Use of Electronic Cigarettes Among Cancer Survivors in the U.S.

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Introduction: The population-level patterns of electronic cigarette (e-cigarette) use among cancer survivors in the U.S. are unknown. The objective of this study was to examine the prevalence and correlates of e-cigarette use among cancer survivors in a nationally representative sample.

Methods: A cross-sectional analysis was conducted of the 2014 National Health Interview Survey of the U.S. non-institutionalized civilian population. The main study outcomes were the prevalence and correlates of ever and current e-cigarette use among adults with self-reported history of cancer, excluding non-melanoma skin cancer (N=2,695). Multivariable logistic regression analyses examined whether e-cigarette use differed by cigarette smoking status and demographic subgroups. The analyses were performed in 2015.

Results: The prevalence of e-cigarette use among adult cancer survivors was lower than the general population: 2.8% of cancer survivors reported currently using e-cigarettes and an additional 6.3% had previously used e-cigarettes but were not currently using them. Use of e-cigarettes was most common among cancer survivors who currently smoked cigarettes: 34.3% of current smokers were ever e-cigarette users and 15.6% were current e-cigarette users, compared with former smokers (2.7% ever and 1.4% current e-cigarette users) and never smokers (small sample/estimates unavailable).

Conclusions: E-cigarettes are not part of current evidence-based smoking-cessation strategies. However, the finding that cancer survivors who currently smoke cigarettes are more likely to use e-cigarettes highlights the importance of addressing e-cigarette use in patient–provider communications around tobacco cessation.

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Introduction

Continued cigarette smoking among cancer survivors may reduce the effectiveness of cancer treatments and is associated with increased overall and cancer-specific mortality and increased risk for a second primary cancer.[1] With the rapid growth in the popularity of electronic cigarettes (e-cigarettes),[2] the risks associated with the use of these products among cancer survivors has become an important question for oncology professionals. Thus far, the health effects associated with e-cigarette use in the general population, and among cancer survivors in particular, remain unclear. Further, it remains controversial whether e-cigarettes are effective as smoking-cessation aides.[3]

Although e-cigarettes are currently not regulated in the U.S., they are under consideration for regulatory action by the Food and Drug Administration as tobacco products.[4] The American Society of Clinical Oncology and the American Association for Cancer Research have issued a joint policy statement on the use of e-cigarettes by cancer survivors, advocating for their regulation.[5] The statement concludes that the long-term effects of e-cigarettes are unknown and they are currently not

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recommended as a smoking-cessation method.[5] Moreover, recent evidence raises doubts concerning the effectiveness of e-cigarettes for facilitating smoking cessation among cancer patients.[3,6] However, the prevalence of e-cigarette use among U.S. cancer survivors remains unknown. Therefore, the purpose of this study is to examine the patterns and correlates of e-cigarette use among adult cancer survivors in a nationally representative sample of U.S. adults. This information can potentially inform future recommendations about e-cigarette use among cancer survivors.

Methods

Data were analyzed from the sample adult component (N=36,697) of the 2014 National Health Interview Survey (NHIS), which provides cross-sectional, nationally representative data on various health-related topics. Details about the NHIS methodology are published elsewhere.[7] Analysis was limited to cancer survivors—participants who answered *yes* to the question *Were you ever told by a doctor you had cancer?*—excluding non-melanoma skin cancer survivors. The most common cancer diagnoses (N=2,695) were breast (18.2%) and prostate (12.6%), consistent with national statistics.[8]

The main outcome of interest, use of e-cigarettes, was derived from two questions. Individuals were first asked, *Have you ever used an e-cigarette, even one time?* Those responding *yes* were considered "ever" e-cigarette users and those responding *no* were considered "never" users. A follow-up question identified current use: *Do you now use e-cigarettes every day, some days or not at all?* Those who responded with *every day* or *some days* were considered "current" e-cigarette users and those who responded with *not at all* were considered "ever" users. Cigarette smoking status was identified as current, former, and never. Other covariates included in the analysis were age, sex, and race/ethnicity.

