HHS Public Access

Author manuscript

Cancer. Author manuscript; available in PMC 2024 November 12.

Published in final edited form as:

Cancer. 2023 October 15; 129(20): 3334–3345. doi:10.1002/cncr.34933.

Use of electronic cigarettes among African American cancer survivors

Christelle E. Wharram, BS[1], **Jaclyn M. Kyko, MPH**[2], **Julie J. Ruterbusch, MPH**[2], **Jennifer L. Beebe-Dimmer, PhD, MPH**[2,3], **Ann G. Schwartz, PhD, MS, MPH**[2,3], **Michele L. Cote, PhD, MPH**[4]

[1]School of Medicine, Wayne State University, Detroit, Michigan, USA

[2]Department of Oncology, School of Medicine, Detroit, Michigan, USA

[3]Population Sciences and Disparities Research Program, Karmanos Cancer Institute, Detroit, Michigan, USA

[4]Indiana University Simon Comprehensive Cancer Center, Indianapolis, Indiana, USA

Abstract

Background: The use of electronic cigarettes (e-cigarettes) is increasing rapidly in the United States, although the negative health outcomes associated with these products are still unknown. Emerging research has examined the use of e-cigarettes in the cancer survivor population as a whole, yet none has focused on e-cigarette use in the African American (AA) cancer survivor population.

Methods: The authors used data from the Detroit Research on Cancer Survivors cohort study, comprised of AA adult cancer survivors. Logistic regression models were used to evaluate factors potentially associated with e-cigarette ever use and current use.

Results: Of 4443 cancer survivors who completed a baseline interview, 8.3% (n= 370) reported ever using e-cigarettes, and 16.5% (n= 61) of those reporting ever use also reported current use of e-cigarettes. Ever users and current users were on average younger than those who did not use e-cigarettes (57.5 vs. 61.2 years; $p < .001$). Current cigarette smokers were >20 times more likely (odds ratio, 20.75; 95% confidence interval, 12.84–33.55) and former smokers were

Correspondence: Michele L. Cote, Fairbanks School of Public Health, Indiana University, 550 University Boulevard AOC 6047, Indianapolis, IN 46202, USA. mlcote@iu.edu.

AUTHOR CONTRIBUTIONS

Christelle E. Wharram: Interpretation of the data, preparation of the article, and review and revision of the final version. **Jaclyn M. Kyko:** Analysis and interpretation of the data and review and revision of the final version. **Julie J. Ruterbusch:** Study concept and design, analysis and interpretation of the data, and review and revision of the final version. **Jennifer L. Beebe-Dimmer:** Study concept and design and review and revision of the final version. **Ann G. Schwartz:** Study concept and design and review and revision of the final version. **Michele L. Cote:** Study concept and design, interpretation of the data, and review and revision of the final version.

CONFLICT OF INTEREST STATEMENT

The authors disclosed no conflicts of interest.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

almost 10 times more likely (odds ratio, 9.50; 95% confidence interval, 6.03–14.97) to have ever used e-cigarettes than never-smokers. Preliminary data suggested that ever use of e-cigarettes is associated with later stage at diagnosis for breast and colorectal cancers.

Conclusions: As the use of e-cigarettes increases in the general population, it is important to continue to monitor their use in cancer survivors and to gain more insight as it pertains to the AA cancer survivor population. Elucidation of the factors associated with e-cigarette use in this population may help inform comprehensive cancer survivorship recommendations and interventions.

Keywords

African American; age; electronic cigarettes (e-cigarettes); cancer survivor; cigarette smoking

INTRODUCTION

Over the past decade, electronic cigarettes (e-cigarettes) have become increasingly popular in the United States.[1,2] During 2012–2013, an estimated 1.9% of the US population used e-cigarettes *either every day or some days*.[1] By 2019, the proportion had increased to 4.5% of the population.[2] Although the negative health effects of combustible cigarettes are well known, particularly the association between cigarette smoking and cancer, the cancer risks of e-cigarette use are still undefined in humans. Recent studies have demonstrated that e-cigarettes themselves may cause cancer because they contain oncogenic substances,[3,4] and e-cigarette use may also be associated with an earlier age of cancer diagnosis as well as a higher cancer risk.[4] Therefore, preventing the use of e-cigarettes is an important strategy for cancer control. Cigarette smoking cessation is strongly encouraged for cancer survivors,[5] and ecigarettes have been marketed as a safer alternative to combustible cigarettes or even as a cessation tool.[6]

It is feasible that some cancer survivors may use e-cigarettes either as a way to quit smoking or because they believe that ecigarettes may be less harmful than combustible cigarettes to their health or to that of those around them.[3] Previous studies that examined the use of e-cigarettes or vaping in cancer survivors indicated that they may not assist with smoking cessation.[7–11] Several studies reported that cancer survivors who vaped also had an increased rate of smoking combustible cigarettes.[12–15] In addition, cancer survivors have mixed beliefs with respect to whether they think that e-cigarettes are less harmful compared with combustible cigarettes.[9,16] The belief that e-cigarettes are a relatively harmless provider of nicotine has also been called into question because tobacco products are linked to negative health outcomes, such as secondary cancers, cancer reoccurrence, and cardiovascular and respiratory issues.[12,17,18] E-cigarette use has also been linked to vaping-related lung injuries, including pneumonia, alveolar hemorrhage, and bronchiolitis.[3,19]

Because e-cigarette use is relatively new, most studies have focused on the demographic characteristics of cancer survivors who use these products. The majority of studies indicate that cancer survivors who use e-cigarettes are most likely to be young adults between ages 18 and 40 years,[9,12,13,20,21] although one study reported that cancer survivors aged 45–54 years were the age group most likely to use e-cigarettes.[14] It has been observed that female

cancer survivors are more likely to use e-cigarettes than male cancer survivors.[4,12,22,23] In addition, non-Hispanic White cancer survivors had higher rates of e-cigarette use than non-Hispanic Black cancer survivors,[13–15] and one study reported that Hispanic cancer survivors were the most likely to use e-cigarettes.[22]

It is well documented that the marketing strategies to promote the use of combustible cigarettes intentionally and differentially targeted communities with higher proportions of African American (AA) residents.[24] Recent work indicates that, at the neighborhood level, e-cigarette advertising is more prevalent in areas with a greater proportion of non-White residents.[25] Monitoring uptake of ecigarettes in all populations, including cancer survivors, is crucial to understand the long-term impact of these newer nicotine-delivery devices. Monitoring use in populations that have poorer outcomes after a cancer diagnoses, such as AA populations, is warranted, particularly if there is the potential for e-cigarettes to negatively affect cancer prognosis and survival.

