionnaires. Participants who reported a history of cancer were referred to as cancer survivors. Participants reporting no prior cancer diagnosis were referred to as respondents without cancer. From 31,428 adults who completed the survey, we excluded 21(0.1%) individuals with missing cancer history. The final sample for this analysis included 2,428 cancer survivors and 28,969 respondents without cancer.

Healthy behaviors and cancer screening

We selected the following indicators of healthy behaviors to compare cancer survivors and respondents without cancer: body mass index (BMI), smoking status, alcohol use, physical activity, fruit/vegetable consumption, sunscreen use, and compliance with recommended screening. Self-reported height and weight were used to calculate BMI (kg/m^2). BMI categories were defined as ≤ 24.9 (underweight or normal weight), 25-29.9 (overweight), 30-34.9 (obese), and $> 35 \text{ kg}/\text{m}^2$ (morbidly obese) [17]. Smoking status of the participants was categorized as never, former smoker, and current smoker. Dietary Guidelines for Americans for 2005 were used to define the person's alcohol use status as never use, former user, current use below recommended limit of > 14 drinks per week if male or > 7 drinks per week if female [18]. Use of sunscreen was categorized as always, sometimes, never, and unknown (including participants who reported not going into the sun).

Participants answered questions about weekly frequency and average duration of moderate and vigorous physical activity. From these, we calculated total minutes per week of vigorous or moderate activity and categorized physical activity as inactive (total minutes=0), insufficiently active (total minutes more than 0 and less than 150), and sufficiently active (total minutes equal to 150 or more) [19].

To estimate the intake of 18 food categories, the 5-Factor Screening was administered as part of the 2005 NHIS questionnaire [20]. For this study, adjusted cup equivalents of vegetables (excluding French fries) per day and adjusted cup equivalents of fruit were used to determine if participants met the US Department of Agriculture 2005 guidelines for adequate fruit/vegetable consumption (4.5 cups daily) [18].

Participants were asked about their participation in cancer screening (PSA, Pap-smear, and mammography, any colorectal cancer screening modality) and to specify when they had their last screening. Based on the provided information, compliance with the screening for prostate, breast, and cervical cancer was categorized as screening within the last 2 years (compliant or regular), screening within the last 2-5 years, and screening more than 5 years ago. For

colorectal cancer screening, the categories were defined as screening within the last 5 years (compliant or regular), screening within the last 5-10 years, and screening more than 10 years ago.

Statistical analyses

All analyses were performed using SAS version 9.3 (SAS Institute, Inc., Cary, NC, USA) and SAS callable SUDAAN10 (Research Triangle Institute, NC, USA). All analyses were adjusted for the complex sampling design (multistage probability sampling) in the NHIS data to obtain population estimates [16]. Because of this complex sampling design, all the results are presented in the form of weighted estimates, which in this case, are more appropriate than the sample statistics [16]. After weighting, our analyses included 15,995,240 cancer survivors and 201,590,979 respondents without cancer, which correspond to 2,428 and 28,969 participants in the sample, respectively.

We used χ^2 test to compare distribution of the following socio-demographic characteristics among cancer survivors and respondents without cancer: age (18-39, 40-49, 50-59, and ≥ 60 years), race/ethnicity (White non-Hispanic, Black non-Hispanic, other), gender, marital status (married or partner, other), education (less than high school level, high school graduate or equivalent, some college or associate degree, bachelor's degree or above), employment (employed, unemployed) and insurance (uninsured, private insurance, Medicare, and other plans). χ^2 test was also used to compare the distribution of healthy behaviors and screening practices among cancer survivors and respondents without cancer: BMI (≤ 24.9 , 25-29.9, 30-34.9, $> 35 \text{ kg}/\text{m}^2$), current user below recommended limit of > 14 drinks per week if male or > 7 drinks per week if female [18], current user above recommended limit), physical activity (none, insufficiently active or < 150 min/week, sufficiently active or ≥ 150 min/week), sunscreen use (always/most of the time, sometimes or rarely, never), adequate fruit/vegetable intake (no or < 4.5 cups/day, yes or ≥ 4.5 cups/day [18]), prostate cancer screening (PSA within past 2 years, within past 3-5, within > 5 years), colorectal cancer screening (within past 5 years, within past 6-10, within > 10 years), breast cancer screening (mammogram within past 2 years, within past 3-5, within > 5 years), and cervical cancer screening (Pap-smear within past 2 years, within past 3-5, within > 5 years).

