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## Current depression among adult cancer survivors: Findings from the 2010 Behavioral Risk Factor Surveillance System

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### Abstract

**Background:** A cancer diagnosis and subsequent treatments constitute a significantly increased psychological burden among cancer patients. This study examined the prevalence of current depression and the risk factors associated with a high burden of depression among cancer survivors in the US.

**Methods:** We analyzed data from 3550 cancer survivors (aged ≥ 18 years) and 26,917 adults without cancer who participated in the 2010 Behavioral Risk Factor Surveillance System. Depressive symptoms were assessed by the Patient Health Questionnaire-8 diagnostic algorithm. Participants with a total depression severity score of ≥ 10 were defined as having current depression. Prevalence and prevalence ratios were estimated by conducting log-linear regression analysis while controlling for potential confounders.

**Results:** Overall, 13.7% of cancer survivors (vs. 8.9% of adults without cancer,  $P < 0.001$ ) reported having current depression; the prevalence varied significantly by cancer category. Among

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#### Authorship contributions

Drs. Zhao, Okoro, and J. Li had full access to the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Zhao, J. Li involved in study concept and design. Zhao involved in acquisition of data. Zhao, Okoro, J. Li, C. Li involved in analysis and interpretation of data. Zhao, Okoro involved in drafting of the manuscript. All authors involved in critical revision of the manuscript for important intellectual content. Zhao involved in statistical analysis. C. Li involved in administrative, technical, and material support, and study supervision.

#### Conflict of interest statement

All authors declare no conflict of interest.

#### Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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cancer survivors, after multivariate adjustment for covariates, cancer diagnosis within a year, being in 'other' racial/ethnic group, divorced, separated, widowed, or never married, current or former smoker, or having histories of diabetes, disability, or depression were associated with significantly higher prevalence ratios for current depression; whereas being at an advanced age ( > 60 years old), attaining educational levels of >high school graduate, or engaging in leisure-time physical activity were associated with significantly lower prevalence ratios for current depression.

**Conclusion:** Our results indicate that cancer survivors are at increased risk of current depression. Targeting cancer survivors at high risk of depressive issues may be especially important for clinical support and interventions aimed at improving mental well-being.

## Keywords

Cancer survivor; Current depression; Depressive symptoms; Patient Health Questionnaire-8 (PHQ-8); BRFSS

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## 1. Introduction

Cancer is a major public health problem and constitutes the second leading cause of death in the US [1–3]. The advances in cancer screening and diagnostic methods, effective treatment, and improved post-treatment follow-up care have led to a sustained decline in cancer mortality and a steady increase in the number of cancer survivors over the past decade in the US [4,5].

Cancer patients experience a significant level of psychosocial problems as a consequence of their cumulative adverse experiences from the time they start coping with their initial diagnosis and uncertain prognosis, through the period when they cope with treatments, side-effects, and financial burden, followed by their survival stage where they face lingering concerns about disease recurrence. For example, previous studies have shown that cancer patients had increased risks for depression, anxiety, and other psychiatric disorders especially within the first year after cancer diagnosis [6–11]. A recent meta-analysis also showed the prevalence of depression was 8–24% among cancer patients; this wide range of prevalence may be attributable to the differences in the type of instruments used to measure depression, the type of cancer, or the treatment phase [12]. In addition, population-based surveys of US adults and Australians have also shown a significantly higher prevalence of serious psychological distress [13–15], depression, anxiety, and post-traumatic stress disorder [16,17] among cancer survivors compared with adults with no cancer history.

Despite the high burden of psychological disorders in cancer patients, utilization of mental health services is low among cancer patients [15,18]. Psychosocial interventions have proven effective and economical for helping cancer patients and families overcome challenges associated with cancer diagnosis, decrease distress, increase coping with cancer treatment, and improve mood and quality of life [19–21]. For example, in a randomized controlled trial, Stagl et al. reported that early cognitive-behavioral stress management was associated with fewer depressive symptoms in long-term breast cancer survivors [22]. Thus, screening and identifying cancer survivors who are at elevated risk of depressive issues would be important

for providing clinical support and interventions to improve long-term psychological well-being in cancer survivors.

To date, no population-based studies have been conducted to evaluate current depression among US cancer survivors. By using a large, US state-based population survey, we sought to (1) determine the prevalence of current depression among cancer survivors overall, by type and number of cancers, by duration of cancer survivorship, and by cancer treatment; (2) compare depression prevalence to that found among adults with no cancer history; and (3) investigate potential predictors to identify cancer survivors at high risk of current depression based on their sociodemographic characteristics, lifestyle factors, and comorbid chronic conditions.

