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Persistent cigarette smoking and other tobacco use after a tobacco-related cancer diagnosis

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Abstract

Introduction—People who continue to smoke after a cancer diagnosis have an increased risk for recurrences or development of new malignancies. These risks may be even higher among tobacco-related cancer survivors (TRCS). We describe tobacco use behaviors among TRCS, other cancer survivors, and people without a history of cancer.

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Methods—We used 2009 Behavioral Risk Factor Surveillance System data to describe demographic characteristics, smoking history, current smoking prevalence, and smokeless tobacco use among TRCS, other cancer survivors, and people without a history of cancer (cigarette smoking and smokeless tobacco use were calculated after adjusting for age, sex, race, and insurance status). Tobacco-related cancers were defined as lung/bronchial, pharyngeal, laryngeal, esophageal, stomach, pancreatic, kidney/renal, urinary bladder, cervical, and acute myeloid leukemia.

Results—A total of 20 % of all cancer survivors were TRCS. TRCS were primarily female (68 %) and white (78 %). Smoking prevalence was higher among TRCS (27 %) compared with other cancer survivors (16 %) and respondents without a history of cancer (18 %). Smokeless tobacco use was higher among respondents without a history of cancer (4 %) compared with TRCS (3 %) and other cancer survivors (3 %).

Conclusions—The self-reported smoking prevalence among TRCS is higher than among other cancer survivors and people without a history of cancer. Targeted smoking prevention and cessation interventions are needed for cancer survivors, especially those diagnosed with a tobacco-related cancer.

Implications for cancer survivors—We recommend all cancer survivors be made aware of the health risks associated with smoking after a cancer diagnosis, and smoking cessation services be offered to those who currently smoke.

Condensed abstract—We provide the first population-based report on demographic characteristics and tobacco use behaviors among self-reported tobacco-related cancer survivors.

Keywords

Tobacco; Epidemiology; Survivors; Neoplasms; Second Primary

Introduction

The cancer survivor population in the United States (US) has grown over the last three decades to a projected 13.8 million in 2010 [1–4]. This is largely due to more cancer diagnoses as a result of an aging population and improvements in early detection and treatment of cancer [5, 6]. Healthy lifestyle behaviors (smoking cessation, physical activity, maintaining healthy weight, and consuming a healthy diet) may help improve quality of life among cancer survivors and prevent recurrent and subsequent cancers [6].

Smoking is the number one preventable cause of disease and death in the US [7]. A 2004 Surgeon General Report reviewed the evidence that smoking causes lung, larynx, oral cavity, esophagus, and bladder cancers and concluded that it also causes cervix, kidney, pancreas, and stomach cancers and acute myeloid leukemia [8]. The annual US incidence of tobacco-related cancers is approximately 500,000 [9].

Continued smoking after a cancer diagnosis places survivors at increased risk for recurrences or development of new malignancies [10–12]. Nevertheless, the prevalence of smoking among cancer survivors is similar to that of the general population [13–18]. Although previous studies have examined smoking behaviors among survivors of selected

tobacco-related cancers (e.g., lung and cervical) [3, 19–21], none has described smoking behaviors among all tobacco-related cancer survivors (TRCS). Furthermore, while smokeless tobacco is linked to some cancers (pancreatic, oral, and esophageal) [22–25], limited information is available on persistent smokeless tobacco use among cancer survivors [13, 26]. We describe tobacco use among persons diagnosed with tobacco-related cancers compared with other cancer survivors and people without a history of cancer. Although other cancers such as breast and colorectal have also been linked to tobacco use [27, 28], this study is limited to tobacco-related cancers identified by the Surgeon General.

Methods

BRFSS survey

The Behavioral Risk Factor Surveillance System (BRFSS) is a state-based system of health surveys that collects information on health risk behaviors, preventive health practices, and health care access primarily related to chronic disease and injury [29]. The BRFSS is a cross-sectional, random-digit-dialed telephone survey of non-institutionalized adults aged 18 years or older, using trained interviewers and standard core and optional questionnaire modules [30]. Data were collected monthly in all 50 states, the District of Columbia, Puerto Rico, Guam, and the US Virgin Islands using disproportionate stratified random sampling in all states and District of Columbia and simple random sampling in Guam, Puerto Rico, and the US Virgin Islands [31]. Approximately 432,607 interviews of adults were completed in 2009. The median Council of American Survey Research Organizations cooperation rate for the 2009 BRFSS was 75 %, and the response rate was 53 % [32].

In the 2009 BRFSS survey, questions about cancer survivorship were included on the core module and thus were administered by all states, District of Columbia, and territories. Respondents were asked if they had ever been told by a doctor, nurse, or other health care professional that they had cancer. If they answered yes, they were asked how many different types of cancer they had had, their age at first diagnosis, and the type of cancer. If respondents reported more than one cancer, the most recent was recorded and included in this study. Respondents who had an unknown history of cancer, who refused to answer the question, or who reported non-melanoma skin cancer were excluded from the analysis. Basal and squamous cell skin cancers typically do not require treatment beyond surgery and are not routinely collected in cancer registries [1].

We assessed demographic characteristics and tobacco use among TRCS, other cancer survivors and respondents without cancer. Respondents who reported a cervical, oral, pharyngeal, esophageal, pancreatic, leukemia, stomach, lung, bladder, or renal (kidney) cancer diagnosis were included in the TRCS population. Respondents who reported a prior cancer diagnosis at any other site (including “other”) were included in the population of other cancer survivors. The tobacco-related cancers acute myelogenous leukemia and laryngeal cancer were not included in the 2009 BRFSS questionnaire. BRFSS does not specify types of leukemia; therefore, all types are combined into one response. Acute myelogenous leukemia is the second most commonly diagnosed leukemia in the US [33]. To capture acute myelogenous leukemia survivors, all patients who reported a leukemia

diagnosis were included in the TRCS population. Laryngeal cancer survivors were listed as “other” in the BRFSS survey and therefore not included in the TRCS analyses.