We used multivariate logistic regression to describe the overall association of healthy behaviors with cancer survivorship status (cancer survivors vs. respondents without cancer) while controlling for age, gender, race/ethnicity, marital status, employment, education, and insurance. Cancer survivors were compared to respondents without cancer (reference group). For each of the behaviors, the category representing the healthy choice was used as the reference. In overall analysis, we modeled overall screening practices as categorical variable with three levels: having all recommended screenings (colorectal and prostate cancer screening for men; breast, cervical and colorectal cancer screening for women), having some screening, and having no screening. Younger participants (age 40 and younger) who had not yet reached the recommended screening age were combined into a separate category. To retain observations with missing data on covariates in the logistic regression analysis, we created an "Unknown" category for each of the variables with missing data.

In a secondary analysis, we examined these associations separately

Table 1: Estimated (weighted) demographic characteristics of cancer survivors and respondents without cancer, US National Health Interview Survey 2005.

Characteristic	All Weighted N 217,586,219		Cancer survivors Weighted N 15,995,240		Respondents without cancer Weighted N 201,590,979	
	Sample N	% (95% CI)	Sample N	% (95% CI)	Sample N	% (95% CI)
Years since diagnosis						
≤4	898	38.6 (36.2-41.0)	898	38.6 (36.2-41.0)	NA	
4/11/2014	739	31.8 (29.7-34.0)	739	31.8 (29.7-34.0)	NA	
>11	737	29.6 (27.7-31.7)	737	29.6 (27.7-31.7)	NA	
Age, years*						
18-39	11804	40.5 (39.7-41.2)	214	10.2 (8.8-11.8)	11590	42.9 (42.1-43.7)
40-49	6133	20.4 (19.9-21.0)	262	12.2 (10.5-14.1)	5871	21.1 (20.6-21.6)
50-59	5361	16.9 (16.4-17.4)	430	19.3 (17.4-21.2)	4931	16.7 (16.2-17.3)
≥60	8099	22.2 (21.6-22.8)	1522	58.4 (56.0-60.8)	6577	19.3 (18.8-19.9)
Race/ Ethnicity*						
White, non-Hispanic	20212	70.9 (70.0-71.7)	2031	88.2 (86.8-89.5)	18181	69.5 (68.6-70.4)
Black, non-Hispanic	4291	11.1 (10.5-11.7)	177	5.0 (4.2-6.0)	4114	11.6 (11.0-12.2)
Other	6894	18.0 (17.3-18.8)	220	6.8 (5.8-8.0)	6674	18.9 (18.2-19.7)
Gender*						
Male	13751	48.2 (47.6-48.8)	952	42.4 (40.2-44.6)	12799	48.7 (48.0-49.3)
Female	17646	51.8 (51.2-52.4)	1476	57.6 (55.4-59.8)	16170	51.4 (50.7-52.0)
Education *						
< High School	4152	9.4 (8.9-9.8)	318	9.5 (8.3-10.8)	3834	9.4 (8.9-9.9)
High School Graduate or Equivalent	7922	24.3 (23.6-25.0)	631	25.7 (23.7-27.9)	7291	24.2 (23.5-24.9)
>Some College or Associate Degree	9447	31.0 (30.3-31.7)	296	29.1 (27.0-31.3)	8751	31.2 (30.4-31.9)
>Bachelor's Degree	9635	35.3 (34.5-36.2)	772	35.7 (33.4-38.1)	8863	35.3 (34.4-36.2)
Marital*						
Married or Partner	16372	63.2 (62.5-63.9)	1282	67.3 (65.2-69.4)	15090	62.8 (62.1-63.5)
Other	14862	36.9 (36.2-37.6)	1135	32.7 (30.6-34.8)	13727	37.2 (36.5-37.9)
Employment *						
Employed	21465	70.9 (70.2-71.7)	987	44.0 (41.6-46.4)	20478	73.1 (72.3-73.8)
Unemployed	9897	29.1 (28.3-29.8)	1436	56.0 (53.7-58.4)	8461	26.9 (26.2-27.7)
Insurance*						
Uninsured	5356	16.4 (15.8-17.0)	162	6.6 (5.4-8.0)	5194	17.2 (16.6-17.8)
Private insurance#	16699	58.8 (58.1-59.6)	857	40.6 (38.2-43.0)	15842	60.3 (59.5-61.1)
Medicare	5027	14.0 (13.5-14.4)	1037	40.3 (38.0-42.5)	3990	11.9 (11.4-12.3)
Other plans§	3721	10.8 (10.3-11.4)	345	12.6 (11.2-14.2)	3376	10.7 (10.1-11.2)