## 2. Methods

### 2.1. Study design

The Behavioral Risk Factor Surveillance System (BRFSS) is a population-based telephone survey conducted annually in all 50 states, Washington, DC, and participating US territories to collect health information including health-related behavioral risk factors, preventive health practices, health care access, and chronic conditions among noninstitutionalized US adults aged 18 years or older. Detailed information about the BRFSS survey design, sampling methods, data collection, and weights has been described elsewhere [23–26]. The median survey response rate for the 2010 BRFSS was 54.6%, and the median cooperation rate (the percentage of eligible persons contacted who completed the interview) was 76.9% [23].

### 2.2. Study population and data collection

In the 2010 BRFSS, 6 states (Indiana, Massachusetts, Missouri, New Jersey, Ohio, and Wisconsin) used both the Cancer Survivorship Module and the Anxiety and Depression Module; therefore, data collected in these 6 states were analyzed for this study. The questionnaire for the Cancer Survivorship Module has been described previously [15]. Participants were asked whether they had ever been told by a doctor, nurse, or other health professional that they had cancer (response dichotomized as yes/no), and if yes, how many different types of cancer they had (dichotomized as having 1 or 2 types of cancer), at what age they received the first cancer diagnosis, and with what type of cancer they were most recently diagnosed. The duration of cancer survivorship was calculated as participants' age subtracted by the age of first diagnosis, and was categorized as 1, >1 to <5, 5 to <10, 10 to <15, 15 to <20, 20 to <25, and ≥25 years. Based on the most recent cancer diagnosis, cancer types were categorized in the following groups: (1) female breast cancer, (2) female reproductive cancer (i.e., cervical, endometrial, and ovarian cancer), (3) male reproductive cancer (i.e., prostate and testicular cancer), (4) gastrointestinal cancer (i.e., cancer of the colon, esophagus, liver, pancreas, rectum, and stomach), (5) melanoma skin cancer (nonmelanoma skin cancer, a relatively benign condition, was excluded from our analysis.), (6) other known cancers (including male breast cancer, leukemia/lymphoma, neuroblastoma, and cancers of the brain, neck, oral cavity, pharynx, thyroid, heart, lung, kidney, bladder, bone, or any other body region), and (7) type-unknown cancers. Cancer treatment was

assessed by asking participants whether they were currently receiving treatment for cancer including surgery, radiation therapy, chemotherapy, or chemotherapy pills (dichotomized as yes/no).

The Anxiety and Depression Module assessed participants' depressive symptoms by using the Patient Health Questionnaire-8 (PHQ-8) diagnostic algorithm as described elsewhere [27,28] with response options and scoring summarized in Table 1. Participants with a total depression severity score of  $\geq 10$  were defined as having current depression. The PHQ-8 has been shown to provide valid measures of depressive symptoms and severity among the general population as used for the diagnostic criteria of the DSM-IV major depressive disorder [29]. A total depression score of  $\geq 10$  has a sensitivity and specificity of 88% for major depression, representing clinically significant depression [29–31].

For study covariates, we included demographic variables such as age in years (18–39, 40–59, 60–79, and  $\geq 80$ ), sex, race/ethnicity (non-Hispanic white, non-Hispanic black, and other), educational attainment (less than high school graduate, high school graduate or GED, and greater than high school graduate), and marital status (currently married/living with a partner, previously married – i.e., divorced, widowed, or separated, and never married). In addition, we also included in our analysis health-related behavioral risk factors (i.e., cigarette smoking, leisure-time physical activity, and excessive alcohol drinking), health care access measures (insurance coverage and routine check-up), and comorbid chronic conditions (i.e., obesity, physician-diagnosed diabetes and heart disease, disability, and ever-diagnosed depression); definitions for these measures are summarized in Table 2.

### 2.3. Statistical analyses

During the data management process, participants who responded “don't know/not sure,” refused to answer, or had missing responses to any of the study variables were set as missing. We estimated the weighted prevalence of current depression by cancer diagnosis overall and by category and number of cancers, duration of survivorship, and cancer treatment. A log-linear regression analysis with robust variance estimator was conducted to estimate the prevalence ratios (PRs) and 95% confidence intervals (CIs) for current depression after adjustment for study covariates. We conducted the analyses by using SAS (version 9.2, SAS Institute, Cary, NC) and SUDAAN software (release 10.0.1, Research Triangle Institute, Research Triangle Park, NC) to account for the multistage, complex sampling design.