To date, some studies have included data on e-cigarette use in AA cancer survivors as part of the baseline demographics but have not provided multivariate analyses to better understand associations between e-cigarette use, combustible cigarette smoking, and other health and demographic factors. In this study, we used data from the Detroit Research on Cancer Survivors (Detroit ROCS) cohort study, comprised of AA adult cancer survivors who live in the Detroit metropolitan area. The aim of this study was to estimate the prevalence of e-cigarette use in this population and investigate possible associations by cancer type, age at diagnosis, stage at diagnosis, comorbidities, and previous or concurrent use of combustible cigarettes.

MATERIALS AND METHODS

Study population

The population-based Detroit ROCS study was designed to examine medical, behavioral, financial, and psychosocial outcomes among AA cancer survivors. Briefly, AA cancer survivors were eligible to join the cohort if they were diagnosed with invasive female breast, colorectal, lung, or prostate cancer between ages 20 and 79 years since January 1, 2013; or with endometrial cancer between ages 20 and 79 years; or with any other invasive cancer between ages 20 and 49 years since January 1, 2016. As previously described, AA individuals with a newly diagnosed cancer were identified through the Metropolitan Detroit Cancer Surveillance System (MDCSS), a population-based cancer registry.[26,27] A founding member of the National Cancer Institute-supported Surveillance, Epidemiology, and End Results data resource, the MDCSS identifies all individuals newly diagnosed with cancer residing in Wayne, Oakland, and Macomb counties of Michigan and records clinical details regarding their cancer and annual collection of vital status. Cancer survivors were sent a letter inviting them to complete the enrollment survey either online, over the phone with a trained interviewer, or by returning a written questionnaire. The protocols and questionnaires were created with the assistance of AA cancer survivor advocates and caretakers from the Metropolitan Detroit community and can be found online Accessed May 4, 2023, (https://detroitrocs.org/dnn/).

As of February 8, 2022, 5038 AA cancer survivors were enrolled in the Detroit ROCS study. This study is based on the first 4512 cancer survivors who had data available, representing a mid-study response rate of 40%. There were no differences in age or disease stage at diagnosis between those who participated and those who did not, although women were more likely to participate (51% of the eligible population, 55% of participants) than men (49% of the eligible population, 45% of participants; data not shown). For our primary research question, we excluded participants with unknown vaping or smoking e-cigarette status in their lifetime ($n = 8$), at enrollment ($n = 2$), or both ($n = 59$), leaving a final cohort size of 4443 AA cancer survivors. This study was approved by the Wayne State University Institutional Review Board (no. 050417M1F), and informed consent was obtained from all participants at study enrollment.

Study measures

Self-reported participant characteristics at ROCS enrollment included age in years as a continuous variable and the following categorial variables: education (less than high school, high school/General Educational Development certificate, some college, 2-year degree, 4-year degree, graduate/professional degree), marital status (married, living as married, widowed, separated, divorced, never married), annual household income (<$10,000, $10,000–$19,999, $20,000–$39,999, $40,000–$59,999, $60,000–$79,000, ≥$80,000), cigarette smoking status (ever smoker and current smoker variables), consumption of alcoholic beverages in the past 4 weeks (yes/no), and cancer treatment status (currently completed treatment, still undergoing treatment, other). Self-reported number of servings of fruits and vegetables and participation in ≥150 minutes per week of moderate-to-vigorous physical activity in the 4 weeks before enrollment were categorized based on American Cancer Society recommendations.[28] The main outcome of interest, e-cigarette use, was self-reported using two questions: *Have you ever vaped or smoked electronic e-cigarettes* (yes/no) and *Do you currently vape or smoke e-cigarettes* (yes/no)?

Participants were also asked whether a physician ever told them that they had any of the following medical conditions: heart problems (including myocardial infarction, congestive heart failure, coronary artery disease, or atrial fibrillation), chronic obstructive pulmonary disease/emphysema, stroke, hypertension, high cholesterol, hepatitis, arthritis, diabetes, fracture after age 50 years, thyroid problems, or depression. Participants were considered to have a history of a comorbid condition if they answered in the affirmative to the specific condition.

Body mass index (BMI; body weight/height [kg/m^2]) was calculated from self-reported height and weight 1 year before cancer diagnosis. Participant weight was divided into five classifications based on BMI: underweight (BMI, <18.5 kg/m^2), normal weight (BMI, 18.5–24.9 kg/m^2), overweight (BMI, 25.0–29.9 kg/m^2), class 1 obesity (BMI, 30.0–34.9 kg/m^2), class 2 obesity (BMI, 35.0–39.9 kg/m^2), and class 3 obesity (BMI, ≥40 kg/m^2). Study surveys are openly available and can be found online Accessed May 4, 2023, (https://detroitrocs.org/dnn/For-Researchers/Questionnaires).

Cancer-related factors obtained from the MDCSS include cancer site and Surveillance, Epidemiology, and End Results summary stage. Months from ROCS enrollment to diagnosis

were calculated from the date of cancer diagnosis listed in the MDCSS to the date of the enrollment interview. Whether the survey was self-administered or completed with the assistance of an interviewer was also captured.

Statistical analysis

The distribution of selected participant characteristics, cancer-related factors, and health behaviors was summarized using counts and percentages for categorical data and means with standard deviations for continuous data. Binomial logistic regression models were used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for e-cigarette ever use and current use and were adjusted for variables that either were selected a priori (age at enrollment, annual household income, cancer site, and cancer stage at diagnosis) or were found to differ between those who ever used ecigarettes and those who did not ($p < .1$) in univariable models (education, marital status, questionnaire administration, BMI, treatment status, cigarette smoking at enrollment, physical activity, servings of fruit and vegetables, and alcohol consumption). A p value was considered to be statistically significant at $p < .05$, and all tests were two-sided. All analyses were conducted using SAS software (version 9.4; SAS Institute Inc.).

RESULTS

In total, 4443 AA cancer survivors enrolled in the ROCS study were included in this analysis. In Table 1, demographic variables and clinical characteristics are shown stratified by ever and current use of ecigarettes. Overall, 8.3% of the population reported ever using ecigarettes, and 16.5% of those reporting ever use also reported current use of e-cigarettes. Ever users and current users were more likely to be younger at enrollment, have less education and have lower incomes than those who did not use e-cigarettes. Ever users were also more likely to have a higher number of comorbid conditions, normal or underweight BMI, a lung cancer diagnosis, and distant-stage disease.

Among those who reported e-cigarette ever use, 92% reported having smoked at least 100 cigarettes in their lifetime, and 43% reported current smoking (Table 1). Of the 61 respondents who reported current e-cigarette use, 85% reported having smoked at least 100 cigarettes in their lifetime, and 46% were current smokers. Ever use of e-cigarettes was also associated with less physical activity, lower consumption of fruits and vegetables, and consumption of alcohol (Table 1).

