



# Food insecure cancer survivors continue to smoke after their diagnosis despite not having enough to eat: implications for policy and clinical interventions

Hermine Poghosyan<sup>1</sup> · Samuel V. Scarpino<sup>2</sup>

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## Abstract

**Purpose** This cross-sectional study examined whether food insecurity among cancer survivors is associated with smoking status and quit attempt.

**Methods** Data from the 2015 behavioral risk factor surveillance system, social context module on 6,481 adult cancer survivors, were used in this study. Outcome variables were smoking status and quit attempt. Key independent variable was food insecurity. We estimated adjusted odds ratios (AOR) and 95% confidence intervals (CI) using weighted multivariable logistic regression models while controlling for individual-level demographic, socioeconomic, clinical, and behavioral characteristics.

**Results** About 19.0% of cancer survivors were current smokers, out of whom 60.4% made attempt to quit smoking in the past 12 months, and 26.2% reported experiencing food insecurity in the past 12 months. Food insecurity was significantly associated with smoking status and quit attempt after controlling for individual-level characteristics. The odds of being a current smoker, [AOR 1.45 (95% CI 1.10–2.02)], and making quit attempt, [AOR 1.74 (95% CI 1.10, 2.83)], were higher for food insecure cancer survivors compared to food secure cancer survivors.

**Conclusions** Food insecurity, in addition to smoking, may hinder the progress of care and treatment, requiring the development of new policies for routine food insecurity screening among cancer survivors. Efforts should be focused on identifying food insecure cancer survivors, targeting their smoking behavior, and offering them appropriate nutritional and smoking cessation interventions.

**Keywords** Tobacco use · Smoking quit attempt · Food insecurity · Cancer survivorship

## Introduction

There are more than 15.5 million cancer survivors living in the United States (US) [1]. Adequate nutrition and smoking cessation have been identified as priorities in the American Cancer Society's *Nutrition and Physical Activity Guidelines for Cancer Survivors* [2] and the Surgeon General's most

recent report on *the Health Consequences of Smoking—50 Years of Progress* in order to maximize the health and well-being of cancer survivors [3]. Unfortunately, many cancer survivors face food insecurity and continue to smoke after their cancer diagnosis [4–7]. Food insecurity is a state in which an individual or household lacks access to adequate and nutritious food because of limited financial or other resources [8]. The prevalence of food insecurity among cancer survivors (56%) [5] is more than four times higher than the prevalence among the general US population (12%) [8]. Furthermore, despite the well-documented adverse health effects of cigarette smoking, a significant proportion of cancer survivors, 10–64% depending on cancer type and patient age, continue to smoke after cancer diagnosis [6, 7, 9]. Across the US population, the prevalence of food insecurity and smoking is higher among racial and ethnic minorities and those living below the poverty line [10, 11].

✉ Hermine Poghosyan  
H.poghosyan@northeastern.edu

Samuel V. Scarpino  
s.scarpino@northeastern.edu

<sup>1</sup> School of Nursing, Bouvé College of Health Sciences, Northeastern University, 360 Huntington Avenue, 106 J Robinson Hall, Boston, MA 02115, USA

<sup>2</sup> Network Science Institute, Northeastern University, 177 Huntington Ave, 2nd Floor, Boston, MA 02115, USA

Evidence is clear that smoking and food insecurity among cancer survivors are associated with poor clinical prognosis and outcomes [3, 4, 12, 13]. For example, continued smoking after cancer diagnosis is associated with increased risk of cancer recurrence, worsened symptom burden, increased smoking-related comorbidities, and decreased quality of life and overall survival [3, 12]. Food insecure cancer survivors have lower quality of life, higher levels of nutritional risk, and higher financial burden than food secure cancer survivors [4, 5, 13]. Moreover, food insecure cancer survivors are more likely to forgo prescribed medications and postpone needed medical care because of limited financial resources [4, 5]. Many cancer survivors are faced with a challenging decision whether to spend the limited financial resources on food or on necessary medical care. Research shows that a significant proportion of cancer survivors, from 16 to 73%, face financial hardship [14]. Delayed needed medical care may adversely affect cancer survivors' quality of life and overall survival [1, 15]. On the other hand, inadequate food intake impacts negatively on cancer survivors' quality of life and overall survival [4, 13]. The evidence suggests that spending money on tobacco may increase the financial hardship of cancer survivors who already experience such burden [16]. Spending money on tobacco can further diminish financial resources available for basic needs such as food, education, and medical care [17, 18].