Note: Estimated percentages are calculated from non-missing data

*Difference between cancer survivors and respondents without cancer is significant at 0.001 level

#Also includes military health insurance

§Also includes Medicaid and Medi-gap

Table 2: Estimated (weighted) prevalence of healthy behaviors among cancer survivors and respondents without cancer, US National Health Interview Survey 2005.

Characteristic	All Weighted N 217,586,219		Cancer survivors Weighted N 15,995,240		Respondents without cancer Weighted N 201,590,979	
	Sample N	% (95% CI)	Sample N	% (95% CI)	Sample N	% (95% CI)
BMI						
≤24.9	11746	39.7 (39.0-40.5)	873	37.0 (34.8-39.2)	10873	40.0 (39.2-40.8)
25-29.9	10581	35.3 (24.7-36.0)	869	37.0 (34.8-39.1)	9712	35.2 (34.5-35.9)
30-34.9	4806	16.0 (15.5-16.5)	379	16.9 (15.1-18.8)	4427	16.0 (15.4-16.5)
>35	2842	8.9 (8.6-9.3)	224	9.2 (8.1-10.5)	2618	8.9 (8.5-9.3)
Smoking status*						
Never smoked	17834	57.6 (56.8-58.3)	1094	45.3 (42.9-47.7)	16740	58.52 (57.7-59.3)
Former smoker	6769	21.6 (21.0-22.1)	913	37.6 (35.3-39.8)	5856	20.3 (19.7-20.9)
Current smoker	6505	20.9 (20.3-21.5)	399	17.1 (15.3-19.1)	6106	21.2 (20.6-21.9)
Alcohol*						
Never used	7743	24.34 (23.6-25.2)	537	21.7 (19.8-23.9)	7206	24.6 (23.8-25.4)
Former user	4677	14.4 (13.9-14.9)	568	21.7 (20.0-23.6)	4109	13.8 (13.3-14.3)

Current user less than recommended limit#	16433	56.4 (55.6-57.2)	1150	52.4 (50.0-54.7)	15283	56.7 (55.9-57.5)
Current user, above recommended limit	1513	4.9 (4.6-5.2)	105	4.2 (3.3-5.2)	1408	4.9 (4.6-5.2)
Physical Activity*§						
None	13178	40.6 (39.5-41.6)	1110	44.9 (42.5-47.3)	12068	40.2 (39.2-41.3)
Insufficiently active	5508	18.4 (17.8-19.0)	451	19.0 (17.3-20.8)	5057	18.3 (17.7-19.0)
Sufficiently active	11842	41.1 (40.2-41.9)	805	36.2 (34.0-38.4)	11037	41.5 (40.6-42.4)
Sunscreen use*						
Always/most of the time	7848	29.6 (28.9-30.3)	755	38.8 (36.4-41.2)	7093	28.9 (28.2-29.6)
Sometimes or rarely	7727	30.3 (29.5-31.1)	493	25.7 (23.5-28.0)	7234	30.7 (29.9-31.5)
Never	11755	40.1 (39.2-40.9)	775	35.5 (33.1-38.1)	10980	40.4 (39.5-41.3)
Adequate fruit/vegetable intake*						
No (<4.5 cups/day) †	26410	90.4 (89.9-90.9)	2115	93.4 (92.2-94.4)	24295	90.2 (89.6-90.6)
Yes (≥4.5 cups/day)	2674	9.6 (9.2-10.1)	159	6.6 (5.7-7.8)	2515	9.9 (9.4-10.4)
Note: estimated percentages are calculated from non-missing data						
*Difference between cancer survivors and respondents without cancer is significant at 0.0001 level						
#Recommended limit of >14 drinks per week if male or >7 drinks per week if female						
§Insufficiently active: total minutes per week > 0 -< 150; sufficiently active: total minutes ≥150						
† According to 2005 Dietary Guidelines for Americans						