Table 2 indicates that cigarette smoking status at enrollment was significantly associated with having ever used e-cigarettes. Compared with never smokers, current smokers were >20 times more likely to have ever used e-cigarettes (OR, 20.75; 95% CI, 12.84–33.55). Former smokers were almost 10 times more likely to have ever used e-cigarettes (OR, 9.50; 95% CI, 6.03–14.97) after adjustment. Among ever smokers, those who reported smoking for ≥11 years and those who reported daily smoking at the time of their cancer diagnosis were more likely to have used e-cigarettes compared with those who reported fewer years of smoking or less frequent use (both $p < .001$; data not shown).

In addition to cigarette smoking, younger age at enrollment was associated with an increased risk of having ever smoked e-cigarettes (p for trend = .0044). Having three comorbidities was associated with a 70% increased risk (OR, 1.70; 95% CI, 1.01–2.97), and having four or more comorbidities was associated with a two-fold increase (OR, 2.15; 95% CI, 1.32–3.52) compared with those who reported no comorbidities, after adjustment. Although a specific BMI at enrollment was not associated with an increased risk of having ever used e-cigarettes, an increase in BMI was associated with less risk (p for trend = .008). Healthy eating (defined as eating at least five servings of fruit and vegetables daily within the past 4 weeks) was associated with decreased risk of having ever used e-cigarettes (OR, 0.69; 95% CI, 0.49–0.98) compared with those who consumed less than five servings of fruit and vegetables daily. Consuming alcoholic beverages within the past 4 weeks was associated with increased risk of having ever used e-cigarettes (OR, 1.51; 95% CI, 1.16–1.97) compared with those who reported abstaining from alcohol.

Table 3 reports estimates between e-cigarette ever use and disease stage, stratified by the most common cancer types in the cohort (breast, colorectal, lung, and prostate). Individuals diagnosed with breast cancer at distant stage were more likely to have ever used e-cigarettes compared with those diagnosed with localized breast cancer (OR, 2.46; 95% CI, 1.23–4.90). This finding was attenuated after adjustment for age, smoking status, physical activity, fruit and vegetable intake, and alcohol consumption (OR, 2.37; 95% CI, 1.08–5.17). Similarly, those diagnosed with colorectal cancers at regional stages (OR, 3.38; 95% CI, 1.10–10.40) or at distant stage (OR, 4.09; 95% CI, 1.16–14.44) were more likely to have ever used ecigarettes compared with individuals diagnosed with colorectal cancer in the localized stage; these results were also attenuated after adjustment (OR, 3.31 [95% CI, 0.96–11.5] and 2.34 [95% CI, 0.54–10.2], respectively). These associations were not observed for prostate or lung cancers. Table S1 provides estimates between selected demographic and health behaviors and current use of e-cigarettes. Similar to ever users, cancer survivors who reported current use of ecigarettes were more likely to be former or current combustible cigarette smokers and to be younger at enrollment.

DISCUSSION

Cigarette smoking is the primary cause of preventable disease and death in the United States and throughout the world, contributing to chronic diseases, such as cardiovascular disease, cerebrovascular disease, diabetes, chronic obstructive pulmonary disease, and cancers.[4,29] Previous work in our ROCS cohort suggests that 57% of AA cancer survivors who reported cigarette smoking at diagnosis continued to smoke after diagnosis.[30] In the United States, e-cigarette use has become increasingly popular as a nicotine source and had been proposed as a potential mechanism to assist with tobacco cessation. The increase in e-cigarette use has been seen among cancer survivors as well as the general population.[31,32] Here, we report that nearly 10% of the AA cancer survivors participating in the ROCS cohort have used e-cigarettes; and, of those, nearly one in five report current e-cigarette use. In addition, nearly one half of e-cigarette users in the ROCS cohort reported current dual (both traditional and e-cigarette) use. Although seemingly high, this value is considerably less than the 67.3%–81.2% reported by Philip and colleagues and the 62% reported by Bjurlin et al.[15,29] Participants in both of those studies were of various racial and ethnic groups, so our data

suggest that dual use may be higher in non-Black populations, supporting the conclusion of Philip et al.[15]

Also concerning are our preliminary data suggesting that ever use of e-cigarettes is associated with later stage at diagnosis for breast and colorectal cancers in our population of AA cancer survivors. Although these findings are based on a small number of participants, evidence exists that ever use of combustible cigarettes is associated with more aggressive disease in prostate cancers[33] and a worse prognosis in those with colorectal cancer.[34–36] The association between ever cigarette use and aggressiveness of breast cancers is less clear, although recent work in breast cancer cell lines provides evidence that exposure to cigarette smoke extract could promote a more aggressive phenotype, including a shift toward a *triple negative-like phenotype*.[37] Lung cancer development is strongly associated with cigarette smoking, and these cancers tend to be diagnosed at distant stages,[38] thus examining whether ever use of cigarettes is associated with more aggressive disease is difficult; however, it is established that continued use after a diagnosis is associated with a poorer prognosis.[39,40] Research delineating the effects of e-cigarette use on cancer incidence is just emerging; however, a continued focus on e-cigarette usage patterns in cancer survivors is critical because continued use of combustible cigarettes is well established as a predictor of worst prognosis, from quality of life to disease recurrence and overall survival, and may be associated with markers of tumor aggressiveness.[41] Overall, research regarding e-cigarette usage amongst cancer survivors is sparse. Dewar et al. reported that Black cancer survivors were about one half as likely as White cancer survivors to use e-cigarettes.[14] Conversely, using cross-sectional data from the National Health and Nutrition Examination Survey, Chidharla et al. reported that, whereas Black cancer survivors were less likely to smoke combustible cigarettes than White cancer survivors, Black cancer survivors had a higher rate of e-cigarette use.[4] Philip et al. observed that White cancer survivors had higher dual-use rates than Black cancer survivors, whereas there were no differences by race in e-cigarette use among cancer survivors who were former smokers.[15] Failure to incorporate past combustible cigarette use may account for the seemingly discrepant results of the previous studies.