Frequencies were computed by cancer history and e-cigarette use status. Multivariable logistic regression models examining ever and current e-cigarette use among cancer survivors controlled for cigarette smoking status, age, sex, and race/ethnicity. Observations with missing values for the outcome or covariates in the model were excluded from the analysis (n=52). All analyses were conducted using SAS, version 9.4. This study was ruled exempt by the University of Florida IRB. The analysis was performed in 2015.

Results

Of the NHIS sample adult component (n=36,424), 6.4% of respondents had a history of cancer and 12.6% had at least tried e-cigarettes (3.7% were current users and 8.9% ever users). Overall, 2.8% of cancer survivors were current e-cigarette users and an additional 6.3% had previously used them (Figure 1). This is comparable to 3.8% current e-cigarette users and 9.0% ever users among those without a history of cancer. Overall, cancer survivors who were current cigarette smokers had the highest rates of e-cigarette use: 15.6% were current e-cigarette users and an additional 34.3% had ever tried them (Table 1). In multivariable logistic regression, cigarette smoking status was significantly associated with e-cigarette use among cancer survivors (Table 2). Current cigarette smokers were significantly more likely than former smokers to be ever and current e-cigarette users. Meanwhile, never smokers were less likely than former smokers to ever use e-cigarettes or currently use them. Compared with cancer survivors aged ≥65 years, younger survivors were more likely to ever use e-cigarettes. Finally, female cancer survivors were more likely to be current e-cigarette users compared with male survivors.

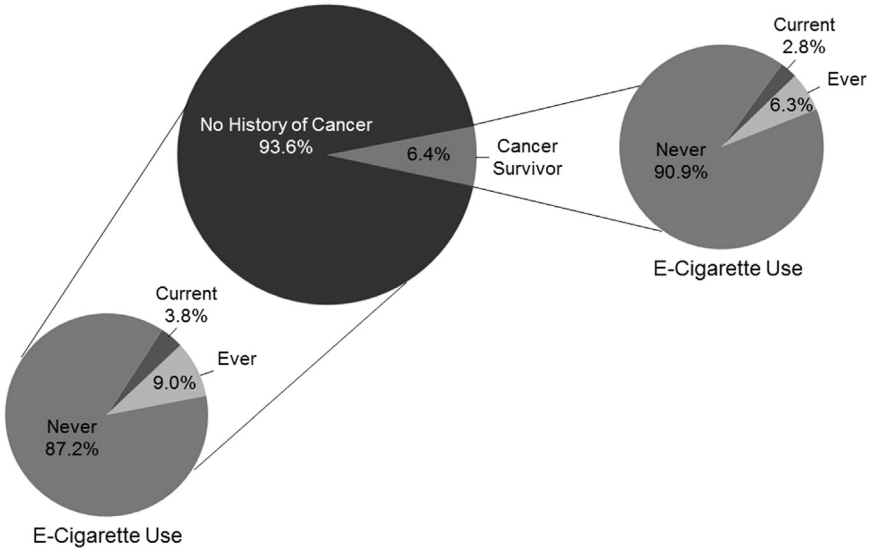

Figure 1. Reported cancer status and use of e-cigarettes: 2014 National Health Interview Survey (N=36,424).

Table 1. Patterns of E-cigarette Use Among Cancer Survivors, 2014 National Health Interview Survey (N=2,695)

Characteristic	E-cigarette use		
	Never, % (95% CI) (*n*=2,452; 90.9%)	Ever, % (95% CI) (*n*=170; 6.3%)	Current, % (95% CI) (*n*=75; 2.8%)
Cigarette smoking			
Never (49.7%)	98.6 (97.3, 99.9)	–[a]	–[a]
Former (36.5%)	95.9 (94.2, 97.5)	2.7 (1.5, 3.9)	1.4 (0.5, 2.4)
Current (13.8%)	50.1 (43.9, 56.3)	34.3 (27.8, 40.8)	15.6 (11.6, 19.6)
Age, years			
18–39 (8.3%)	72.9 (63.8, 82.0)	19.2 (11.6, 26.8)	7.8 (2.8, 12.9)
40–64 (39.9%)	87.8 (84.8, 90.8)	8.2 (5.8, 10.7)	4.0 (2.2, 5.7)
≥65 (51.8%)	96.2 (95.0, 97.5)	2.7 (1.7, 3.8)	1.0 (0.4, 1.6)
Sex			
Male (41.0%)	93.1 (90.7, 95.5)	5.5 (3.3, 7.7)	1.4 (0.6, 2.2)
Female (59.0%)	89.5 (87.6, 91.3)	6.8 (5.3, 8.4)	3.7 (2.6, 4.8)
Race/ethnicity			
White, NH (82.1%)	91.0 (89.4, 92.5)	6.1 (4.8, 7.5)	2.9 (2.1, 3.7)
Black, NH (7.6%)	94.1 (90.7, 97.5)	4.9 (1.7, 8.1)	–[a]
Other, NH (2.9%)	92.3 (86.2, 98.4)	5.3 (0.7, 9.9)	–[a]
Hispanic (7.4%)	87.2 (78.7, 95.7)	9.7 (1.4, 18.0)	3.1 (0.2, 6.0)