Table 3: Estimated prevalence of recommended screening practices among cancer survivors and respondents without cancer at age 40 and older, US National Health Interview Survey 2005, overall and by gender.

Characteristic	Males, % (95% CI)		Females, % (95% CI)	
	Cancer survivors	Respondents without cancer	Cancer survivors	Respondents without cancer
Prostate cancer screening (PSA)				
within past 2 years	52.2 (44.1-60.2)	44.8 (41.3-48.3)		
within past 3-5	32.3 (25.0-40.5)	38.1 (34.5-41.9)	NA	NA
within >5 years	15.5 (10.4-22.5)	17.1 (14.7-19.9)		
Colorectal cancer screening				
within past 5 years	70.7 (64.7-76.0)	67.5 (64.2-70.7)	68.0 (62.1-73.3)	62.8 (60.0-65.6)
within past 6-10	21.5 (16.7-27.3)	20.3 (17.7-23.1)	19.7 (15.2-25.3)	23.3 (21.0-25.7)
within >10 years	7.8 (5.1-11.8)	12.2 (10.2-14.5)	12.3 (8.9-16.7)	13.9 (12.1-15.9)
Breast cancer screening (mammogram)				
within past 2 years			41.2 (35.6-47.1)	38.4 (36.1-40.8)
within past 3-5	NA	NA	30.3 (25.5-35.5)	35.4 (33.2-37.8)
within >5 years			28.5 (24.0-33.4)	26.2 (24.2-28.3)
Cervical cancer screening (pap-smear)*				
within past 2 years	NA	NA	23.2 (19.1-27.9)	29.6 (27.8-31.5)
within past 3-5			26.8 (22.3-31.9)	31.3 (29.6-33.1)
within >5 years			50.0 (44.9-55.1)	39.1 (37.2-41.0)

Note: estimated percentages are calculated from non-missing data
 *Difference between cancer survivors and respondents without cancer is significant at 0.0001 level

Table 4: Risk estimates for health behaviors and screening practices, National Health Interview Survey 2005.

Characteristic	Overall OR (95% CI)*	Men OR (95% CI)#	Women OR (95% CI)#
BMI			
≤24.9	1.00	1.00	1.00
25-29.9	1.07 (0.95-1.21)	1.09 (0.89-1.33)	1.14 (0.97-1.33)
30-34.9	1.18 (1.01-1.38)	1.44 (1.12-1.84)	1.09 (0.87-1.36)
>35	1.31 (1.10-1.57)	1.50 (1.05-2.13)	1.27 (1.04-1.56)
Smoking status			
Never smoked	1.00	1.00	1.00
Former smoker	1.43 (1.27-1.62)	1.24 (1.03-1.50)	1.43 (1.22-1.69)
Current smoker	1.56 (1.32-1.84)	1.26 (0.95-1.66)	1.74 (1.44-2.10)
Alcohol			
Never used	1.00	1.00	1.00
Former user	1.10 (0.93-1.29)	0.93 (0.70-1.23)	1.11 (0.91-1.37)
Current user less than recommended limit	1.04 (0.89-1.22)	0.78 (0.59-1.02)	1.20 (1.01-1.43)
Current user, above recommended limit	0.93 (0.70-1.24)	0.82 (0.49-1.36)	0.99 (0.71-1.38)
Physical Activity[§]			
None	1.06 (0.93-1.20)	1.02 (0.83-1.24)	1.09 (0.93-1.29)
Insufficiently active	1.00 (0.87-1.15)	0.82 (0.65-1.05)	1.11 (0.94-1.32)
Sufficiently active	1.00	1.00	1.00
Sunscreen use			
Always/most of the time	1.00	1.00	1.00
Sometimes or rarely	0.70 (0.61-0.80)	0.65 (0.50-0.83)	0.75 (0.63-0.88)
Never	0.65 (0.56-0.75)	0.53 (0.42-0.67)	0.77 (0.64-0.93)
Adequate fruit/vegetable intake			
No (<4.5 cups/day)	1.20 (0.99-1.46)	1.36 (1.03-1.80)	1.02 (0.78-1.33)
Yes (≥4.5 cups/day)	1.00	1.00	1.00
Screening practices			
All recommended screenings	1.00	1.00	1.00
Some screening	0.92 (0.64-1.32)	1.10 (0.70-1.74)	0.82 (0.47-1.44)
None	0.49 (0.28-0.85)	0.78 (0.34-1.77)	0.37 (0.16-0.85)