We also report that younger cancer survivors are more likely to use e-cigarettes. This in in line with the results reported by Philip et al.[15] but contrasts with the study by Dewar and colleagues, who reported higher rates of vaping among those aged 45–65 years compared with participants younger than 45 years.[14] The higher rate of vaping in younger cancer survivors is not surprising because e-cigarette use is especially popular among adolescents and young adults and is rapidly increasing. One study demonstrated a 10% increase in vaping among high school seniors in a single year (2017–2018) and a further increase of 4.5% from 2018 to 2019.[31] The increase in vaping among adolescents is alarming because they are likely more susceptible to nicotine addiction. E-cigarette use may serve as a gateway to conventional cigarette smoking by causing nicotine addiction as well as lowering psychological impediments to smoking.[3]

Finally, cigarette smoking status at enrollment showed the strongest and largest association with having ever or currently used e-cigarettes, and our analysis indicated stronger associations compared with those reported by Dewar et al.[14] This may be related to research

suggesting that AA smokers have lower odds of quitting smoking than all other racial/ethnic groups in the United States other than American Indian/Alaska Natives.[42] Thus strategies to reduce cigarette smoking initiation need to continue to be developed for those at greatest risk, along with concurrent support for cessation. Implementation of methods to discourage e-cigarette use are part of a comprehensive tobacco-control program. Because e-cigarette use was also associated with other modifiable health behaviors, specifically, exercise, fruit and vegetable consumption, and alcohol use, counseling regarding e-cigarette avoidance or cessation should be included as a component in total wellness education efforts.

Our analysis had several strengths and limitations that should be considered. The ROCS study is one of the largest studies exclusively focused on the cancer survivorship experience of the AA population. It is a contemporary and population-based cohort study in which all patients were diagnosed within the last decade. Despite the large size, analyses were limited by low rates of e-cigarette use reported, particularly current use, and sufficient longitudinal data are yet to be collected to adequately examine outcomes associated with e-cigarette use. In addition, only limited data were collected regarding e-cigarette use. We cannot determine age at first use, frequency of use, or amount of nicotine delivered. Finally, the findings of this study, like all observational studies, may be affected by bias and confounding. Survival bias, when only those who are well enough to participate in a study, is always a concern. The low response rate overall may have introduced selection bias into the study, although key variables that may have affected e-cigarette use, such as age, cancer site, and disease stage at diagnosis, were similar between participants and nonparticipants. We have also presented both univariate and multivariable analyses to explore relationships between e-cigarette use and other health behaviors, relying on a data-driven approach versus a causal model. Given the nascent research on e-cigarette use in the cancer survivor population, this work represents a first step in understanding an emerging exposure in a population that is frequently underrepresented in cancer survivor research.

In conclusion, younger age and the use of traditional combustible cigarettes are associated with the use of e-cigarettes in an AA population of cancer survivors, and ever use may be associated with later stage at diagnosis for some cancer subtypes. As e-cigarette usage expands, it is likely that the rates will continue to grow among cancer survivors. Established strategies to discourage nicotine use should be assessed to determine whether they are equally effective in deterring e-cigarette consumption, particularly in underrepresented populations at higher risk for cancer. Early work suggests that lower income neighborhoods and neighborhoods with a higher percentage of AA residents are more likely to harbor smoke/vape shops, making access to these substances easier and disproportionately increasing their use in the surrounding populations.[43] Other initiatives to reduce the uptake of e-cigarettes will undoubtedly be an important part of cancer control in the decades to come, given the association with combustible cigarette use and other modifiable risk factors, such as alcohol use and poorer quality diets.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

ACKNOWLEDGMENTS

This work was supported by the National Cancer Institute of the National Institutes of Health (U01CA199240), the Epidemiology Research Core and the National Cancer Institute Center Grant (P30CA022453) to the Karmanos Cancer Institute at Wayne State University.

DATA AVAILABILITY STATEMENT

Data may be requested through the Research on Cancer Survivors (ROCS) website (https://detroitrocs.org/dnn/).

REFERENCES

1. Agaku IT, King BA, Husten CG, et al. Tobacco product use among adults—United States, 2012–2013 [published correction appears in MMWR Morb Mortal Wkly Rep. 2014;63(26):576]. MMWR Morb Mortal Wkly Rep. 2014;63(25):542–547. [PubMed: 24964880]
2. Cornelius ME, Wang TW, Jamal A, Loretan CG, Neff LJ. Tobacco product use among adults—United States, 2019. MMWR Morb Mortal Wkly Rep. 2020;69(46):1736–1742. doi:10.15585/mmwr.mm6946a4 [PubMed: 33211681]
3. Bracken-Clarke D, Kapoor D, Baird AM, et al. Vaping and lung cancer—a review of current data and recommendations. Lung Cancer. 2021;153:11–20. doi:10.1016/j.lungcan.2020.12.030 [PubMed: 33429159]
4. Chidharla A, Agarwal K, Abdelwahed S, et al. Cancer prevalence in e-cigarette users: a retrospective cross-sectional NHANES study. World J Oncol. 2022;13(1):20–26. doi:10.14740/wjon1438 [PubMed: 35317331]
5. Tao L, Wang R, Gao YT, Yuan JM. Impact of postdiagnosis smoking on long-term survival of cancer patients: the Shanghai cohort study. Cancer Epidemiol Biomarkers Prev. 2013;22(12):2404–2411. doi:10.1158/1055-9965.EPI-13-0805-T [PubMed: 24319070]
6. Croyle RT, Morgan GD, Fiore MC. Addressing a core gap in cancer care—the NCI Moonshot Program to help oncology patients stop smoking. N Engl J Med. 2019;380(6):512–515. doi:10.1056/nejmp1813913 [PubMed: 30601710]
7. Peeters S, Gilmore AB. Understanding the emergence of the tobacco industry's use of the term tobacco harm reduction in order to inform public health policy. Tob Control. 2015;24(2):182–189. doi:10.1136/tobaccocontrol-2013-051502 [PubMed: 24457543]
8. McCausland K, Maycock B, Leaver T, Jancey J. The messages presented in electronic cigarette-related social media promotions and discussion: scoping review. J Med Internet Res. 2019;21(2):e11953. doi:10.2196/11953 [PubMed: 30720440]
9. Salloum RG, Huo J, Lee JH, et al. Tobacco and e-cigarette use among cancer survivors in the United States. PLoS One. 2019;14(12):e0226110. doi:10.1371/journal.pone.0226110 [PubMed: 31815948]
10. McQueen N, Partington EJ, Harrington KF, Rosenthal EL, Carroll WR, Schmalbach CE. Smoking cessation and electronic cigarette use among head and neck cancer patients. Otolaryngol Head Neck Surg. 2016;154(1):73–79. doi:10.1177/0194599815613279 [PubMed: 26519457]
11. Borderud SP, Li Y, Burkhalter JE, Sheffer CE, Ostroff JS. Electronic cigarette use among patients with cancer: characteristics of electronic cigarette users and their smoking cessation outcomes [published correction appears in Cancer. 2015;121(5):800]. Cancer. 2014;120(22):3527–3535. doi:10.1002/cncr.28811 [PubMed: 25252116]
12. Akinboro O, Nwabudike S, Elias R, Balasire O, Ola O, Ostroff JS. Electronic cigarette use among survivors of smoking-related cancers in the United States. Cancer Epidemiol Biomarkers Prev. 2019;28(12):2087–2094. doi:10.1158/1055-9965.EPI-19-0105 [PubMed: 31501150]
13. Antwi GO, Lohrmann DK, Jayawardene W, Chow A, Obeng CS, Sayegh AM. Associations between e-cigarette and combustible cigarette use among U.S. cancer survivors: implications for research and practice. J Cancer Surviv. 2019;13(2):316–325. doi:10.1007/s11764-019-00753-1 [PubMed: 30955182]