We report the following demographic characteristics: sex, age, age at first cancer diagnosis, years since first diagnosis, race, ethnicity, education level, health insurance status, and US census region of residence. We calculated years since diagnosis using the respondents’ current age and age at first cancer diagnosis. Respondents were asked the following question: “Would you say that in general your health is—excellent, very good, good, fair, or poor?” As a proxy for general health status, we compared the proportion of respondents who indicated “poor health.” To determine cigarette smoking status, respondents were asked, “Have you smoked at least 100 cigarettes in your entire life?” Those who answered yes were classified as “current smokers” if they smoked at the time of the interview and “former smokers” if they did not. Current smokeless tobacco use was defined as an answer of “every day” or “some days” to the following question: “Do you currently use chewing tobacco, snuff, or snus [a small pouch of smokeless tobacco] every day, some days, or not at all?” To measure cigarette smoking cessation, quit ratios (also termed quit rates) were calculated by dividing the number of former smokers by the number of ever smokers (current+former) [34].

We compared demographic characteristics and tobacco use reported by respondents without cancer, TRCS, and other cancer survivors. Current smoking prevalence was also stratified by sex, age, race, years since diagnosis, and cancer site. For some analyses (indicated as “adjusted”), we used logistic regression to produce adjusted percentages (i.e., predicted marginals [65]), which is a method of standardization that produces a weighted average for each level of the health variable of interest. This method allows for comparison between cancer survivors and individuals with no cancer history as if both groups had the same demographic characteristics. Separate models were fit with each health variable as the dependent variable while controlling for age, race/ethnicity, sex, employment status, insurance coverage, and cancer status as independent variables. We used multinomial logistic regression if the categorical dependent variable of interest had more than two levels. Separate logistic regression models were run for each time period since diagnosis to estimate the smoking prevalence among cancer survivors 5, 6–10, and >10 years since diagnosis. Unadjusted smoking prevalence was used for analyses in which we stratified data by demographics included in the adjusted model (age, sex, race, and insurance status); otherwise, adjusted smoking prevalence data are presented.

We used SAS (SAS Institute, Cary, NC) version 9.2 and SAS-callable SUDAAN release 10 (Research Triangle Institute, Research Triangle Park, NC) to account for the complex sampling design of the BRFSS and to provide population estimates. Weights were applied to calculate respondents’ probability of being selected for the survey in their respective state or territory and adjusted to race/ethnicity-, age-, and sex-specific population numbers from current census data (or intercensal estimates). We present weighted self-reported prevalence estimates, along with 95 % confidence intervals to indicate statistical significance. *P* values were calculated from Rao Scott chi-square test or linear contrasts between populations.

Results

Demographic characteristics

Eight percent of all BRFSS respondents reported previously being diagnosed with cancer (Table 1). Among cancer survivors, 20 % were TRCS. Women accounted for a majority of respondents without cancer (51 %), TRCS (68 %), and other cancer survivors (58 %). The mean age of TRCS was 57 years, compared with 63 years for other cancer survivors and 45 years for respondents without cancer.

Among cancer survivors (Table 1), TRCS were younger when diagnosed with cancer (mean age=45 years) compared with other cancer survivors (53 years), and a larger proportion of TRCS had been diagnosed more than 10 years ago (45 %) compared with other cancer survivors (38 %). Nonwhite respondents accounted for 22 % of TRCS and 19 % of other cancer survivors. A larger proportion of TRCS reported poor general health status (16 %), when compared with other cancer survivors (10 %) and respondents without cancer (4 %). TRCS were less educated compared with other cancer survivors; only 26 % of TRCS were college graduates, compared with 36 % of other cancer survivors. A total of 11 % of TRCS were uninsured, compared with 6 % of other cancer survivors. Cervical cancer was the most commonly reported among TRCS, followed by lung, bladder, and renal cancer (Table 2).

Tobacco use

The adjusted current smoking prevalence was 27 % among TRCS compared with 16 % among other cancer survivors and 18 % among respondents without cancer (Table 3). The adjusted smokeless tobacco prevalence was higher among respondents without cancer (4 %) compared with TRCS (3 %) and other cancer survivors (3 %). One third of TRCS were former smokers, compared with 26 % of other cancer survivors and 24 % of respondents without cancer. The smoking quit ratio was highest among other cancer survivors (62 %), followed by respondents without cancer (57 %) and TRCS (55 %).

The unadjusted smoking prevalence was higher among men (20 %) than women (16 %) among respondents without cancer, but was higher among women than men for TRCS (31 % vs. 18 %) and other cancer survivors (12 % vs. 10 %) (Fig. 1). Smoking prevalence decreased with older age in all 3 groups studied (Fig. 2). When stratified by time since diagnosis, adjusted smoking prevalence slightly increased among TRCS and other cancer survivors by comparing those recently diagnosed with cancer (<5 years) to long-term cancer survivors (10<years) (Fig. 3). Nearly half of all American Indian/Alaska Native (AI/AN) and multiracial TRCS were current smokers (Fig. 4). Smoking prevalence in all racial/ethnic groups was higher among TRCS when compared with other cancer survivors and respondents without cancer (Fig. 4). When examined by selected cancer sites, adjusted smoking prevalence was significantly higher among cervical cancer survivors (32.9 %) compared with bladder (27.3 %), lung (23.5 %), and renal (23.2 %) cancer survivors (Fig. 5).

Discussion

We found a high prevalence of cigarette smoking among TRCS, despite the well-documented health risks of smoking after a cancer diagnosis [10, 35]. Smoking prevalence was significantly higher among TRCS, compared with other cancer survivors and highest among younger survivors.