## 3. Results

### 3.1. Characteristics of the study population

During data collection for the 2010 BRFSS survey, a total of 35,926 adults participated in the survey for both the Cancer Survivorship Module and the Anxiety and Depression Module in the 6 states that chose to use these modules, which included 4085 adults who reported having cancer, 30,950 adults who reported no history of cancer, and 891 adults who reported “don't know/not sure” or had a missing response to the question on whether they had ever been told that they had cancer. After further excluding participants

who had missing data on any of the study variables, 3550 cancer survivors and 26,917 adults with no history of cancer remained in our analytical sample. The characteristics of eligible participants by cancer status are shown in Table 3. Compared with adults with no cancer history, cancer survivors were more likely to be older, female, and non-Hispanic white, be physically inactive, have insurance coverage and a routine check-up during the previous year, or have chronic conditions including diabetes, heart disease, disability, and ever-diagnosed depression; however, they were less likely to be married or living with a partner, attain educational levels of >high school, have never smoked, or excessively drank alcohol ( $P < 0.05$  for all comparisons). Among cancer survivors, the composition of the cancer category ranged from 7.2% for gastrointestinal cancer to 24.9% for other known cancers. Approximately 86.2% reported having only 1 cancer, and 11.8% reported receiving cancer treatment at the time the survey was conducted. The mean and median durations of cancer survivorship were 11.2 and 7.6 years, respectively.

### 3.2. Prevalence of current depression among cancer survivors versus adults with no cancer history

The prevalence of current depression was significantly higher among cancer survivors than among adults with no cancer history (prevalence 13.7% versus 8.9%, PR: 1.54, 95% CI: 1.31–1.80, Table 4). After multivariable adjustment for demographic variables (including age, sex, race/ethnicity, education, and marital status), health-related behavioral risk factors (leisure-time physical activity, smoking, and excessive alcohol drinking), and health care access (health insurance coverage and routine check-up) (Model 2, Table 4), the PR for current depression was 66% ( $P < 0.001$ ) higher among cancer survivors than adults without cancer; the PR remained 25% ( $P < 0.001$ ) higher among cancer survivors following further adjustment for major chronic comorbidities including obesity, diabetes, heart disease, disability, and ever-diagnosed depression (Model 3, Table 4). Exclusion of adults who reported having ever-diagnosed depression ( $n = 5492$ ) yielded similar results (adjusted PR: 1.40, 95% CI: 1.11–1.77).

The prevalence of current depression varied significantly by category of cancer—the lowest was among men with reproductive cancers (5.8%) and the highest was among women with reproductive cancers (26.4%). After multivariable adjustment for demographic variables, health-related behavioral risk factors, and health care access (Model 2, Table 4), the PR for current depression was 74% ( $P < 0.001$ ) higher among female reproductive cancer survivors versus women without cancer, and the PRs were 85%, 141%, 64%, and 74% ( $P < 0.001$  for all) higher among adults with gastrointestinal cancer, melanoma skin cancer, other known cancers, and type-unknown cancers, respectively, than among adults without cancer (Model 2, Table 4). These associations remained statistically significant (except for other known cancers) after further adjustment for chronic comorbid conditions (Model 3, Table 4).

### 3.3. Potential predictors to identify cancer survivors who were at elevated risk of current depression

Among cancer survivors, the multivariable adjusted PR for current depression was 61% ( $P < 0.001$ ) higher among cancer survivors who received a cancer diagnosis within the past year compared with those with  $\geq 25$  years of survivorship; however, the prevalence of

depression did not vary much by number of cancers and by current cancer treatment (Table 5). Moreover, after adjustment for potential confounding factors, being in ‘other’ racial/ethnic group, never married, current or former smoker, and having histories of diabetes, disability, or ever-diagnosed depression were associated with significantly higher PRs for current depression; being divorced, separated, or widowed was marginally associated with a higher PR ( $P = 0.056$ ); whereas being 60 years or older, educational level of >high school graduate, and engaging in leisure-time physical activity were associated with significantly lower PRs for current depression (Table 5).

#### 4. Discussion

Our results from a 6-state population survey demonstrated a significantly higher prevalence of current depression among cancer survivors than adults with no history of cancer (14% versus 9%). Compared with those who had no cancer history, women with reproductive cancers were 22% more likely to report current depression and adults with gastrointestinal cancers and melanoma skin cancer were 53% and 58% more likely to report so, respectively. In addition, cancer diagnosis within a year, being in ‘other’ racial/ethnic group, divorced, separated, widowed, or never married, current or former smoker, or having histories of diabetes, disability, or depression were associated with a significantly higher risk for current depression. This information has important implications for providing clinical support and optimizing intervention strategies targeting cancer survivors who are at elevated risk of depression to improve their mental health and overall well-being.