* Estimates adjusted for other behavioral factors and also for age, gender, race, employment status, marital status, education, and insurance
 # Estimates adjusted for other behavioral factors and also for age, race, employment status, marital status, education, and insurance
 §Insufficiently active: total minutes per week > 0 -< 150; sufficiently active: total minutes ≥150

Supplementary Table 1: Distribution of leading self-reported cancers, by site and by gender.

Cancer site	Males	Females	All
Bladder	5.3%	1.1%	2.8%
Breast	0.5%	28.3%	16.5%
Cervix	NA	13.3%	13.3%
Colon	9%	5.7%	7.1%
Kidney	2.5%	1.0%	1.6%
Leukemia	1.6%	1.5%	1.5%
Lung	3.6%	2.2%	2.8%
Lymphoma	4.5%	3.8%	4.1%
Melanoma	7.8%	6.4%	7.0%
Ovary	NA	5.2%	5.2%
Prostate	27.2%	NA	27.2%
Skin (non-melanoma or unknown kind)	31.1%	22.1%	25.8%
Testis	1.3%		1.3%
Thyroid	1.1%	3.7%	2.6%
Uterus	NA	9.6%	9.6%
Other*	16.1%	8.4%	11.9%

*Includes cancers with frequency<1%.

among male and female respondents. Statistical significance was assessed at $\alpha=0.05$ level in all analyses.

Result

Characteristics of cancer survivors (weighted N=15,995,240) and respondents without cancer (weighted N=201,590,979) are presented in Table 1. Compared to respondents without cancer, cancer survivors were older, were more likely to be females and White non-Hispanic (Table 1). Among women, breast, non-melanoma skin, female reproductive (cervical, ovarian or uterine), colorectal cancer, and melanoma were the most common cancers. Among men, non-melanoma skin, prostate, colorectal, bladder cancer, and melanoma were the most common cancers (Supplementary Table 1).

With the exception of BMI, cancer survivors and respondents without cancer differed significantly with respect to all health behaviors in the analysis (Table 2).

Cancer survivors were less likely to currently smoke or use alcohol, less likely to be physically active and to have adequate fruit/vegetable intake, and more likely to use sunscreen. Adherence to screening practices was similar in cancer survivors and respondents without cancer, with exception of the cervical cancer screening; women with cancer were less likely to have had Pap smear within the last 5 years (Table 3). Distribution of healthy behaviors and screening practices was similar in cancer survivors regardless of the time since cancer diagnosis (data not shown).

In multivariate logistic regression analysis, cancer survivors were more likely to be obese, to be current or former smokers, to use sunscreen regularly, and to have recommended cancer screenings (Table 4). The associations of BMI and sunscreen use with survivorship status were similar in the stratified analyses by gender. Female cancer survivors were more likely to be former or current

smokers as compared to their cancer-free counterparts (former: OR=1.43, 95% CI 1.22-1.69; current: OR=1.74, 95% CI 1.44-2.10) and more likely to consume alcohol below recommended limit (OR=1.20, 95% CI 1.01-1.43) (Table 4). They were also more likely to follow recommended cancer screenings (none vs. all recommended screenings OR=0.37, 95% CI 0.16-0.85). Male cancer survivors were more likely to be former smokers (OR=1.24, 95% CI 1.03-1.50) and to have inadequate fruit/vegetable intake (OR=1.36, 95% CI 1.03-1.80) (Table 4).