Cigarette smoking is especially harmful for people previously diagnosed with cancer [10]. Cancer survivors who continue to smoke are less likely to respond to treatment [36], experience exacerbated toxicity due to chemotherapy [37], and have lower survival rates than patients who stopped smoking before or at time of diagnosis [19, 38]. Despite these risks, studies have shown persistent smoking among cancer survivors. Smoking rates among childhood [13], adolescent [15], and adult cancer survivors [17] are similar to the smoking prevalence in the general population. One study reported a higher smoking prevalence in cancer survivors in Massachusetts compared with the general population [18]. Similar to prior reports [39], the smoking prevalence in our non-cancer population was highest among men. In the two groups of cancer survivors, however, rates were higher among women. A prior report using data from the National Health Interview Survey showed high smoking rates among selected subgroups of cancer survivors, including young cancer survivors (<40 years) [3]. This is consistent with our finding of the highest smoking prevalence among young persons diagnosed with cancer.

Time since cancer diagnosis also influences smoking prevalence among cancer survivors. Smoking prevalence initially declines after a cancer diagnosis, but eventually re-emerges among longer-term survivors (>20 years) [40]. Similarly, we found that the smoking prevalence among TRCS increased with time since diagnosis, although we did not observe an initial decline in the first years post diagnosis. Smoking prevalence among other cancer survivors also slightly increased among long-term survivors.

Compared with other cancer survivors, a larger proportion of TRCS was younger than 40 years, AI/AN, multiracial, less educated, and uninsured. According to previous findings on smoking prevalence among the US population, the same demographics are associated with high smoking prevalence [41]. Smoking is highest among young people and declines with increasing age [42]. Compared with other cancer survivors, the TRCS population in this study had a larger proportion of younger people, which may have contributed to a higher smoking prevalence. The larger proportion of multiracial and AI/AN respondents may also contribute to the higher smoking prevalence among TRCS because these groups have a high smoking prevalence compared with other racial/ethnic groups [39]. Finally, the higher smoking prevalence among TRCS (compared with other cancer survivors) may also be driven by poor and less educated populations, which have significantly higher smoking rates in the general population [39]. Socio-economic factors such as less education and lower household income may have influenced our findings, as they have been linked with high smoking rates, specifically among cancer survivors [66]. Though we attempted to control for SES by adjusting for insurance status when calculating smoking prevalence among the different populations, we were unable to provide a detailed description of SES in this study.

Cancer survivors have an increased risk for second primaries (subsequent cancers), osteoporosis, obesity, cardiovascular disease, diabetes, and other comorbidities [67]. A recent publication on cancer survivorship found that a substantial proportion of cancer survivors also suffer from heart disease, diabetes, asthma, and other health-related illness [68]. Persons with co-morbidities are typically older and have more interaction with health care providers, therefore more opportunity for counseling to quit smoking. Thus, the lower smoking prevalence among the older non-TRCS population may be associated with comorbidities.

While studies have shown that approximately 15–20 % of lung, larynx, and pharynx survivors continue to smoke after cancer diagnosis [40, 69]; we currently have limited information on the smoking prevalence of many TRCS. This is not the case for cervical cancer survivors, who have a well-documented, high persistent smoking prevalence [3, 71]. In fact, the high smoking prevalence among the TRCS population in our study was largely due to smoking among cervical cancer survivors. Cervical cancer is typically diagnosed in younger women and treated successfully [43]; therefore, cervical cancer survivors account for a large proportion of TRCS—44 % in this study—and they report a smoking prevalence of nearly 35 %. Prior studies also report high rates of smoking among cervical cancer survivors and subsequently an increased risk for future cancer diagnoses [3, 44, 45]. A recent CDC report found cervical cancer survivors have an increased risk for other subsequent tobacco-related cancers when compared with persons never diagnosed with cancer and other cancer survivors [70]. Among cervical cancer survivors, those who continue to smoke after diagnosis are 21 % more likely to die from cervical cancer compared with those who do not smoke [46]. Much like smoking prevalence [47–49], cervical cancer is most common in poor and underserved women [50, 51] and those who reside in rural areas [52]. Because of the high smoking prevalence among cervical cancer survivors and the potential effect of socioeconomic status on access to quality care, smoking prevention and cessation services should be prioritized for this high-risk population.

Tobacco cessation treatments are effective among smokers with various medical conditions, including cancer [53]. We found differences in smoking cessation prevalence (quit ratios) among cancer survivors; the prevalence of ever smokers who have quit was 7 % higher among other cancer survivors compared with TRCS. Our assessment of general health status revealed TRCS reported poorer health than other cancer survivors. This may result in more interaction with health care providers, providing opportunity for intervention with evidence-based smoking cessation treatment. Therefore, we recommend targeting TRCS with effective, evidence-based tobacco cessation strategies, such as counseling by a health care provider and pharmacotherapy [54]. A recent study reported that the smoking status among one in four cancer survivors who currently smoke is not known by a health care provider and that only 72 % of cancer survivors who currently smoke were advised to quit smoking by a health care provider [55]. These findings reveal missed opportunities for health care providers to advise cancer survivors against smoking and provide evidence-based interventions. A separate report found that despite the importance of tobacco use cessation counseling for all cancer patients, the diagnosis of cancer may be underused as a teachable moment [54].

To our knowledge, this is the first population-based study to examine smokeless tobacco use among TRCS. Approximately 3 % of cancer survivors (TRCS and other cancer survivors) in this study used smokeless tobacco products. Previous cohort studies have shown the prevalence of use ranges from 1–6 % [56, 57]. The same studies also report smokeless tobacco use was significantly higher among males. Our comparably low prevalence of smokeless tobacco use may be partly because fewer males were among cancer survivors in this report. Current smokers who are attempting to quit may substitute cigarettes for smokeless tobacco products [58]; however, we were unable to determine if our respondents did so. A global evaluation by the International Agency for Research on Cancer linked oral cancers to the use of smokeless tobacco products in several studies [59]. Further studies on smokeless tobacco use and smoking cessation among cancer survivors are warranted.