Previous studies have shown that non-specific serious psychological distress, mood disorders, depression and anxiety are highly prevalent among patients diagnosed with cancer [6–15]. Studies with population-based survey samples of US adults also showed that cancer survivors had poor physical and mental health-related quality of life than adults without cancer [32,33]. For depressive symptoms, a wide range of depression prevalence (pooled mean prevalence varied from 8% to 24%) among cancer patients has been reported in studies with different settings, different depression screening tools applied, different types of cancer, and different durations of cancer survivorship [12]. For example, in palliative cancer care settings in Australia, the prevalence of depression was much higher among patients with cancers (45.8% based on the 14-item screening tool of Hospital Anxiety and Depression Scale [HADS] cutoff point 8 and 22.7% based on HADS cutoff point 11) [10]. In contrast, studies of population-based survey samples of cancer survivors in Australia showed that the prevalence of depression was 14% (HADS cutoff point 8) among adult cancer survivors 6 months after diagnosis [17] and was 7% (HADS cutoff point 8) and 4% (HADS cutoff point 12) among cancer survivors 5 years after diagnosis [16]. Meta-analyses of interview-based samples from palliative cancer care settings across 7 countries reported that the pooled prevalence of depression, defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM) or International Classification of Diseases criteria, was 16.5% [9]; however, the prevalence of depression was 11.6% among long-term cancer survivors (diagnosed with cancer at least 2 years ago), which was not significantly different from that reported among healthy controls (10.2%, pooled relative risk 1.11, 95% CI: 0.96–1.27) [34]. Our results from a large, population-based sample of US adult cancer survivors showed that cancer survivors had significantly higher depressive symptoms than adults without cancer;

this relationship persisted even after multivariable adjustment for potential confounding factors including ever-diagnosed depression, or among participants who had never been diagnosed with depression.

Consistent with previous studies, our results showed the prevalence of current depression varied significantly by type of cancers and by duration of survivorship. A study conducted among Canadian cancer patients after cancer diagnosis but before beginning treatment showed that women with breast and gynecological cancers had higher rates of depression [7]. In the present study, a majority of female breast cancer survivors (89.5%) had survived more than 1 year. In addition, breast cancer can be detected earlier through widely used mammogram screening in the US with good prognosis after treatment. Therefore, it is not unexpected that depression status among breast cancer survivors was similar to women without cancer in the present study. This also suggests that most breast cancer survivors may have adjusted well to their cancer experience. On the other hand, women with ovarian and cervical cancers may have reproduction-related concerns, especially younger women who may be concerned about loss of fertility [35–37]. Patients with colorectal cancer may have colostomy bags and other issues that impact their quality of life [38,39]. Patients with melanoma skin cancer may concern the visibility of affected body site that affects body image and self-identity [40]. All these concerns and worries may help explain why cancer survivors were at increased risk of depression compared with adults with no history of cancer as observed in the present study. Taken together, our study provides important information on psychological challenges among cancer survivors, especially among women with reproductive cancers, and among both men and women with gastrointestinal and melanoma skin cancers.

Our results further demonstrated that depression was an issue among newly diagnosed cancer patients; however, with increasing years of survivorship, the prevalence of depression was gradually attenuated and, by more than 20 years of survivorship, it was at a similar level as shown among adults with no cancer history. This is consistent with the finding of a meta-analysis showing the pooled prevalence of depression across seven countries did not differ significantly between long-term cancer survivors (diagnosed with cancer at least 2 years ago) and healthy controls [34]. Another study conducted among German female breast cancer survivors also reported no differences in the frequency of depression among patients during various postdiagnosis months ranging from 18 to 24 months to more than 60 months [41]. For cancer treatment, it has been reported that chemotherapy [17] or radiotherapy [11] during the previous month was associated with an increased likelihood of depression; whereas hormone treatment during the previous month was associated with a lower likelihood of having depression [17]. Our results showed that overall current cancer treatment (including surgery, radiation therapy, chemotherapy, or chemotherapy pills) did not affect depression status. The type of cancer determines the type of treatment a patient receives. Some prostate cancer patients may choose watchful waiting rather than undergo treatment [42,43]; other cancer patients may undergo more extensive treatment. In the present study, data on the type of treatment were not available; therefore, the impact of individual treatment protocols on depressive symptoms could not be evaluated. This needs to be investigated further in future studies.