14. Dewar EO, Dee EC, Arega MA, Ahn C, Sanford NN. Trends in frequency of e-cigarette use among cancer patients and survivors in the United States, 2014–2018. Addict Behav. 2021;119:106913. doi:10.1016/j.addbeh.2021.106913 [PubMed: 33798916]
15. Philip HE, Hein DM, Sanford NN. Racial disparities in e-cigarette use among conventionally smoking cancer survivors in the United States, 2014–2018. Subst Use Misuse. 2022;57(4):660–663. doi:10.1080/10826084.2021.2019786 [PubMed: 34958287]
16. Bjurlin MA, Basak R, Zambrano I, et al. Perceptions of e-cigarette harm among cancer survivors: findings from a nationally representative survey. Cancer Epidemiol. 2022;78:102037. doi:10.1016/j.canep.2021.102037 [PubMed: 34561186]
17. National Center for Chronic Disease Prevention and Health Promotion (US), Office on Smoking and Health. The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General. Centers for Disease Control and Prevention (US); 2014.
18. Paek J, Son S, Choi YJ. E-cigarette and cigarette use among cancer survivors versus general population: a case-control study in Korea. J Cancer Surviv. 2022;16(4):741–750. doi:10.1007/s11764-021-01067-x [PubMed: 34132983]
19. Petrella F Electronic cigarettes, vaping-related lung injury and lung cancer: where do we stand? Eur J Cancer Prev. 2021;30(4):293–296. doi:10.1097/CEJ.0000000000000630 [PubMed: 34103460]
20. Boyd P, Lowry M, Morris KL, et al. Health behaviors of cancer survivors and population controls from the National Health Interview Survey (2005–2015). JNCI Cancer Spectr. 2020;4(5):pkaa043. doi:10.1093/jncics/pkaa043 [PubMed: 33134825]
21. Parsons HM, Jewett PI, Sadak K, Turcotte LM, Vogel RI, Blaes AH. E-cigarette use among young adult cancer survivors relative to the US population. JAMA Oncol. 2020;6(6):923–926. doi:10.1001/jamaoncol.2020.0384 [PubMed: 32271357]
22. Azagba S, Shan L, Manzione L. Cigarette, e-cigarette, alcohol, and marijuana use by cancer diagnosis status: a longitudinal analysis. Subst Abuse. 2020;14:1178221820980470. doi:10.1177/1178221820980470 [PubMed: 33424226]
23. Salloum RG, Getz KR, Tan ASL, et al. Use of electronic cigarettes among cancer survivors in the U.S. Am J Prev Med. 2016;51(5):762–766. doi:10.1016/j.amepre.2016.04.015 [PubMed: 27242079]
24. Robinson RG, Barry M, Bloch M, et al. Report of the Tobacco Policy Research Group on marketing and promotions targeted at African Americans, Latinos, and women. Tob Control.1992;1(suppl 1):S24–S30. doi:10.1136/tc.1.suppl1.s24
25. Grilo G, Crespi E, Cohen JE. A scoping review on disparities in exposure to advertising for e-cigarettes and heated tobacco products and implications for advancing a health equity research agenda. Int J Equity Health. 2021;20(1):238. doi:10.1186/s12939-021-01576-2 [PubMed: 34717629]
26. Beebe-Dimmer JL, Albrecht TL, Baird TE, et al. The Detroit Research on Cancer Survivors (ROCS) pilot study: a focus on outcomes after cancer in a racially diverse patient population. Cancer Epidemiol Biomarkers Prev. 2019;28(4):666–674. doi:10.1158/1055-9965.EPI-18-0123 [PubMed: 30482875]
27. Beebe-Dimmer JL, Ruterbusch JJ, Harper FWK, et al. Physical activity and quality of life in African American cancer survivors: the Detroit Research on Cancer Survivors study. Cancer. 2020;126(9):1987–1994. doi:10.1002/cncr.32725 [PubMed: 32090322]
28. Rock CL, Doyle C, Demark-Wahnefried W, et al. Nutrition and physical activity guidelines for cancer survivors [published correction appears in CA Cancer J Clin. 2013;63(3):215]. CA Cancer J Clin. 2012;62(4):243–274. doi:10.3322/caac.21142 [PubMed: 22539238]
29. Bjurlin MA, Basak R, Zambrano I, et al. Patterns and associations of smoking and electronic cigarette use among survivors of tobacco related and non-tobacco related cancers: a nationally representative cross-sectional analysis. Cancer Epidemiol. 2022;78:101913. doi:10.1016/j.canep.2021.101913 [PubMed: 33674247]
30. Malburg CM, Fucinari J, Ruterbusch JJ, et al. Continued smoking in African American cancer survivors: the Detroit Research on Cancer Survivors cohort. Cancer Med. 2020;9(20):7763–7771. doi:10.1002/cam4.3368 [PubMed: 32822118]