Our findings are subject to several limitations. First, BRFSS data are self-reported and subject to recall bias and misclassification, which could lead to inaccurate estimates of cancer prevalence [60]. Recall bias may be responsible for the slightly higher cancer prevalence we observed of certain cancers, compared with a recent study using cancer registry data [1]. Over-reporting of cervical cancer may have occurred in this study because some women may misunderstand abnormal Pap smears, cervical cancer precursors, and cervical intraepithelial neoplasia to be cancer because of treatments used to remove the precancerous lesions [61]. Some of the tobacco-related cancers defined by the Surgeon General (acute myelogenous leukemia and laryngeal cancer) were not specifically queried in the BRFSS survey. To capture acute myelogenous leukemia survivors, we included all patients who reported a leukemia diagnosis in tobacco-related analyses, thereby possibly overestimating the TRCS population. Laryngeal cancer survivors would have likely indicated “other” cancer type and been included in the analyses of other cancer survivors. Second, the survey may not be representative of people who do not have a landline telephone, which is required for BRFSS participation [62]. Households with landline telephone are associated with higher educational attainment [62]. Third, because our findings are limited to non-institutionalized US citizens, we did not assess cancer survivors who may have advanced disease and are living in nursing homes, long-term care facilities, or hospice. Fourth, this survey does not collect information from people younger than 18 years; thus, we are unable to describe the characteristics and health behaviors of this population. Fifth, BRFSS does not assess any indicators of smoking dependence or intensity. Therefore, we are unable to draw conclusions on the magnitude of tobacco use among cancer survivors. Finally, low cooperation for the BRFSS survey may limit the generalizability of our study findings to all cancer survivors living in the US. However, studies have concluded that the national survey findings are reliable and valid [63], providing a major strength to this study.

Too many cancer survivors continue to smoke despite evidence that doing so places them at increased risk for a new or recurrent cancer diagnosis [10]. Continued smoking after a cancer diagnosis can also increase toxicity due to chemotherapy, delay healing after surgery, impede patient recovery to daily functioning, and decrease a patient’s chance for survival [54]. We recommend that smoking cessation services be offered to all cancer survivors. Public health practitioners should implement programs that promote effective tobacco cessation and prevention practices for cancer survivors, such as patient education, cessation

counseling, pharmacotherapy (e.g., nicotine replacement and antidepressants), and any combination of proven practices [54]. One such program for cancer survivors provided peer counseling, tailored educational materials, and free pharmacotherapy, resulting in a significantly higher smoking quit rate among program participants compared with those assigned to a self-help group [64]. Patient education about the risks associated with smoking after a cancer diagnosis is also warranted to decrease smoking among cancer survivors. Finally, we recommend that health care professionals continue to advise cancer survivors against smoking and offer evidence-based tobacco cessation options to patients who are smokers.

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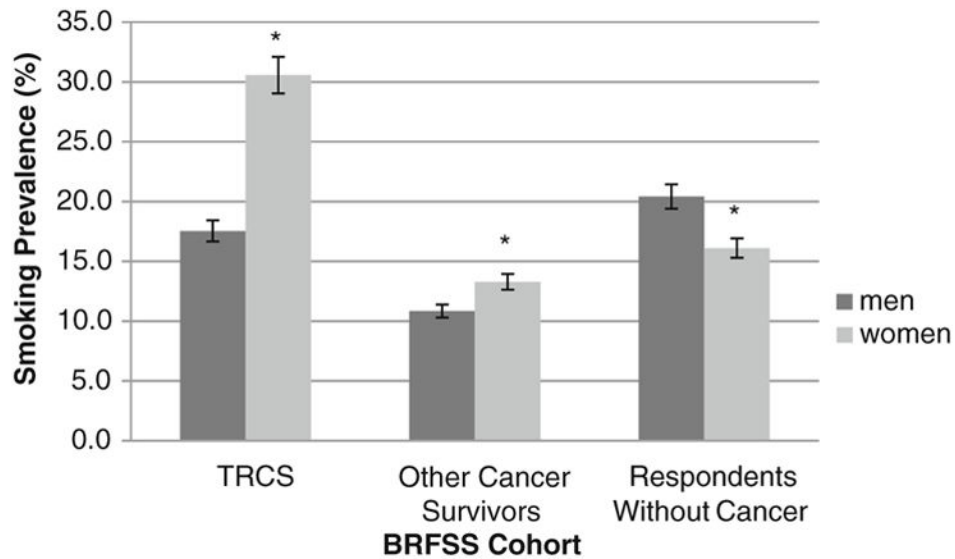


Fig. 1. Unadjusted smoking prevalence by sex among TRCS, other cancer survivors, and respondents without cancer [32]. *BRFSS* Behavioral Risk Factor Surveillance System. All data are based on self-report and are weighted. For cancer survivors reporting more than one cancer diagnosis, the cancer site reported was the most recently diagnosed cancer. TRCS include respondents who report a prior diagnosis of lung/bronchial, pharyngeal, esophageal, stomach, pancreatic, kidney/renal, urinary bladder, or cervical cancer. Tobacco-related cancers are defined according to a 2004 Surgeon General report [8]. To capture acute myelogenous leukemia survivors, all patients who reported a leukemia diagnosis were included in the tobacco-related cancer survivor population. Other cancer survivors include respondents who report a prior diagnosis of any cancer, not designated as tobacco related. Respondents without cancer include anyone who reports never being diagnosed with cancer. Current smoking defined as regular or intermittent smoking and having smoked >100 cigarettes ever. * $p < 0.05$; p values calculated from Rao Scott chi-square test