Research conducted among the general US population shows that food insecure adults are more likely to be current smokers than food secure adults [19, 20]. To date, only five studies [4, 5, 13, 21, 22] reported food insecurity among cancer survivors to the best of our knowledge. However, none of these studies explored the relationships between food insecurity and smoking and quitting among adult cancer survivors. The current study addresses this gap by producing evidence using a large, cross-sectional, nationally representative population-based sample of adult cancer survivors living in 12 US States. The aims of this study were (1) to estimate the prevalence of food insecurity and smoking behaviors among cancer survivors and (2) to examine whether food insecurity among cancer survivors is associated with smoking status and quit attempt. We hypothesized that (1) food insecure cancer survivors are more likely to be current smokers than food secure cancer survivors; and (2) smokers who experienced food insecurity in the past 12 months would be more likely to try to quit smoking compared to smokers who did not experience food insecurity, even after controlling for confounding factors (e.g., socioeconomic characteristics). The findings of this study underline opportunities for public health efforts and policies to reduce both food insecurity and smoking among adult US cancer survivors.

## Methods

### Data and study population

We used data from the Social Context module of the 2015 Behavioral Risk Factor Surveillance System (BRFSS) [23], which is a nationally representative, state-based survey conducted annually by State Health Departments in collaboration with the Centers for Disease Control and Prevention. Computer-assisted telephone interviews are conducted with non-institutionalized US population aged  $\geq 18$  years in all 50 states, as well as in the District of Columbia, Puerto Rico, the US Virgin Islands, and Guam. BRFSS consists of a core questionnaire that is administered in all states and optional modules that states may choose to administer. Detailed BRFSS survey methodology is published elsewhere [23]. The core questionnaire included measures of smoking behaviors. The Social Context module is an optional module and only 12 states administered this module in 2015 (Alabama, Arkansas, Delaware, District of Columbia, Georgia, Louisiana, Minnesota, Mississippi, Missouri, Rhode Island, Tennessee, and Utah). This module included the question for measuring food insecurity. The data analyzed in this study come from only these 12 states. The median response rate for the 12 states ranged from 37.9% in District of Columbia to 61.1% in Utah [23]. The publicly available dataset of BRFSS survey requires no Institutional Review Board approval.

Cancer survivors were identified based on a single question "Have you ever been told by doctors, nurses, or other health professionals that you had cancer?" We extracted data on a total of 8,466 non-institutionalized cancer survivors of 18 years of age and older living in 12 study states who reported having a history of cancer diagnosis. Observations with incomplete data (missing values, responded did not know, or refused to answer) were excluded from analysis. Our analytic sample consisted of 6,481 cancer survivors. A subset of 877 out of the 6,481 adult cancer survivors who reported being current smokers was further analyzed for quit attempt.

## Measures

### Outcome variables

Our dependent variables were self-reported smoking status and quit attempt. Smoking status variable was dichotomized as current smokers (who smoked  $\geq 100$  cigarettes in their entire life and reported smoking cigarettes every

day or some days during the interview) and non-smokers (who never smoked  $\geq 100$  cigarettes in their entire life and who smoked at least 100 cigarettes in their entire life but reported not smoking during the interview) [24]. For measuring quit attempt in the past 12 months, current smokers were also asked the following question: “During the past 12 months, have you stopped smoking for one day or longer because you were trying to quit smoking?” Those who responded “yes” were labeled as current smokers who made quit attempt and those with “no” responses were labeled as current smokers who did not make a quit attempt [25].

### Independent variable

The key independent variable of interest was food insecurity, which was measured based on the following question: “How often in the past 12 months would you say you were worried or stressed about having enough money to buy nutritious meals?” We followed established methods in the literature and classified food insecurity as having food insecurity if participants responded “always,” “usually,” or “sometimes.” Those who responded “rarely” or “never” were classified as food secure [26].

### Other covariates

A robust set of individual-level demographic, socioeconomic, clinical, and behavioral covariates that were believed might be potential confounding factors that influence the relationship between food insecurity, smoking status, and quit attempt were included in this study. Demographic characteristics included age (18–64,  $\geq 65$ ), sex (female vs. male), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, or non-Hispanic other), and marital status (married/partnered vs. not-married). Socioeconomic characteristics included education level (high-school diploma or less, attended college or technical school, or graduated from college or technical school) and employment status (employed, unemployed, or retired/students). Clinical characteristics included health insurance coverage (insured vs. uninsured) and general health status (excellent/very good, good, or fair/poor). Behavioral characteristics included body mass index (BMI) that was calculated based on weight and height (underweight with BMI of  $< 18.5$ , normal weight with BMI of 18.5–24.9, overweight with BMI of 25.0–29.9, or obese with BMI of  $\geq 30.0$ ), alcohol use (having at least one drink of alcohol in the past 30 days vs. had no alcohol), and physical activity (participated in 150 + min of physical activity per week, 1–149 min, or 0 min).