Of importance is that by using a large population-based survey sample, we were able to conduct stratified analyses to identify cancer survivors who were at increased risk of depression. In general, younger adults have worse prognosis after cancer diagnosis than middle-aged and old adults; adults who are in 'other' racial/ethnic group, divorced/separated/widowed or never married, or less educated are generally in low socioeconomic status and lack of family or social support; adults with unhealthy lifestyle behaviors (smoking or physically inactive) or with comorbid chronic conditions (diabetes, disability, or ever-diagnosed depression) may already be experiencing some kind of distress. These patients are socially vulnerable which may help explain why they had increased risk for depression. Thus, enhanced clinical support and public intervention programs could target these socially vulnerable groups to improve their mental well-being. On the other hand, studies have shown improved education and knowledge of cancer status through counseling and engaging in physical activity elicit favorable effects on mental health [15,44], which is consistent with our findings that advanced education and a physically active lifestyle were associated with a lower risk of depression among cancer survivors.

There are several limitations we would like to acknowledge. First of all, information on cancer status and depressive symptoms was self-reported and subject to recall bias. Also, the nature of our cross-sectional study design does not allow us to establish a causal relationship between cancer status and depression. Second, the 2010 BRFSS survey excluded institutionalized adults, those with only mobile phone service, and the homeless. This coverage issue in sampling frame in combination with the overall low response rate may have resulted in selection bias. This would result in an underestimated prevalence of depression because adults who are institutionalized (such as those hospitalized or live in nursing homes), or adults who are in low socioeconomic status (such as those with mobile phone service only and those who are homeless), or those who are unable to answer or complete phone calls due to severe cancer status are more likely to have mental illness. Third, detailed information about cancer stages and type of treatments were not assessed because of lack of data. Fourth, due to a relatively small sample size, we were only able to evaluate cancer types by categories (e.g. reproductive cancers, gastrointestinal cancers). There are significant differences by type of cancer in screening options, diagnosis, treatment, and prognosis that may have differentially affected patients' mental health. Thus, future prospective studies are needed to establish the relative contributions of type of cancer, type of treatment, and treatment phase to depression in cancer survivors. Finally, our data were collected from 6 states; this did not allow us to capture cancer survivors at the national level, so the generalizability of the results is limited.

The number of cancer survivors continues to increase in the US because of the growth of the aging population and improved survival (advanced cancer detection, effective cancer treatment, and supportive care services) [4]. There were an estimated 14.5 million cancer survivors as of January 1, 2014, which is projected to increase to about 19.0 million by January 1, 2024 [45]. Thus, understanding their psychosocial characteristics and mental health challenges is important to improve the quality of survivorship. Our results provide timely important information about depression status among cancer survivors with different characteristics. Targeting cancer survivors who are at elevated risk of depression as



identified in this study is essential for providing clinical support and interventions to improve their mental well-being.

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**Table 1**

Patient Health Questionnaire-8 (PHQ-8) diagnostic algorithm for assessing depressive symptoms in a general population.

Item	PHQ-8 question	Response	Depression severity score
1	Over the last 2 weeks, how many days have you had little interest or pleasure in doing things?	0-1 day	0
		2-6 days	1
		7-11 days	2
		12-14 days	3
2	Over the last 2 weeks, how many days have you felt down, depressed or hopeless?	0-1 day	0
		2-6 days	1
		7-11 days	2
		12-14 days	3
3	Over the last 2 weeks, how many days have you had trouble falling asleep or staying asleep or sleeping too much?	0-1 day	0
		2-6 days	1
		7-11 days	2
		12-14 days	3
4	Over the last 2 weeks, how many days have you felt tired or had little energy?	0-1 day	0
		2-6 days	1
		7-11 days	2
		12-14 days	3
5	Over the last 2 weeks, how many days have you had a poor appetite or eaten too much?	0-1 day	0
		2-6 days	1
		7-11 days	2
		12-14 days	3
6	Over the last 2 weeks, how many days have you felt bad about yourself or that you were a failure or had let yourself or your family down?	0-1 day	0
		2-6 days	1
		7-11 days	2
		12-14 days	3
7	Over the last 2 weeks, how many days have you had trouble concentrating on things, such as reading the newspaper or watching TV?	0-1 day	0
		2-6 days	1
		7-11 days	2
		12-14 days	3
		0-1 day	0
		2-6 days	1
		7-11 days	2

Item	PHQ-8 question	Response	Depression severity score
8	Over the last 2 weeks, how many days have you moved or spoken so slowly that other people could have noticed? Or the opposite – being so fidgety or restless that you were moving around a lot more than usual?	12–14 days 0–1 day 2–6 days 7–11 days 12–14 days	3 0 1 2 3
A sum of depression severity score			0–24

**Table 2**

Measures and definitions for health-related behavioral risk factors, healthcare access, and chronic comorbid conditions used in the 2010 BRFSS.