[a]Estimate was omitted; the relative SE was >30% or denominator <50.
NH, non-Hispanic.

Discussion

This study provides the first estimates of e-cigarette use patterns and associated demographics among cancer survivors using a nationally representative sample. Prevalence of current and ever e-cigarette use is lower among cancer survivors compared with the general population. In general, current cigarette smokers and young adults are more likely to use e-cigarettes.[9] Among cancer survivors, current cigarette smoking is also associated with e-cigarette experimentation and use. Hence, it is plausible that cancer survivors who smoke cigarettes are attracted to e-cigarettes because of perceived harm reduction. The uncommon occurrence of e-cigarette use among cancer survivors who are never smokers is also reflective of a similar finding from the general adult population.[9] Meanwhile, given the low representation of young adults (1.5%) among cancer survivors in the NHIS, there is inadequate power for testing differences in e-cigarette use between young adult and older cancer survivors.

The finding that cancer survivors who currently smoke cigarettes are more likely to use e-cigarettes highlights the importance of addressing e-cigarette use from a more global perspective. Findings from the current study extend the work of recent research examining e-cigarette use,[9–11] and document similar prevalence of e-cigarette use in cancer survivors among a nationally representative sample. Not only do cancer survivors represent a unique population that warrants assessment of e-cigarette use, but also these findings highlight the importance of addressing e-cigarettes within conversations about smoking cessation in cancer survivorship programs. Given the concordance between e-cigarette use and smoking in cancer survivors, it is essential that healthcare providers caring for cancer survivors consider, and assess, the use of e-cigarettes with their patients.

Limitations

This study is not without limitations. The sample size of current e-cigarette users among cancer survivors is small, which may limit generalizability of findings. In addition, given the low representation of young adult cancer survivors in the NHIS, this study is not sufficiently powered to observe differences in e-cigarette use in young adults compared with older adults. Further, the timing of e-cigarette use initiation relative to the diagnosis of cancer cannot be identified from the NHIS.

Table 2. Odds of Ever and Current E-cigarette Use Among Cancer Survivors, 2014 National Health Interview Survey

	E-cigarette use			
	Ever		Current	
Characteristic	AOR (95% CI)	*p*-value	AOR (95% CI)	*p*-value
Cigarette smoking				
Never	**0.21 (0.08, 0.57)**	<0.01	**0.10 (0.01, 0.68)**	0.02
Former	1 (ref)		1 (ref)	
Current	**16.96 (9.52, 30.21)**	<0.001	**8.46 (3.69, 19.35)**	<0.001
Age, years				
18–39	**5.02 (1.78, 14.16)**	<0.01	2.72 (0.80, 9.26)	0.11
40–64	**2.02 (1.21, 3.38)**	<0.01	2.00 (0.95, 4.21)	0.07
≥65	1 (ref)		1 (ref)	
Sex				
Male	1 (ref)		1 (ref)	
Female	1.25 (0.71, 2.18)	0.44	**2.20 (1.07, 4.53)**	0.03
Race/ethnicity				
White, NH	1 (ref)		1 (ref)	
Black, NH	0.52 (0.22, 1.26)	0.15	0.33 (0.09, 1.23)	0.10
Other, NH	0.42 (0.05, 3.77)	0.44	0.57 (0.08, 4.25)	0.58
Hispanic	2.98 (0.84, 10.58)	0.09	1.43 (0.44, 4.63)	0.54

Note: Boldface indicates statistical significance ($p<0.05$).
NH, non-Hispanic.