### Statistical analyses

We used descriptive statistics, weighted percentages, and 95% confidence intervals (CIs) to characterize the study sample. Then, we estimated the prevalence of food insecurity by study participant characteristics. Subsequently, we built separate weighted multivariable logistic regression models to explore the association between food insecurity and smoking status and between food insecurity and quit attempt while controlling for demographic, socioeconomic, clinical, and behavioral characteristics. We applied sample weights to adjust for BRFSS’s complex survey design. We performed data analysis in STATA, version 14.2 and presented weighted adjusted odds ratios (AOR) and 95% CI from logistic regression models. A *p* value of less than or equal to 0.05 was considered statistically significant.

### Study results

The total sample of 6,481 cancer survivors is representative of an estimated population of 1.9 million cancer survivors. Table 1 presents detailed sample characteristics. Among respondents, 62.0% were female, 50.4% were 65 years or older, 82.0% were white, and 23.2% graduated from college or technical school. About 19.0% of the study participants were current smokers, out of whom 60.4% made attempts to quit smoking in the past 12 months. One in every four cancer survivor (26.2%) reported experiencing food insecurity in the past 12 months.

Table 1 also presents the prevalence of food insecurity by study participant characteristics. We found that food insecurity was more prevalent among cancer survivors who were current smokers with approximately 44.0% of them experiencing food insecurity in the past 12 months. Almost half (49.6%) of the cancer survivors who tried to quit smoking in the past 12 months experienced food insecurity. Among racial ethnic groups, about 45.0% of Hispanics reported food insecurity, 33.0% of non-Hispanic Blacks, and 24.0% of non-Hispanic Whites.

Table 2 presents the findings from the weighted multivariable logistic regression models. After controlling for the covariates, food insecurity was significantly associated with smoking status; the odds of being a current smoker were 1.45 (95% CI 1.10–2.02) times higher for food insecure cancer survivors compared to food secure cancer survivors. The association between food insecurity and quit attempt was also statistically significant with food insecure cancer survivors having 1.74 (95% CI 1.10, 2.83) times higher odds of making quit attempt in the past 12 months