31. Miech R, Johnston L, O'Malley PM, Bachman JG, Patrick ME. Trends in adolescent vaping, 2017–2019. N Engl J Med. 2019;381(15):1490–1491. doi:10.1056/NEJMc1910739 [PubMed: 31532955]
32. Sanford NN, Sher DJ, Xu X, Aizer AA, Mahal BA. Trends in smoking and e-cigarette use among US patients with cancer, 2014–2017. JAMA Oncol. 2019;5(3):426–428. doi:10.1001/jamaoncol.2018.6858 [PubMed: 30763430]
33. Foerster B, Pozo C, Abufaraj M, et al. Association of smoking status with recurrence, metastasis, and mortality among patients with localized prostate cancer undergoing prostatectomy or radiotherapy: a systematic review and meta-analysis. JAMA Oncol. 2018;4(7):953–961. doi:10.1001/jamaoncol.2018.1071 [PubMed: 29800115]
34. Phipps AI, Shi Q, Newcomb PA, et al. Associations between cigarette smoking status and colon cancer prognosis among participants in North Central Cancer Treatment Group phase III trial N0147. J Clin Oncol. 2013;31(16):2016–2023. doi:10.1200/JCO.2012.46.2457 [PubMed: 23547084]
35. Zhu Y, Yang SR, Wang PP, et al. Influence of pre-diagnostic cigarette smoking on colorectal cancer survival: overall and by tumour molecular phenotype. Br J Cancer. 2014;110(5):1359–1366. doi:10.1038/bjc.2014.6 [PubMed: 24448365]
36. Yang B, Jacobs EJ, Gapstur SM, Stevens V, Campbell PT. Active smoking and mortality among colorectal cancer survivors: the Cancer Prevention Study II nutrition cohort. J Clin Oncol. 2015;33(8):885–893. doi:10.1200/JCO.2014.58.3831 [PubMed: 25646196]
37. Benoit L, Tomkiewicz C, Delit M, et al. Cigarette smoke and tumor microenvironment co-promote aggressiveness of human breast cancer cells. Toxicol Sci. 2023;192(1):30–42. doi:10.1093/toxsci/kfad013 [PubMed: 36847453]
38. Schabath MB, Cote ML. Cancer progress and priorities: lung cancer. Cancer Epidemiol Biomarkers Prev. 2019;28(10):1563–1579. doi:10.1158/1055-9965.EPI-19-0221 [PubMed: 31575553]
39. Ferketich AK, Niland JC, Mamet R, et al. Smoking status and survival in the National Comprehensive Cancer Network non-small cell lung cancer cohort. Cancer. 2013;119(4):847–853. doi:10.1002/cncr.27824 [PubMed: 23023590]
40. Caini S, Del Riccio M, Vettori V, et al. Quitting smoking at or around diagnosis improves the overall survival of lung cancer patients: a systematic review and meta-analysis. J Thorac Oncol. 2022;17(5):623–636. doi:10.1016/j.jtho.2021.12.005 [PubMed: 34995798]
41. Jassem J Tobacco smoking after diagnosis of cancer: clinical aspects. Transl Lung Cancer Res. 2019;8(suppl 1):S50–S58. doi:10.21037/tlcr.2019.04.01 [PubMed: 31211105]
42. Carroll DM, Cole A. Racial/ethnic group comparisons of quit ratios and prevalences of cessation-related factors among adults who smoke with a quit attempt. Am J Drug Alcohol Abuse. 2022;48(1):58–68. doi:10.1080/00952990.2021.1977310 [PubMed: 34752715]
43. Ashing KT, Song G, Tiep B, et al. Does neighborhood or residence influence continued smoking among cancer patients: a spatial-ecological and descriptive analyses brief report. Cancer Causes Control. 2022;34(4):389–398. doi:10.1007/s10552-022-01655-x [PubMed: 36447032]

TABLE 1

Demographic and clinical characteristics of African American cancer survivors enrolled in the Detroit Research on Cancer Survivors cohort, by electronic cigarette use.

	Total		*Ever* used e-cigarettes				*Currently* use e-cigarettes			
Survivor characteristic	**No.**	**%**	**No**	**Yes**	**%**	***p***	**No**	**Yes**	**%**	***p***
Total	4443		4073	370	8.3		4382	61	1.4	
Age at enrollment, years						< .001				.038
<40	179	4.0	151	28	15.6		175	4	2.2	
40–49	477	10.7	433	44	9.2		469	8	1.7	
50–59	1126	25.3	1000	126	11.2		1106	20	1.8	
60–69	1709	38.5	1576	133	7.8		1688	21	1.2	
≥70	952	21.4	913	39	4.1		944	8	0.8	
Age at enrollment: Mean ± SD, years	60.9 ± 10.7		61.2 ± 10.7	57.5 ± 10.5		< .001	60.9 ± 10.7	57.7 ± 11.3		.019
Sex						.077				.038
Men	2032	45.7	1879	153	7.5		1999	33	1.6	
Women	2411	54.3	2194	217	9.0		2383	28	1.2	
Education						.001				.059
<High school	434	9.9	391	43	9.9		425	9	2.1	
High school	1243	28.3	1131	112	9.0		1224	19	1.5	
Some college or 2-year college degree	1676	38.2	1520	156	9.3		1650	26	1.6	
≥4-year college degree	1033	23.6	979	54	5.2		1028	5	0.5	
Marital status						.083				.761
Married or living with a partner	1670	37.9	1550	120	7.2		1650	20	1.2	
Widowed	456	10.3	422	34	7.5		449	7	1.5	
Divorced or separated	1139	25.8	1035	104	9.1		1124	15	1.3	
Never married	1145	26.0	1035	110	9.6		1126	19	1.7	
Annual household income						< .001				.017
<$20,000	1697	41.7	1519	178	10.5		1662	35	2.1	
$20,000-$39,999	910	22.3	838	72	7.9		900	10	1.1	
$40,000-$79,999	939	23.1	873	66	7.0		930	9	1.0	
≥$80,000	526	12.9	504	22	4.2		524	2	0.4	

	Total		*Ever* used e-cigarettes				*Currently* use e-cigarettes			
Survivor characteristic	**No.**	**%**	**No**	**Yes**	**%**	***p***	**No**	**Yes**	**%**	***p***
Comorbidity count						.006				.656
0	599	13.6	556	43	7.2		592	7	1.2	
1	863	19.5	797	66	7.6		850	13	1.5	
2	917	20.8	849	68	7.4		905	12	1.3	
3	843	19.1	778	65	7.7		833	10	1.2	
>4	1195	27.1	1067	128	10.7		1176	19	1.6	
Comorbidity count; Mean ± SD	2.5 ± 1.7									
BMI at enrollment, kg/m^2						< .001				< .001
Underweight, <18.5	66	1.5	61	5	7.6		64	2	3.0	
Normal weight, 18.5–24.9	834	19.0	732	102	12.2		814	20	2.4	
Overweight, 25.0–29.9	1422	32.4	1308	114	8.0		1400	22	1.5	
Class 1 obesity, 30.0–34.9	1060	24.2	982	78	7.4		1050	10	0.9	
Class 2 obesity, 35.0–39.9	564	12.9	520	44	7.8		559	5	0.9	
Class 3 obesity, ≥40.0	439	10.0	415	24	5.5		438	1	0.2	
BMI at enrolment: Mean ± SD, kg/m^2	30.7 ± 7.5									
Cancer-related factors										
Cancer site						< .001				.516
Female breast	1582	35.6	1454	128	8.1		1562	20	1.3	
Prostate	1536	34.6	1438	98	6.4		1515	21	1.4	
Female colorectal	232	5.2	218	14	6.0		230	2	0.9	
Male colorectal	220	5.0	207	13	5.9		215	5	2.3	
Female lung	292	6.6	238	54	18.5		289	3	1.0	
Male lung	197	4.4	168	29	14.7		191	6	3.0	
Female other	305	6.9	284	21	6.9		302	3	1.0	
Male other	79	1.8	66	13	16.5		78	1	1.3	
SEER summary stage						< .001				.124
Localized	2653	60.2	2460	193	7.3		2619	34	1.3	
Regional	1297	29.5	1184	113	8.7		1282	15	1.2	
Distant	454	10.3	396	58	12.8		443	11	2.4	
In treatment for initial cancer diagnosis at ROCS enrollment						.071				.181

Cancer. Author manuscript; available in PMC 2024 November 12.