Measure	Category	Definition
<i>Health-related behavior</i>		
Cigarette smoking	Current smoker	Participants who had smoked 100 cigarettes during their lifetime and were still smoking at the survey time.
	Former smoker	Participants who had smoked 100 cigarettes in their entire life but stopped smoking at the survey time.
	Never smoked	Participants who had smoked <100 cigarettes during their lifetime.
Leisure-time physical activity	Yes	Participants who had participated in, other than their regular job, any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise during the previous month.
	Yes	Participants who consumed a daily average of any alcoholic beverages of >2 drinks (for men) or >1 drink (for women), or who had an episode of consuming at least 5 (for men) or 4 (for women) drinks on one occasion during the previous 30 days.
<i>Healthcare access</i>		
Insurance coverage	Yes	Participants who reported having any kind of healthcare coverage including health insurance, prepaid plans such as HMOs, or government plans such as Medicare during the previous year.
Routine check-up	Yes	Participants who reported having routine health check-up during the previous year.
<i>Chronic condition</i>		
Obesity status	Under/normal weight	BMI <25.0 kg/m <sup>2</sup>
	Overweight	BMI 25.0 to <30.0 kg/m <sup>2</sup>
	Obesity	BMI ≥30.0 kg/m <sup>2</sup>
Diabetes	Yes	Participants who had ever been told by a doctor or other health professional that they had diabetes.
Heart disease	Yes	Participants who had ever been told by a doctor or other health professional that they had heart diseases including heart attack or myocardial infarction and angina pectoris.
Disability	Yes	Participants who reported being limited in any way in any activities because of physical, mental, and emotional problems or having any health problem that requires them to use special equipment such as a cane, wheelchair, special bed, or telephone.
Ever-diagnosed depression	Yes	Participants who had ever been told by a doctor or other health professional that they had depressive disorders including depression, major and minor depression, or dysthymia.

BMI: body mass index – calculated from self-reported weight and height.

Characteristics of adult cancer survivors in comparison with adults without a history of cancer who participated in the 6 state-based BRFSS in 2010.

**Table 3**

Characteristic	Cancer survivor (n = 3550)		Adult with no cancer history (n = 26,917)	
	n	% (95% CI)	n	% (95% CI)
<i>Demographics</i>				
Age (years)	3550	62.1 (62.8) <sup>a</sup>	26,917	46.2 (43.6) <sup>a</sup>
Women	2301	58.4 (55.8–60.9)	16,458	49.9 (49.0–50.9)
Non-Hispanic white	3095	89.0 (87.3–90.6)	22,145	83.0 (82.3–83.7)
Non-Hispanic black	270	4.9 (3.9–6.1)	2661	6.9 (6.5–7.4)
Hispanic	68	2.2 (1.6–3.2)	1067	4.8 (4.4–5.2)
>High school graduate	1998	60.0 (57.5–62.5)	15,954	63.9 (63.0–64.8)
Married/unmarried couple	1804	65.3 (62.9–67.6)	15,373	68.1 (67.2–69.0)
<i>Health-related behavior</i>				
Current smoking	575	17.7 (15.6–20.0)	4927	18.8 (18.1–19.6)
Never smoked	1575	43.2 (40.7–45.8)	14,132	55.5 (54.6–56.5)
Physically inactive	1245	33.1 (30.8–35.4)	7312	23.6 (22.9–24.4)
Excessive alcohol drinking	308	10.8 (9.2–12.6)	3861	18.8 (18.0–19.6)
<i>Healthcare access</i>				
Health insurance coverage	3390	94.0 (92.3–95.3)	24,336	88.8 (88.2–89.5)
Routine check-up	2989	81.9 (79.7–83.9)	19,861	69.2 (68.3–70.1)
<i>Chronic condition</i>				
Obesity	1099	30.6 (28.3–33.0)	8185	28.5 (27.7–29.4)
Diabetes	674	16.8 (15.1–18.6)	3167	7.8 (7.4–8.3)
Heart disease	626	15.8 (14.2–17.6)	2264	5.4 (5.1–5.7)
Disability	1452	39.5 (37.0–42.1)	7085	20.4 (19.7–21.1)
Ever-diagnosed depression	699	19.8 (17.7–22.1)	4793	16.1 (15.4–16.8)
<i>Cancer status</i>				
Female breast cancer	610	16.4 (14.8–18.1)	–	–
Female reproductive cancer	355	12.4 (10.7–14.4)	–	–
Male reproductive cancer	326	12.9 (11.2–14.8)	–	–