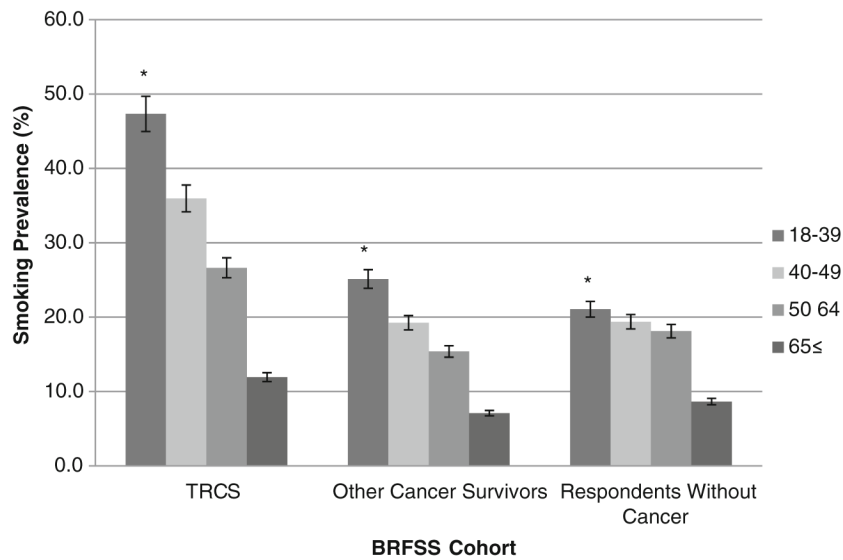


Fig. 2. Unadjusted smoking prevalence by age among TRCS, other cancer survivors, and respondents without cancer [32]. *BRFSS* Behavioral Risk Factor Surveillance System. All data are based on self-report and are weighted. For cancer survivors reporting more than one cancer diagnosis, the cancer site reported was the most recently diagnosed cancer. TRCS include respondents who report a prior diagnosis of lung/bronchial, pharyngeal, esophageal, stomach, pancreatic, kidney/renal, urinary bladder, or cervical cancer. Tobacco-related cancers are defined according to a 2004 Surgeon General report [8]. To capture acute myelogenous leukemia survivors, all patients who reported a leukemia diagnosis were included in the tobacco-related cancer survivor population. Other cancer survivors include respondents who report a prior diagnosis of any cancer not designated as tobacco related. Respondents without cancer include anyone who reports never being diagnosed with cancer. Current smoking defined as regular or intermittent smoking and having smoked >100 cigarettes ever. * $p < .05$; p values calculated from Rao Scott chi-square test

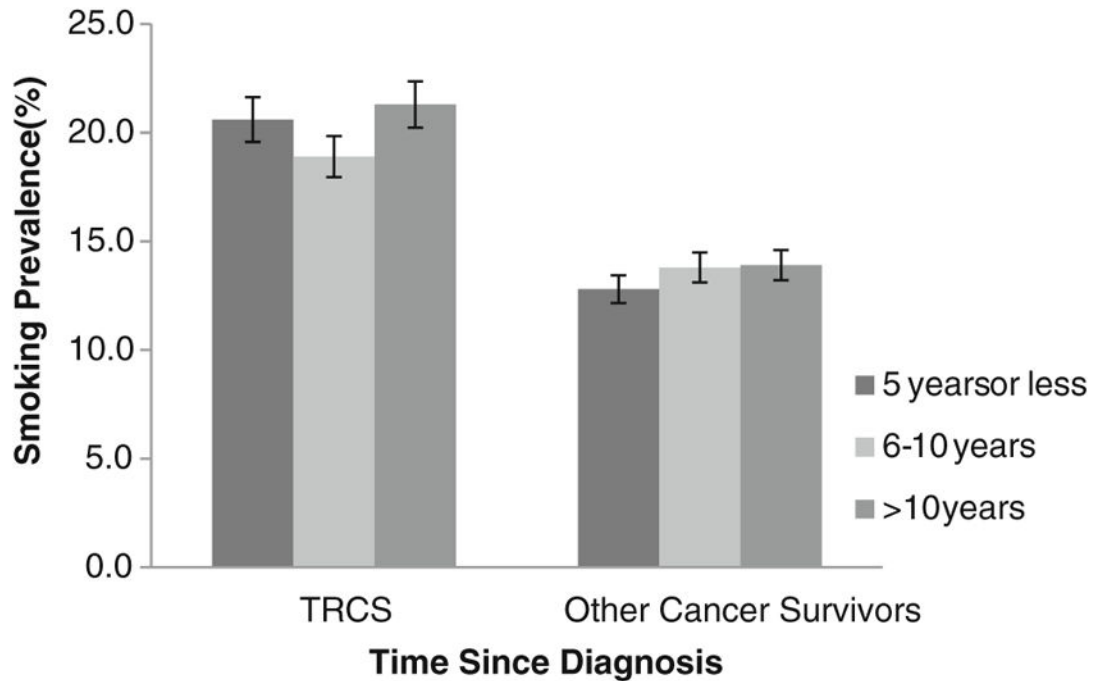


Fig. 3.

Adjusted smoking prevalence by time since diagnosis among TRCS and other cancer survivors [32]. *BRFSS* Behavioral Risk Factor Surveillance System. All data are based on self-report and are weighted. For cancer survivors reporting more than one cancer diagnosis, the cancer site reported was the most recently diagnosed cancer. TRCS include respondents who report a prior diagnosis of lung/bronchial, pharyngeal, esophageal, stomach, pancreatic, kidney/renal, urinary bladder, or cervical cancer. Tobacco-related cancers are defined according to a 2004 Surgeon General report [8]. To capture acute myelogenous leukemia survivors, all patients who reported a leukemia diagnosis were included in the tobacco-related cancer survivor population. Other cancer survivors include respondents who report a prior diagnosis of any cancer, not designated as tobacco-related. Current smoking defined as regular or intermittent smoking and having smoked >100 cigarettes ever. Smoking prevalence adjusted for race/ethnicity, sex, age, insurance coverage, and employment status