**Table 1** Sample characteristics and prevalence of food insecurity by participant characteristics, BRFSS 2015, US

Characteristics	Unweighted sample size, <i>n</i> = 6,481	Weighted % (95% CI)	Food insecure weighted % (95% CI)	Food secure weighted % (95% CI)
<b>Food insecurity</b>				
Yes	1,317	26.2 (24.2–28.2)	–	–
No	5,164	73.8 (71.7–75.8)	–	–
<b>Smoking status</b>				
Current smokers	883	18.6 (16.6–20.6)	44.3 (38.4–50.2)	55.7 (49.7–61.5)
Non-smokers	5,598	81.4 (79.3–83.3)	22.0 (19.9–24.2)	80.0 (75.7–80.0)
<b>Quit attempt<sup>a</sup></b>				
Yes	526	60.4 (54.4–66.1)	49.6 (40.9–58.2)	50.4 (41.7–59.0)
No	351	39.6 (33.8–45.5)	35.5(27.9–43.8)	64.5 (56.1–72.0)
<b>Age</b>				
18–64	2,405	49.6 (47.4–51.7)	36.8 (33.4–40.3)	63.2 (59.6–66.5)
65+	4,076	50.4 (48.2–52.5)	15.7 (13.8–17.7)	84.3 (82.2–86.1)
<b>Gender</b>				
Male	2,312	38.1 (36.1–40.2)	17.1 (14.4–20.2)	82.9 (79.7–85.5)
Female	4,169	61.9 (59.7–63.9)	31.7 (29.1–34.4)	68.3 (65.5–70.8)
<b>Race/ethnicity</b>				
Hispanic	91	1.8 (1.3–2.4)	45.6 (31.7–60.1)	54.4 (39.8–68.2)
Non-Hispanic white	5,535	82.0 (79.9–83.9)	24.0 (21.9–26.1)	76.0 (73.8–78.1)
Non-Hispanic black	679	13.1 (11.3–15.1)	33.1 (26.4–40.4)	66.9 (59.5–73.5)
Non-Hispanic other	176	3.1 (2.3–3.9)	44.00(32.1–56.8)	56.0 (43.1–67.8)
<b>Marital status</b>				
Married	3,300	56.1 (53.9–58.2)	18.2 (15.9–20.8)	81.3 (79.1–84.1)
Not-married	3,181	43.2 (41.7–46.0)	36.3 (33.0–39.6)	63.70(60.3–66.9)
<b>Education</b>				
High-school or less	2,477	46.3 (44.1–48.5)	33.7 (30.5–37.0)	66.3 (62.9–69.4)
Attended college	1,714	30.5 (28.4–32.4)	25.5 (21.8–29.4)	74.5 (70.5–78.1)
Graduated college	2,290	23.2 (21.7–24.7)	12.0 (9.4–15.0)	88.0 (84.9–90.5)
<b>Employment</b>				
Employed	1,688	29.9 (27.8–31.9)	22.2 (18.5–26.2)	77.8 (73.7–81.4)
Unemployed	199	4.9 (3.9–6.0)	59.8 (48.5–70.1)	40.2 (29.8–51.4)
Retired/student	4,594	65.2 (63.0–67.3)	25.5 (23.2–27.8)	74.5 (72.1–76.7)
<b>Health status</b>				
Excellent/very good	2,115	29.8 (27.9–31.8)	12.8 (9.8–16.5)	87.2 (83.4–90.1)
Good	2,117	32.9 (30.8–35.0)	18.4 (15.4–21.7)	81.6 (78.2–84.5)
Fair/poor	2,249	37.3 (35.2–39.3)	43.7 (40.3–47.1)	56.3 (52.8–59.6)
<b>Health insurance</b>				
Insured	6,274	94.7 (93.5–95.6)	24.5 (22.5–26.6)	75.5 (73.3–77.4)
Uninsured	207	5.3 (4.3–6.4)	55.2 (44.7–65.1)	44.8 (34.8–55.2)
<b>Physical activity</b>				
0 min	2,313	37.9 (35.8–40.0)	32.5 (29.2–35.9)	67.5 (64.0–70.7)
1–149 min	996	17.0 (15.4–18.7)	31.1 (25.8–36.9)	68.9 (63.0–74.0)
150+ min	3,172	45.1 (42.9–47.2)	19.0 (16.5–21.6)	81.0 (78.3–83.4)
<b>Alcohol consumption</b>				
Yes	2,505	37.3 (35.2–39.0)	18.8 (15.6–22.4)	81.2 (77.6–84.3)
No	3,976	62.7 (60.6–64.7)	30.5 (28.0–33.1)	69.5 (66.8–71.9)
<b>Body weight status</b>				
Underweight	117	2.1 (1.5–2.7)	43.1 (28.6–58.7)	56.9 (41.2–71.3)
Normal	1,974	29.7 (27.7–31.7)	25.1 (21.3–29.2)	74.9 (70.7–78.6)
Overweight	2,376	34.4 (32.4–36.3)	21.3 (18.4–24.5)	78.7 (75.4–81.5)

**Table 1** (continued)

Characteristics	Unweighted sample size, <i>n</i> = 6,481	Weighted % (95% CI)	Food insecure weighted % (95% CI)	Food secure weighted % (95% CI)
Obese	2,014	33.8 (31.7–36.0)	31.0 (24.2–28.2)	69.0 (65.2–72.5)

<sup>a</sup>Total number of quit attempt, *n* = 877 (only current smokers responded to this questions)

compared to food secure cancer survivors. Compared to their reference groups, odds of making quit attempt were higher among adult cancer survivors who were black, married, unemployed, and participated in physical activity.

## Discussion

In the present study, we estimated the prevalence of food insecurity and smoking behaviors among cancer survivors. In addition, this is the first study that examined whether food insecurity is independently associated with smoking status and quit attempt among cancer survivors. We found that a significant proportion of cancer survivors face food insecurity (26.2%) and continue to smoke after cancer diagnosis (18.6%). The prevalence rates of smoking and food insecurity are significantly higher compared to the national prevalence rates of smoking (15.5% in 2016) and food insecurity (12.3% in 2016) in the general US population [8, 27]. Food insecurity among cancer survivors is almost double the rate of food insecurity among the general population indicating that in addition to facing the hardship of cancer treatment these survivors also face basic nutritional issues which prevents them from achieving proper health and quality of life. Food insecurity coupled with smoking behavior challenges the progress of care and treatment and predisposes cancer survivors to negative outcomes.