Characteristic	Cancer survivor (n = 3550)		Adult with no cancer history (n = 26,917)	
	n	% (95% CI)	n	% (95% CI)
Gastrointestinal cancer	243	7.2 (6.1–8.5)	–	–
Melanoma skin cancer	230	9.3 (7.6–11.4)	–	–
Other known cancers	709	24.9 (22.6–27.2)	–	–
Type-unknown cancers	1077	17.0 (15.7–18.5)	–	–
Having only 1 cancer	2982 <sup>b</sup>	86.2 (84.6–87.7)	–	–
Under cancer treatment	416 <sup>c</sup>	11.8 (10.4–13.3)	–	–
Duration of survivorship	3408	11.2 (7.6) <sup>a</sup>	–	–

<sup>a</sup> Presented as mean and median in parenthesis.

<sup>b</sup> Among 3538 cancer survivors.

<sup>c</sup> Among 3485 cancer survivors.



Prevalence and prevalence ratios with 95% confidence intervals for current depression among cancer survivors versus adults without a history of cancer, BRFSS 2010.

Table 4

	<i>n</i>	% (95% CI)	PR <sup>a</sup> (95% CI)	Model 1	Model 2	Model 3
<i>Cancer status</i>						
Yes	3550	13.7 (11.9–15.9)	1.54 (1.31–1.80)	1.66 (1.42–1.94)	1.25 (1.09–1.44)	
No	26,917	8.9 (8.4–9.5)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	
<i>Among women</i>						
Breast cancer	610	8.4 (5.8–11.9)	0.81 (0.56–1.17)	1.11 (0.80–1.56)	0.93 (0.69–1.24)	
Reproductive cancer	355	26.4 (19.6–34.4)	2.56 (1.91–3.42)	1.74 (1.33–2.27)	1.22 (1.00–1.59)	
No cancer	16,458	10.3 (9.6–11.1)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	
<i>Among men</i>						
Reproductive cancer	326	5.8 (2.8–11.9) <sup>b</sup>	0.77 (0.37–1.63)	1.22 (0.58–2.56)	1.28 (0.63–2.62)	
No cancer	10,459	7.6 (6.8–8.4)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	
<i>Among both men and women</i>						
Gastrointestinal cancer	243	14.3 (9.4–21.3)	1.61 (1.06–2.44)	1.85 (1.24–2.74)	1.53 (1.10–2.14)	
Melanoma skin cancer	230	16.9 (9.1–26.8)	1.89 (0.99–3.79)	2.41 (1.37–4.25)	1.58 (1.19–2.11)	
Other known cancers	709	13.0 (9.8–17.1)	1.46 (1.10–1.94)	1.64 (1.24–2.17)	1.20 (0.86–1.66)	
Type-unknown cancers	1077	14.8 (12.1–17.9)	1.65 (1.35–2.03)	1.74 (1.41–2.15)	1.41 (1.16–1.71)	
No cancer	26,917	8.9 (8.4–9.5)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	

<sup>a</sup>PR: prevalence ratio, Model 1: unadjusted, Model 2: adjusted for demographic variables (including age, sex [except for sex-specific cancer], race/ethnicity, education, and marital status), health-related behavioral risk factors (including leisure-time physical activity, smoking, and excessive alcohol drinking), and healthcare access (including health insurance coverage and routine check-up within the previous year), Model 3: adjusted for the same set of variables as used in Model 2 plus chronic conditions (including obesity status, having histories of diabetes, heart disease, or depression, and disability).

<sup>b</sup>Relative standard error = 37.7%.

**Table 5**

Prevalence and adjusted prevalence ratios with 95% confidence intervals for current depression among cancer survivors ( $n = 3403$ ) by selected characteristics, BRFSS 2010.