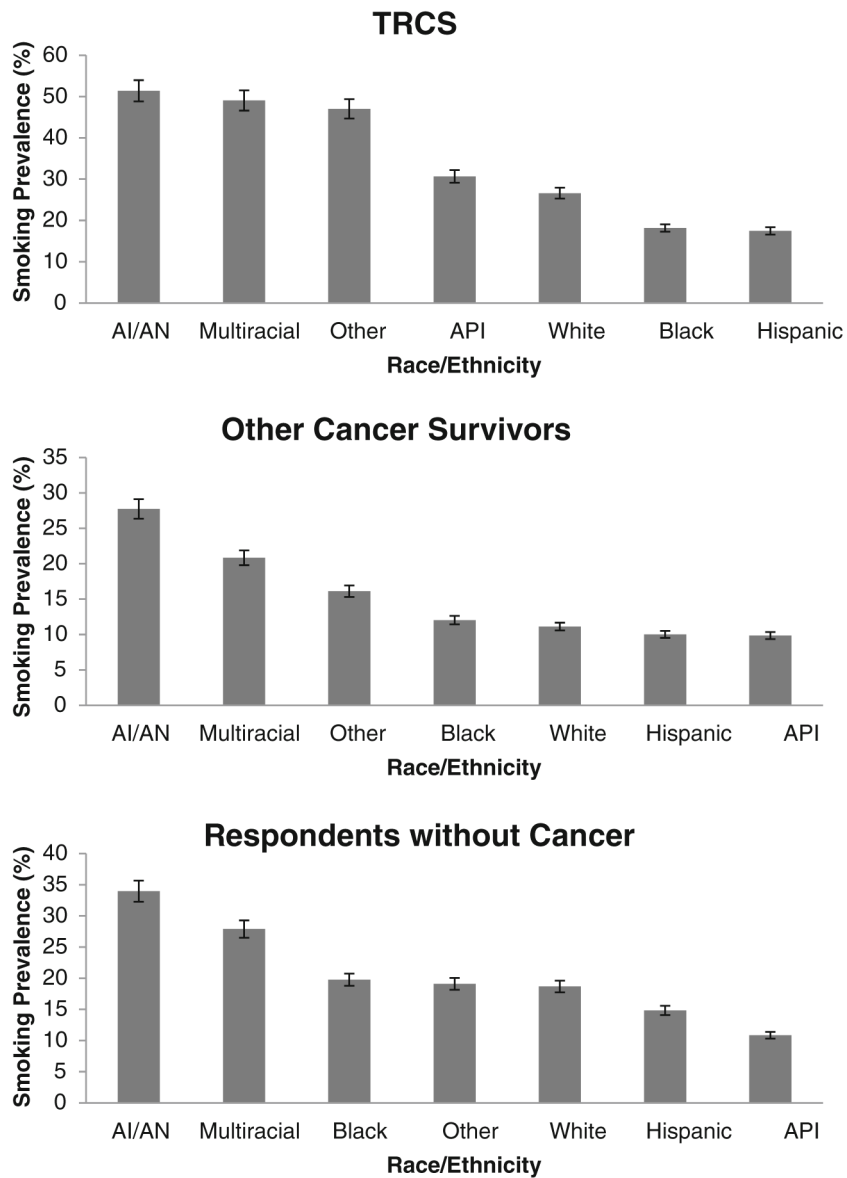


Fig. 4. Unadjusted smoking prevalence by race and ethnicity among TRCS, other cancer survivors, and respondents without cancer [32]. *BRFSS* Behavioral Risk Factor Surveillance System, *NH* Native Hawaiian, *PI* Pacific Islander, *AI/AN* American Indian/Alaska native. All data are based on self-report and are weighted. For cancer survivors reporting more than one cancer diagnosis, the cancer site reported was the most recently diagnosed cancer. TRCS include respondents who report a prior diagnosis of lung/bronchial, pharyngeal, esophageal, stomach, pancreatic, kidney/renal, urinary bladder, or cervical cancer. Tobacco-related cancers are defined according to a 2004 Surgeon General report [8]. To capture acute myelogenous leukemia survivors, all patients who reported a leukemia diagnosis were included in the tobacco-related cancer survivor population. Other cancer survivors include respondents who report a prior diagnosis of any cancer, not designated as tobacco-related.

Respondents without cancer include anyone who reports never being diagnosed with cancer. Current smoking defined as regular or intermittent smoking and having smoked >100 cigarettes ever

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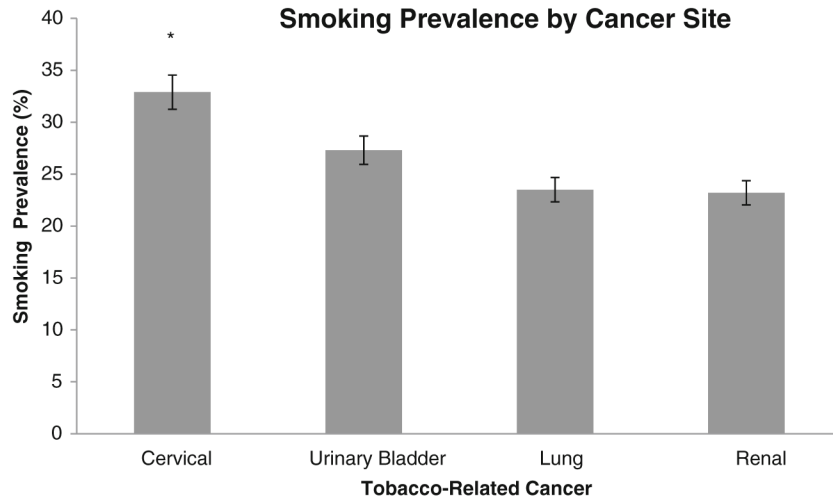


Fig. 5.