Results support hypothesis 1 that food insecure cancer survivors are more likely to be current smokers than those who were not food insecure even after controlling for all confounding factors. Cancer survivors experiencing food insecurity in the past 12 months had 45% increase in the odds of current smoking than those who were not food insecure. Thus, food insecurity is independently associated with smoking status of cancer survivors. Similar findings have been previously reported for the general population. For example, research by Hosler and Michaels [20] found that adults who experience food insecurity had 77% increase in the odds of current smoking compared to adults who were not food insecure [20]. However, due to different study population, the direct comparisons between the current study and this study is challenging. Thus, our study produced novel evidence to help guide future policy and practice interventions to assist this vulnerable population—cancer survivors.

Results also indicated that majority (60%) of the cancer survivors tried to quit smoking. The results examining the association between food insecurity and quit attempt among smokers provide support for hypothesis 2. Smokers who experienced food insecurity in the past 12 months had 74% higher odds of making quit attempt compared to smokers who were not food insecure, possibly indicating that these survivors attempt to shift the financial resources from tobacco to food. Despite these attempts, many cancer survivors are unable to quit smoking successfully and continue to smoke after cancer diagnosis [6, 7, 9]. Health care providers need to assess cancer survivors' smoking status and offer effective smoking cessation interventions. Such interventions could increase the rate of successful quit attempt given that the majority of cancer survivors are highly motivated to quit smoking as demonstrated by the significant quit attempt in this study. Effective tobacco dependence treatments are available for smokers. The National Comprehensive Cancer Network guideline of smoking cessation specifically for cancer survivors [28] and the US Public Health Service clinical practice guideline [29] identify combined use of pharmacotherapy and behavioral interventions as the best treatment for smoking cessation. Over the past several years, the reimbursement for providers for smoking cessation treatment has improved significantly. As of June 2017, Medicaid programs in all 50 states covered at least one of the recommended smoking cessation treatments for Medicaid enrollees and 10 states covered all treatments [30]. Targeted efforts are needed to identify food insecure cancer survivors who are current smokers and eligible for Medicaid programs to provide them with smoking cessation interventions.

In addition to smoking cessation interventions, the study findings highlight critical need for addressing food insecurity among cancer survivors. One possible mechanism to address food insecurity is to raise awareness among health care providers. They can routinely screen cancer survivors for food insecurity and refer them to federal or state-funded food programs. For example, the federally funded Supplemental Nutrition Assistance Program (SNAP) is designed to reduce food insecurity in the US and offers nutrition assistance to low-income families [31]. The SNAP has been effective at reducing food insecurity among eligible households [31] and many cancer survivors facing financial hardship might be eligible for these programs [14, 16]. For food insecure cancer survivors, multifaceted interventions—combining

**Table 2** Multivariate logistic regression models for smoking status and quit attempt, BRFSS 2015, US

Characteristics	Current smoking versus non-smoking	Quit attempt <sup>a</sup> Yes versus No
	AOR (95% CI)	AOR (95% CI)
<b>Food insecurity</b>		
No	1	1
Yes	1.45 (1.04–2.02)*	1.74 (1.07–2.84)*
<b>Age</b>		
18–64	1	1
65+	0.24 (0.17–0.34)***	0.81 (0.49–1.35)
<b>Gender</b>		
Female	1	1
Male	0.74 (0.54–1.01)	0.71 (0.43–1.16)
<b>Race/ethnicity</b>		
Non-Hispanic white	1	1
Hispanic	1.18 (0.50–2.78)	1.58 (0.40–6.21)
Non-Hispanic black	1.05 (0.61–1.81)	3.57 (1.49–8.53)**
Non-Hispanic other	1.76 (0.91–3.39)	1.43 (0.62–3.31)
<b>Marital status</b>		
Not-married	1	1
Married	0.48 (0.37–0.64)***	1.86 (1.18–2.95)**
<b>Education</b>		
High-school or less	1	1
Attended college	0.69 (0.50–0.95) *	0.86 (0.51–1.44)
Graduated college	0.43 (0.29–0.62)***	1.27 (0.67–2.43)
<b>Employment</b>		
Employed	1	1
Unemployed	1.12 (0.60–2.08)	3.37 (1.16–9.81) *
Retired/student	1.12 (0.80–1.57)	1.52 (0.90–2.58)
<b>Health status</b>		
Fair/poor	1	1
Good	1.06 (0.75–1.50)	0.75 (0.43–1.30)
Excellent/very good	0.58 (0.40–0.86)**	0.88 (0.49–1.57)
<b>Health Insurance</b>		
No	1	1
Yes	0.74 (0.45–1.23)	1.09 (0.55–2.16)
<b>Physical activity</b>		
0 min	1	1
1–149 min	0.85 (0.58–1.24)	3.11 (1.59–6.09)***
150+ min	1.13 (0.82–1.56)	2.22 (1.33–3.68)**
<b>Alcohol consumption</b>		
No	1	1
Yes	1.38 (1.02–1.87) *	0.69 (0.43–1.13)
<b>Body weight status</b>		
Normal	1	1
Underweight	2.30 (1.21–4.38)**	0.72 (0.19–2.72)
Overweight	0.68 (0.49–0.93)**	0.74 (0.44–1.26)
Obese	0.57 (0.39–0.82)**	1.05 (0.60–1.83)