Discussion

This study compared healthy behaviors among cancer survivors and respondents without a cancer history using data from 2005 National Health Interview Survey. Significant associations with cancer survivorship status were found for BMI, smoking, sunscreen use, and cancer screening practices. The magnitude of the associations for selected healthy behaviors differed by gender.

Our findings on the prevalence of smoking among cancer survivors and respondents without cancer are similar to previous reports [13,21,22]. Unlike earlier studies, we found overall lower prevalence of obesity, adequate fruit/vegetable intake and risky alcohol consumption, and increased prevalence of moderate to high physical activity and regular sunscreen use in our study population [13,21-23].

Previous studies found no association between smoking and survivorship status [13,21]. In contrast, our findings showed that cancer survivors were more likely to be current smokers. Furthermore, the magnitude of this association appeared to be greater among females. Some studies suggested differences in prevalence of smoking by cancer site and found higher smoking prevalence among survivors of female reproductive cancers [23,24]. Female reproductive cancers were among the most common cancer types in this study, and thus, the association with smoking might have been driven in part by this large subgroup of female cancer survivors.

Consistent with others, we found a positive association between cancer screening and cancer survivorship status [25,26]. Trask et al. reported that both male and female cancer survivors were more likely to follow recommended gender-specific cancer screening as compared to their cancer-free counterparts. Schumacher et al., on the other hand, found such an association only in females. Similarly, the association of screening with survivorship status in our study appeared to be stronger among women. However, it was previously shown that respondents tend to overestimate their screening practices [27-31], and thus, these findings should be interpreted with caution.

In our study, cancer survivors did not differ significantly from their cancer-free counterparts with respect to physical activity, consumption of fruits and vegetables, and alcohol use. The majority of the previous studies found no association between physical activity and survivorship status, though some authors suggested that cancer survivors were more likely to follow recommended guidelines for physical activity as compared to healthy controls and that there are differences in these associations by gender [13,21,23,32]. Our findings of no association between adequate fruit/vegetable intake and cancer survivorship status are consistent with previous reports

[33]. However, we found that among males, cancer survivors were 36% more likely not to have adequate fruit/vegetable intake. Previous studies showed that as many as 90% of respondents do not meet dietary recommendations regardless of their cancer survivorship status [33]. Similarly, the low prevalence of adequate fruit/vegetable intake in our study sample (9.6%), indicates that despite potential benefits of proper diet, the majority of respondents fail to comply with current dietary recommendations, irrespective of their cancer survivorship status [23].

This analysis uses the data from a large representative sample of the US population. Nonetheless, our study has few limitations. The cross-sectional nature of the data does not allow us to establish any temporal relationships and to determine if the behaviors were influenced by the cancer diagnosis, which is likely. Both cancer diagnosis and healthy behaviors are self-reported. Previous studies demonstrated high accuracy of self-reported cancer diagnosis [34-36]. However, some reports suggest that self-reported data can underestimate the number of people with risky behaviors [28,37], and thus, objective measures rather than self-reports of risky behaviors are preferred for better understanding of the true associations.

Conclusion

Healthy behaviors among cancer survivors continue to remain a public health concern. Our findings showed that the cancer survivors were similar to the respondents without cancer with respect to most of the healthy behaviors and that some of the risky behaviors continued to be highly prevalent among the survivors. Furthermore, some of these behaviors showed disparities by gender. These findings suggest that certain population groups might benefit from tailored preventive service delivery that would address concerns related to selected healthy behaviors, such as smoking among women and adequate fruit/vegetable intake among men. Behavioral intervention studies would provide a better insight into benefits of these targeted interventions among cancer survivors.

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