Adjusted smoking prevalence by site among TRCS [32]. *BRFSS* Behavioral Risk Factor Surveillance System. All data are based on self-report and are weighted. For cancer survivors reporting more than one cancer diagnosis, the cancer site reported was the most recently diagnosed cancer. TRCS include respondents who report a prior diagnosis of lung/bronchial, pharyngeal, esophageal, stomach, pancreatic, kidney/renal, urinary bladder, or cervical cancer. Tobacco-related cancers are defined according to a 2004 Surgeon General report [8]. To capture acute myelogenous leukemia survivors, all patients who reported a leukemia diagnosis were included in the tobacco-related cancer survivor population. Data for pharyngeal, esophageal, stomach, pancreatic, urinary, and leukemia cancer sites were suppressed because of sample size of <50 or half width of CI of >10. Current smoking defined as regular or intermittent smoking and having smoked >100 cigarettes ever. Smoking prevalence adjusted for race/ethnicity, sex, age, insurance coverage, and employment status. * $p < .05$; p values calculated from linear contrasts between cervical and other cancer sites

Table 1
Demographic characteristics among TRCS, other cancer survivors and respondents without cancer [32]

Characteristic	Cancer survivors (8 %)			Other cancer survivors ^b (80 %)			Respondents without cancer ^c (92 %)		
	TRCS ^a (20 %)								
	<i>n</i>	%	95 % CI	<i>n</i>	%	95 % CI	<i>n</i>	%	95 % CI
Sex									
Male	1,029,045	32.5	30.6–34.5	5,366,835	42.2	41.2–43.2	96,237,611	49.1	48.8–49.5
Female	2,132,864	67.5	65.5–69.4	7,350,156	57.8	56.8–58.9	99,616,696	50.9	50.5–51.2
Age (year)									
18–39	583,578	18.5	16.5–20.5	888,346	7.0	6.2–7.7	80,476,921	41.1	40.7–41.5
40–49	461,755	14.6	13.1–16.1	1,344,271	10.6	9.9–11.3	39,887,329	20.4	20.1–20.6
50–65	928,246	29.4	27.5–31.2	3,989,957	31.4	30.5–32.3	47,249,515	24.1	23.9–24.4
65	1,175,323	37.2	35.3–39.0	6,422,819	50.5	49.5–51.5	27,299,966	13.9	13.8–14.1
Mean		57	56.2–57.8		63.2	62.9–63.6		44.8	44.7–44.9
Age at cancer diagnosis (year)									
<18	165,823	5.2	3.9–6.6	274,848	2.2	1.7–2.6	NA		
18–39	1,243,503	39.3	37.3–41.4	2,447,504	19.2	18.4–20.1	NA		
40–49	413,520	13.1	11.4–14.7	2,215,676	17.4	16.6–18.2	NA		
50–64	684,600	21.7	20.1–23.2	4,285,244	33.7	32.8–34.6	NA		
65	654,462	20.7	19.2–22.2	3,493,718	27.5	26.7–28.2	NA		
Mean		45.0	44.1–45.8		53.1	52.7–53.5			
Years since cancer diagnosis									
5	1,067,508	33.8	31.7–35.8	4,754,828	37.4	36.4–38.4	NA		
6–10	592,684	18.7	17.2–20.3	2,754,224	21.7	20.8–22.5	NA		
>10	1,433,583	45.3	43.3–47.4	4,864,766	38.3	37.3–39.2	NA		
Race/ethnicity									
Non-Hispanic white	2,455,100	77.7	75.4–79.9	10,265,358	80.7	79.7–81.8	131,080,300	66.9	66.6–67.3
Non-Hispanic black	245,122	7.8	6.2–9.3	952,489	7.5	6.8–8.2	20,287,602	10.4	10.1–10.6
Asian/NH/PI	26,607	0.8	0.5–1.2	170,450	1.3	0.9–1.7	7,235,775	3.7	3.5–3.9
AI/AN	38,226	1.2	0.9–1.5	130,258	1	.08–1.2	2,019,550	1.0	1.0–1.1

Characteristic	Cancer survivors (8 %)			Other cancer survivors ^b (80 %)			Respondents without cancer ^c (92 %)		
	n	%	95 % CI	n	%	95 % CI	n	%	95 % CI
TRCS^d (20 %)									
n=3,161,908									
Hispanic	275,026	8.7	6.9–10.5	788,198	6.2	5.5–6.9	29,413,819	15.0	14.7–15.4
Multiracial	79,350	2.5	1.8–3.2	213,697	1.7	1.4–1.9	3,012,400	1.5	1.4–1.6
Other	41,328	1.3	0.8–1.8	191,328	1.5	1.3–1.7	2,755,648	1.4	1.3–1.5
General health status									
Poor	499,450	15.8	14.4–17.2	1,312,350	10.3	9.7–10.9	7,016,718	3.6	3.5–3.7
Education									
<High school diploma	416,684	13.2	11.6–14.8	1,143,436	9.0	8.5–9.5	20,441,996	10.5	10.2–10.7
High school diploma	1,923,613	61.0	58.9–63.0	6,978,867	55.0	54.0–55.9	106,843,435	54.6	54.3–55.0
College graduate	814,599	25.8	23.9–27.7	4,569,910	36.0	35.1–36.9	68,221,639	34.9	34.6–35.2
Health insurance									
Yes	2,822,696	89.3	87.8–90.7	11,961,355	94.1	93.5–94.7	164,146,080	83.8	83.5–84.1
No	336,284	10.6	9.2–12.1	727,740	5.7	5.1–6.3	30,963,569	15.8	15.5–16.1
Residence by US Census region ^d									
Northeast	560,107	17.8	16.2–19.5	2,467,607	19.5	18.7–20.4	35,346,698	18.3	18.0–18.6
Midwest	684,260	21.8	20.3–23.3	2,917,472	23.1	22.3–23.9	43,164,810	22.4	22.1–22.6
South	1,247,543	39.7	37.6–41.9	4,704,178	37.3	36.3–38.2	71,508,559	37.1	36.7–37.4
West	646,771	20.6	19.0–22.2	2,539,021	20.1	19.4–20.8	42,973,600	22.3	22.0–22.6

All data are based on self-report and are weighted. For cancer survivors reporting more than one cancer diagnosis, the cancer site reported was the most recently diagnosed cancer

BRFSS Behavioral Risk Factor Surveillance System, NH Native Hawaiian, PI Pacific Islander, AI/AN American Indian/Alaska Native, TRCS tobacco-related cancer survivors