AOR adjusted odds ratio, CI confidence interval

\* $p \leq 0.05$ ; \*\* $p \leq 0.01$ ; \*\*\* $p \leq 0.001$ <sup>a</sup>Total number of quit attempt,  $n=877$  (only current smokers responded to this questions)

pharmacotherapy and behavioral smoking cessation interventions and referral to food programs—might be the most effective way to decrease smoking and food insecurity among them. Such comprehensive interventions for food insecure cancer survivors who also smoke could lead to significant improvements in their clinical outcomes, quality of life, and overall survival. Quitting smoking is particularly important for food insecure cancer survivors by allowing them to divert the financial resources from tobacco purchase to spending on necessary medical care and nutritious food.

Despite the fact that most of the study participants were white, racial and ethnic minorities disproportionately faced food insecurity, suggesting there might be racial and ethnic disparities among cancer survivors related to food security. Future research is necessary to further investigate food insecurity among minority cancer survivors. Providing smoking cessation interventions with nutritional assistance to racial and ethnic minority cancer survivors may be effective in improving smoking quit rates as well as reducing tobacco-related disparities and food insecurity. Moreover, the results of this study showed that unemployed, married, non-Hispanic black cancer survivors, and those who participate in weekly physical activities were more likely to try to quit smoking compared to their reference groups. These factors can be further explored in future research studies to produce evidence for designing targeted smoking cessation interventions. Food insecurity among cancer survivors is an understudied area, and future research is necessary. Particularly, studies focusing on designing and testing effective interventions aimed reducing food insecurity specifically for cancer survivors.

The study has several limitations. First, due to cross-sectional nature of the data, the causal direction between food insecurity and smoking behaviors could not be determined. Future longitudinal studies are needed. Second, food insecurity was measured with one self-reported item. Future studies using comprehensive measures of food insecurity are needed. Third, smoking status and quit behaviors were also self-reported and it is possible that participants may under- or over-report smoking behaviors. Fourth, the results of this study can only be generalized to cancer survivors living in 12 US states and the findings cannot be generalized to the entire US cancer survivors. Besides, low response rate in some states (e.g., 37.9%,) may limit the generalizability of the findings; however, such response rates are typical for telephone surveys [32]. Fifth, because a majority of study participants were non-Hispanic Whites (82%), future studies are needed with more diverse sample of cancer survivors. Lastly, missing important variable such as time since cancer diagnosis may be another limitation. Despite these limitations, the study is strengthened by its population-based methodology. The findings reinforce the need for screening cancer survivors for food insecurity. Evidence produced

by this study can guide efforts to identify most vulnerable cancer survivors and design policy interventions to address food insecurity and smoking behavior.

## Conclusion

Tobacco use and food insecurity are serious issues affecting health and well-being of many adult cancer survivors in the US. The results show that food insecurity is significantly associated with smoking status and quit attempts behaviors. Efforts should be focused on identifying food insecure cancer survivors, targeting their smoking behavior, and offering them appropriate nutritional and smoking cessation interventions. Future research should focus on designing and testing effective interventions and policies to reduce food insecurity and smoking behavior among cancer survivors. Quitting smoking has particular importance for cancer survivors by allowing them to divert the financial resources from tobacco purchase to spending on necessary medical care and nutritious food.

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## Compliance with ethical standards

**Conflict of interest** The author(s) declared no potential conflicts of interest.

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