	Total		*Ever* used e-cigarettes				*Currently* use e-cigarettes			
Survivor characteristic	**No.**	**%**	**No**	**Yes**	**%**	***p***	**No**	**Yes**	**%**	***p***
Yes	962	22.4	868	94	9.8		944	18	1.9	
No	3338	77.6	3073	265	7.9		3295	43	1.3	
Time since diagnosis, months						.735				.162
<12	1332	30.0	1225	107	8.0		1308	24	1.8	
12–23	1502	33.8	1364	138	9.2		1484	18	1.2	
≥24	1609	36.2	1484	125	7.8		1590	19	1.2	
Time since diagnosis: Mean ± SD, months	23.2 ± 17.7									
Survey method at enrollment						.064				.352
Interviewer-assisted	1499	33.7	1358	141	9.4		1475	24	1.6	
Online or written questionnaire	2944	66.3	2715	229	7.8		2907	37	1.3	
Health behaviors										
Cigarette smoking										
Have you smoked at least 100 cigarettes in your life?						< .001				< .001
Yes	2335	52.8	1996	339	14.5		2283	52	2.2	
No	2091	47.2	2060	31	1.5		2082	9	0.4	
Do you currently smoke cigarettes on a regular basis?						< .001				< .001
Yes	742	16.8	583	159	21.4		714	28	3.8	
No	3669	83.2	3461	208	5.7		3636	33	0.9	
Cigarette smoking status at enrollment						< .001				< .001
Never	2091	47.5	2060	31	1.5		2082	9	0.4	
Former	1574	35.8	1398	176	11.2		1551	23	1.5	
Current	736	16.7	577	159	21.6		708	28	3.8	
Other health behaviors										
In the past 4 weeks, at least 150 minutes of moderate-to-vigorous physical activity						.050				.791
Yes	1210	28.2	1123	87	7.2		1194	16	1.3	
No	3081	71.8	2802	279	9.1		3037	44	1.4	
In the past 4 weeks, servings of fruit and vegetables						.002				.348
Less than five per day	3473	78.3	3160	313	9.0		3423	50	1.4	
Five or more per day	960	21.7	904	56	5.8		950	10	1.0	
In the past 4 weeks, consumed alcohol						<.001				.280

Cancer. Author manuscript; available in PMC 2024 November 12.

	Total		*Ever* used e-cigarettes				*Currently* use e-cigarettes			
Survivor characteristic	**No.**	**%**	**No**	**Yes**	**%**	***p***	**No**	**Yes**	**%**	***p***
Yes	1945	44.0	1743	202	10.4		1914	31	1.6	
No	2478	56.0	2310	168	6.8		2448	30	1.2	

Note: Values were not reported or were unknown for the following: education (n = 57), marital status (n = 33), household income (n = 371), comorbidity count (n = 58), current BMI (n = 58), cancer stage (n = 39), currently in treatment (n =143), ever smoking (n = 17), current smoking (n = 32), smoking at enrollment (n = 42), physical activity (n =152), and alcohol use (n = 20).

Abbreviations: BMI, body mass index; ROCS, the Detroit Research on Cancer Survivors cohort; SEER, the National Cancer Institute's Surveillance, Epidemiology, and End Results Program; SD, standard deviation.

TABLE 2

Associations between select demographics and health behaviors and ever use of electronic cigarettes in African American cancer survivors enrolled in the Detroit Research on Cancer Survivors cohort.

	***Ever* used e-cigarettes**							
	Yes		**No**		**Unadjusted**		**Multivariate[a]**	
Variable	**No.**	**Row %**	**No.**	**Row %**	**or**	**95% CI**	**or**	**95% CI**
Total	370	8.3	4073	91.7				
Age at enrollment, years								
<40	28	15.6	151	84.4	Ref		Ref	
40–49	44	9.2	433	90.8	0.55	0.33–0.91	0.34	0.18–0.65
50–59	126	11.2	1000	88.8	0.68	0.44–1.06	0.29	0.16–0.53
60–69	133	7.8	1576	92.2	0.46	0.29–0.71	0.13	0.07–0.25
≥70	39	4.1	913	95.9	0.23	0.14–0.39	0.07	0.03–0.14
p for trend					< .0001		.0044	
Education								
<High school	43	9.9	391	90.1	Ref		Ref	
High school	112	9.0	1131	91.0	0.90	0.62–1.30	1.26	0.80–1.96
Some college or 2-year college degree	156	9.3	1520	90.7	0.93	0.65–1.33	1.62	1.04–2.54
≥4-year college degree	54	5.2	979	94.8	0.50	0.33–0.76	1.43	0.84–2.46
Marital status								
Married or living with a partner	120	7.2	1550	92.8	Ref		Ref	
Widowed	34	7.5	422	92.5	1.04	0.70–1.55	0.97	0.59–1.59
Divorced or separated	104	9.1	1035	90.9	1.30	0.99–1.71	0.93	0.67–1.31
Never married	110	9.6	1035	90.4	1.37	1.05–1.80	0.79	0.55–1.12
Annual household income								
<$20,000	178	10.5	1519	89.5	Ref		Ref	
$20,000-$39,999	72	7.9	838	92.1	0.73	0.55–0.98	1.09	0.78–1.54
$40,000-$79,999	66	7.0	873	93.0	0.65	0.48–0.87	1.44	0.982.10
≥$80,000	22	4.2	504	95.8	0.37	0.24–0.59	0.72	0.38–1.34
p for trend					< .0001		.2425	
Comorbidity count								