	<i>n</i>	% (95% CI)	APR <sup>a</sup> (95% CI)
<i>Cancer survivorship status</i>			
No. of cancers			
1	2910	13.8 (11.6–16.2)	1.00 (ref.)
1	493	12.5 (9.0–17.1)	1.00 (0.74–1.36)
Duration of survivorship (years)			
1	420	16.2 (11.6–22.2)	1.61 (1.05–2.47)
>1 to <5	585	13.9 (8.6–21.5)	1.16 (0.78–1.74)
5 to <10	774	12.8 (9.6–17.1)	1.22 (0.86–1.75)
10 to <15	594	14.4 (10.0–20.2)	1.32 (0.90–1.95)
15 to <20	300	14.8 (9.6–22.3)	1.28 (0.84–1.95)
20 to <25	218	12.1 (6.7–20.8)	1.07 (0.58–1.99)
25	512	10.6 (7.6–14.6)	1.00 (ref.)
Current cancer treatment			
Yes	412	14.4 (10.7–19.2)	1.15 (0.83–1.60)
No	2991	13.5 (11.4–15.9)	1.00 (ref.)
<i>Demographic</i>			
Age (years)			
20–39	130	31.5 (20.2–45.5)	1.00 (ref.)
40–59	873	18.6 (15.2–22.6)	0.75 (0.52–1.07)
60–79	1820	9.1 (7.3–11.4)	0.52 (0.34–0.79)
80	580	4.2 (2.6–6.7)	0.24 (0.13–0.44)
Sex			
Men	1189	10.7 (7.5–15.0)	1.00 (ref.)
Women	2214	15.6 (13.4–18.2)	1.18 (0.90–1.55)
Race/ethnicity			
Non-Hispanic white	2980	12.6 (10.6–14.9)	1.00 (ref.)
Non-Hispanic black	250	14.6 (9.3–22.1)	1.03 (0.60–1.77)
Hispanic	64	19.5 (9.4–36.0) <sup>b</sup>	0.98 (0.64–1.50)
Other	109	32.5 (18.9–49.9)	1.47 (1.04–2.06)
Education			
<High school graduate	303	28.3 (19.9–38.4)	1.00 (ref.)
High school graduate/GED	1159	15.0 (11.1–20.1)	0.77 (0.54–1.09)
>High school graduate	1941	11.0 (9.1–13.2)	0.69 (0.49–0.97)
Marital status			
Married/living with a partner	1747	10.0 (8.2–12.2)	1.00 (ref.)
Divorced/separated/widowed	1394	18.5 (15.2–22.2)	1.22 (0.99–1.56)
Never married	262	28.4 (15.7–45.8)	1.58 (1.02–2.44)

	<i>n</i>	% (95% CI)	APR <sup>a</sup> (95% CI)
<i>Health-related behavior</i>			
Smoking			
Current smoker	552	34.9 (27.9–42.6)	2.24 (1.68–2.99)
Former smoker	1342	10.5 (8.1–13.5)	1.41 (1.05–1.88)
Never smoked	1509	7.6 (5.9–9.9)	1.00 (ref.)
Leisure-time physical activity			
Yes	2222	10.1 (7.9–12.8)	0.73 (0.58–0.93)
No	1181	20.8 (17.3–24.7)	1.00 (ref.)
Excessive alcohol drinking			
Yes	292	15.5 (10.4–22.4)	1.09 (0.71–1.68)
No	3111	13.4 (11.3–15.7)	1.00 (ref.)
<i>Healthcare access</i>			
Health insurance coverage			
Yes	3258	12.7 (10.8–14.9)	1.29 (0.84–1.97)
No	145	27.8 (17.8–40.7)	1.00 (ref.)
Routine check-up			
Yes	2868	12.0 (10.0–14.3)	0.80 (0.60–1.06)
No	535	21.0 (15.9–27.3)	1.00 (ref.)
<i>Chronic condition</i>			
Obesity status			
Under/normal weight	1097	12.4 (9.7–15.6)	1.00 (ref.)
Overweight	1250	11.8 (8.5–16.1)	0.82 (0.63–1.06)
Obesity	1056	17.1 (13.6–21.3)	0.92 (0.68–1.24)
Diabetes			
Yes	641	20.5 (15.9–26.0)	1.30 (1.01–1.66)
No	2762	12.2 (10.2–14.7)	1.00 (ref.)
Heart disease			
Yes	597	18.2 (14.0–23.3)	1.09 (0.82–1.45)
No	2806	12.8 (10.6–15.2)	1.00 (ref.)
Disability			
Yes	1378	26.0 (22.0–30.5)	2.85 (2.12–3.84)
No	2025	5.7 (4.3–7.5)	1.00 (ref.)
Ever-diagnosed depression			
Yes	674	42.7 (36.2–49.4)	3.23 (2.44–4.26)
No	2729	6.4 (5.1–8.0)	1.00 (ref.)

<sup>a</sup>APR: adjusted prevalence ratio, adjusted for all other variables listed in the table.

<sup>b</sup>Relative standard error = 34.6%.