^d Include respondents who report a prior diagnosis of lung/bronchial, pharyngeal, esophageal, stomach, pancreatic, kidney/renal, urinary bladder, or cervical cancer. Tobacco-related cancers are defined according to a 2004 Surgeon General report [8]. To capture acute myelogenous leukemia survivors, all patients who reported a leukemia diagnosis were included in the tobacco-related cancer survivor population

^b Include respondents who report a prior diagnosis of any cancer, not designated as tobacco-related by the US Surgeon General

^c Include anyone who reports never being diagnosed with cancer

^d Northeast: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, and Pennsylvania; Midwest: Indiana, Illinois, Michigan, Ohio, Wisconsin, Iowa, Nebraska, Kansas, North Dakota, Minnesota, South Dakota, Missouri; South: Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia,

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Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas; West: Arizona, Colorado, Idaho, New Mexico, Montana, Utah, Nevada, Wyoming, Alaska, California, Hawaii, Oregon, and Washington

Table 2

Distribution of self-reported cancer survivors by site[32]

Cancer type	Number	Percentage	95 % CI
<i>TRCS^a</i>			
Cervical	1,398,474	44.2	42.2–46.3
Head/neck	106,612	3.4	2.7–4.1
Oral	83,167	2.6	1.9–3.4
Pharyngeal	96,759	3.1	2.4–3.7
Esophageal	47,296	1.5	1.1–1.9
Pancreatic	61,153	1.9	1.4–2.5
Stomach	73,788	2.3	1.8–2.9
Leukemia	237,209	7.5	6.4–8.6
Lung	445,055	14.1	12.4–15.8
Bladder	367,569	11.6	10.5–12.7
Renal	244,826	7.7	6.7–8.8
<i>Other cancer survivors^b</i>			
Breast cancer	3,135,383	24.7	23.9–25.5
Endometrial cancer (cancer of the uterus)	519,140	4.1	3.7–4.5
Ovarian cancer (cancer of the ovary)	467,568	3.7	3.3–4.1
Thyroid	429,033	3.4	3.0–3.7
Colon	1,000,723	7.9	7.4–8.4
Liver	66,426	0.5	0.4–0.7
Rectal	76,851	0.6	0.5–0.7
Hodgkin's lymphoma	276,828	2.2	1.9–2.5
Non-Hodgkin's lymphoma	309,034	2.4	2.0–2.9
Prostate	2,155,621	17.0	16.2–17.7
Testicular	185,258	1.5	1.1–1.8
Melanoma	1,971,310	15.5	14.9–16.2
Heart ^c	–	–	–
Bone	110,416	0.9	0.6–1.1
Brain	93,969	0.7	0.5–0.9
Neuroblastoma ^c	–	–	–
Other ^d	1,434,360	11.3	10.6–12.0

All data are based on self-report and are weighted. For cancer survivors reporting more than one cancer diagnosis, the cancer site reported was the most recently diagnosed cancer

BRFSS Behavioral Risk Factor Surveillance System, *TRCS* tobacco-related cancer survivors

^a Include respondents who report a prior diagnosis of lung/bronchial, pharyngeal, esophageal, stomach, pancreatic, kidney/renal, urinary bladder, or cervical cancer. Tobacco-related cancers are defined according to a 2004 Surgeon General report [8]. To capture acute myelogenous leukemia survivors, all patients who reported a leukemia diagnosis were included in the tobacco-related cancer survivor population

^b Include respondents who report a prior diagnosis of any cancer not designated as tobacco-related

^c Data for heart and neuroblastoma cancer sites were suppressed because of sample size of <50 or half width of CI of >10

^dOther cancer sites include brain, bone, thyroid, heart and the response category of other; laryngeal cancer (a tobacco-related cancer) was not included in the 2009 BRFSS survey and is therefore included as “other” cancer

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Adjusted and unadjusted prevalence of tobacco use and health status among TRCS, other cancer survivors, and respondents without cancer [32]

Table 3

	TRCS ^a	SE	Other ^b	SE	No cancer ^c	SE	<i>p</i> ^d
Unadjusted prevalence							
Tobacco use							
Current smoker ^e	26 %	±0.903	12 %	±0.354	18 %	±0.148	<0.001
Current smokeless ^f	2 %	±0.295	2 %	±0.124	4 %	±0.075	<0.001
Former smoker	40 %	±0.104	37 %	±0.460	23 %	±0.139	<0.001
Quit rate ^g	0.60		0.75		0.56		
Adjusted prevalence ^h							
Tobacco use							
Current smoker	27 %	±0.009	16 %	±0.004	18 %	±0.001	<0.001
Current smokeless	3 %	±0.004	3 %	±0.002	4 %	±0.001	<0.001
Former smoker	33 %	±0.095	26 %	±0.004	24 %	±0.001	<0.001
Quit rate	0.55		0.62		0.57		

All data are based on self-report and are weighted. For cancer survivors reporting more than one cancer diagnosis, the cancer site reported was the most recently diagnosed cancer

BREFFS Behavioral Risk Factor Surveillance System, TRCS tobacco-related cancer survivors, SE standard error, Other other cancer survivors, No cancer respondents without cancer

^a Include respondents who report a prior diagnosis of lung/bronchial, pharyngeal, esophageal, stomach, pancreatic, kidney/renal, urinary bladder, or cervical cancer. Tobacco-related cancers are defined according to a 2004 Surgeon General report [8]. To capture acute myelogenous leukemia survivors, all patients who reported a leukemia diagnosis were included in the tobacco-related cancer survivor population

^b Include respondents who report a prior diagnosis of any cancer, not designated as tobacco-related

^c Include anyone who reports never being diagnosed with cancer

^d *P* values were calculated from linear contrasts between TRCS and respondents without cancer

^e Current smoking defined as regular or intermittent smoking and having smoked >100 cigarettes ever

^f Smokeless tobacco includes chewing tobacco, snus, and snuff

^g Quit ratio is based on attempts to quit smoking, defined as not smoking for at least one day in the last year in an effort to quit smoking

^h Adjusted for race/ethnicity, sex, age, insurance coverage and employment status