	Ever used e-cigarettes							
	Yes		No		Unadjusted		Multivariate[a]	
Variable	**No.**	**Row %**	**No.**	**Row %**	**or**	**95% CI**	**or**	**95% CI**
0	43	7.2	556	92.8	Ref		Ref	
1	66	7.6	797	92.4	1.07	0.72–1.60	1.20	0.72–1.99
2	68	7.4	849	92.6	1.04	0.70–1.54	1.52	0.93–2.50
3	65	7.7	778	92.3	1.08	0.72–1.61	1.70	1.01–2.87
≥4	128	10.7	1067	89.3	1.55	1.08–2.22	2.15	1.32–3.52
p for trend					.0059		.2471	
BMI at enrollment, kg/m^2								
Underweight, 0.0–18.49	5	7.6	61	92.4	Ref		Ref	
Normal weight, 18.5–24.99	102	12.2	732	87.8	1.70	0.67–4.33	2.13	0.78–5.82
Overweight, 25.0–29.99	114	8.0	1308	92.0	1.06	0.42–2.70	1.84	0.67–5.05
Class 1 obesity, 30.0–34.99	78	7.4	982	92.6	0.97	0.38–2.48	1.70	0.61–4.74
Class 2 obesity, 35.0–39.99	44	7.8	520	92.2	1.03	0.39–2.70	1.94	0.68–5.55
Class 3 obesity, ≥40.0	24	5.5	415	94.5	0.71	0.26–1.92	1.29	0.43–3.90
p for trend					.0002		.0082	
Cancer site								
Female breast	128	8.1	1454	91.9	Ref		Ref	
Prostate	98	6.4	1438	93.6	0.77	0.59–1.02	0.75	0.53–1.06
Female colorectal	14	6.0	218	94.0	0.73	0.41–1.29	1.00	0.52–1.94
Male colorectal	13	5.9	207	94.1	0.71	0.40–1.29	0.60	0.29–1.23
Female lung	54	18.5	238	81.5	2.58	1.82–3.64	1.85	0.20–2.87
Male lung	29	14.7	168	85.3	1.96	1.27–3.03	1.20	0.68–2.15
Female other	21	6.9	284	93.1	0.84	0.52–1.36	0.87	0.46–1.64
Male other	13	16.5	66	83.5	2.24	1.20–4.17	1.04	0.46–2.36
Stage								
Localized	193	7.3	2460	92.7	Ref		Ref	
Regional	113	8.7	1184	91.3	1.22	0.96–1.55	1.01	0.75–1.35
Distant	58	12.8	396	87.2	1.87	1.37–2.55	1.14	0.74–1.77
Currently in treatment at ROCS enrollment								
Yes	94	9.8	868	90.2	1.26	0.98–1.61	1.10	0.81–1.50

	Ever used e-cigarettes							
	Yes		No		Unadjusted		Multivariate[a]	
Variable	**No.**	**Row %**	**No.**	**Row %**	**or**	**95% CI**	**or**	**95% CI**
No	265	7.9	3073	92.1	Ref		Ref	
Survey method at enrollment								
Interviewer-assisted	141	9.4	1358	90.6	1.23	0.99–1.53	1.02	0.78–1.34
Other, online or written questionnaire	229	7.8	2715	92.2	Ref		Ref	
Cigarette smoking status at enrollment								
Never	31	1.5	2060	98.5	Ref		Ref	
Current	159	21.6	577	78.4	18.31	12.33–27.20	20.75	12.84–33.55
Former	176	11.2	1398	88.8	8.37	5.68–12.33	9.50	6.03–14.97
150 minutes of moderate-to-vigorous physical activity								
Yes	87	7.2	1123	92.8	0.78	0.61–1.00	0.91	0.67–1.23
No	279	9.1	2802	90.9	Ref		Ref	
Servings of fruit and vegetables per day								
Less than five per day	313	9.0	3160	91.0	Ref		Ref	
Five or more per day	56	5.8	904	94.2	0.63	0.47–0.84	0.69	0.49–0.98
Alcoholic beverages in prior month								
Yes	202	10.4	1743	89.6	1.59	1.29–1.97	1.51	1.16–1.97
No	168	6.8	2310	93.2	Ref		Ref	

Note: Values were not reported or were unknown for the following: education ($n = 57$), marital status ($n = 33$), household income ($n = 371$), comorbidity count ($n = 26$), BMI at enrollment ($n = 58$), cancer stage ($n = 39$), currently in treatment ($n = 143$), cigarette smoking status at enrollment ($n = 42$), ≥150 minutes of physical activity ($n = 152$), servings of fruits and vegetables ($n = 10$), and alcohol consumption ($n = 20$).

Abbreviations: BMI, body mass index; CI, confidence interval; e-cigarettes, electronic cigarettes; OR, odds ratio; Ref, reference category; ROCS, the Detroit Research on Cancer Survivors cohort; SEER, the National Cancer Institute's Surveillance, Epidemiology, and End Results Program.

[a]Multivariate models included age at enrollment, education, marital status, household income, comorbidity count, BMI at enrollment, cancer site, cancer stage, currently in treatment, survey method at enrollment, cigarette smoking status at enrollment, ≥150 minutes of physical activity, servings of fruit and vegetables, and alcohol consumption.

TABLE 3

Associations between stage and electronic cigarette use stratified by cancer type.

	Ever vaped or smoked e-cigs							
	Yes		No		Unadjusted		Adjusted[a]	
Cancer type	No.	Row %	No.	Row %	or	95% CI	or	95% CI
Breast								
SEER summary stage								
Localized	70	7.3	892	92.7	Ref		Ref	
Regional	45	8.2	504	91.8	1.14	0.77–1.68	1.12	0.72–1.73
Distant	11	16.2	57	83.8	2.46	1.23–4.90	2.37	1.08–5.17
Colorectal								
SEER summary stage								
Localized	4	2.4	166	97.6	Ref		Ref	
Regional	15	7.5	184	92.5	3.38	1.10–10.40	3.31	0.96–11.5
Distant	7	9.0	71	91.0	4.09	1.16–14.42	2.34	0.54–10.2
Lung								
SEER summary stage								
Localized	27	17.9	124	82.1	Ref		Ref	
Regional	26	15.4	143	84.6	0.84	0.46–1.51	0.74	0.40–1.36
Distant	30	18.0	137	82.0	1.01	0.57–1.79	0.91	0.50–1.68
Prostate								
SEER summary stage								
Localized	71	6.2	1082	93.8	Ref		Ref	
Regional	19	6.5	274	93.5	1.06	0.63–1.78	1.00	0.57–1.73
Distant	7	10.6	59	89.4	1.81	0.80–4.10	1.67	0.71–3.97

Abbreviations: CI, confidence interval; e-cigs, electronic cigarettes; OR, odds ratio; Ref, reference category; SEER, the National Cancer Institute's Surveillance, Epidemiology, and End Results Program.

[a]Estimates were adjusted for age, smoking status, reported exercise, servings of fruits and vegetables, and alcohol consumption.