Finally, current smokers' reasons for using e-cigarettes cannot be ascertained in this study, which may limit interpretation. For example, it is unclear whether cancer survivors are using e-cigarettes as cessation aides or in conjunction with cigarettes to supplement their delivery of nicotine.

Conclusions

Although its prevalence seems lower among adult cancer survivors compared with the general population, e-cigarette use is common in this group, especially among cigarette smokers. There is a lack of consensus in whether e-cigarettes aid or impede smoking cessation.[6,12] Future research should examine the use of e-cigarettes among larger cohorts of cancer survivors who are current cigarette smokers in order to more clearly understand patterns and trajectories of e-cigarette use and associated cigarette smoking longitudinally. In addition, this study underscores the need for patient-centered communication to support cancer survivors with approved cessation options while addressing the uncertainty surrounding the safety and efficacy of e-cigarettes.

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References

1. Centers for Disease Control and Prevention (CDC). *The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General*. Atlanta, GA: CDC; 2014.
2. Mcmillen RC, Gottlieb MA, Whitmore Shaefer RM, Winickoff JP, Klein JD. Trends in electronic cigarette use among U.S. adults: use is increasing in both smokers and nonsmokers. *Nicotine Tob Res*. 2014;17(10):1195–1202. http://dx.doi.org/10.1093/ntr/ntu213.

3. Kalkhoran S, Glantz S. E-cigarettes and smoking cessation in real-world and clinical settings: a systematic review and meta-analysis. *Lancet Respir Med*. 2016;4(2):116–128. http://dx.doi.org/10.1016/S2213-2600(15)00521-4.
4. Food and Drug Administration. Deeming tobacco products to be subject to the Federal Food, Drug, and Cosmetic Act, as amended by the Family Smoking Prevention and Tobacco Control Act; Regulations on the Sale and Distribution of Tobacco Products and Required Warning Statements for Tobacco Products. *Fed Regist*. www.federalregister.gov/articles/2014/04/25/2014-09491/deeming-tobacco-products-to-be-subject-to-the-federal-food-drug-and-cosmetic-act-as-amended-by-the. Published April 25, 2014. Accessed January 12, 2016.
5. Brandon TH, Goniewicz ML, Hanna NH, et al. Electronic nicotine delivery systems: a policy statement from the American Association for Cancer Research and the American Society of Clinical Oncology. *Clin Cancer Res*. 2015;21(3):OF1–OF12. http://dx.doi.org/10.1158/1078-0432.CCR-14-2544.
6. 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. *Cancer*. 2014;120(22):3527–3535. http://dx.doi.org/10.1002/cncr.28811.
7. Parsons V, Moriarity C, Jonas K, Moore T, Davis K, Tompkins L. Design and estimation for the National Health Interview Survey, 2006–2015. *Vital Heal Stat*. 2014;2(165):1–53.
8. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2015. *CA Cancer J Clin*. 2015;65:5–29. http://dx.doi.org/10.3322/caac.21254.
9. Delnevo CD, Giovenco DP, Steinberg MB, et al. Patterns of electronic cigarette use among adults in the United States. *Nicotine Tob Res*. In press. Online November 2, 2015. http://dx.doi.org/10.1093/ntr/ntv237.
10. Tan AS, Lee C, Bigman CA. Comparison of beliefs about e-cigarettes' harms and benefits among never users and ever users of e-cigarettes. *Drug Alcohol Depend*. 2015;158:67–75. http://dx.doi.org/10.1016/j.drugalcdep.2015.11.003.
11. Schoenborn CA, Gindi RM. *Electronic Cigarette Use Among Adults: United States, 2014. NCHS Data Brief, no. 217*. Hyattsville, MD: National Center for Health Statistics; 2015.
12. Bullen C. Electronic cigarettes for smoking cessation. *Curr Cardiol Rep*. 2014;16(11):1–8. http://dx.doi.org/10.1007/s11886-014-0538-8.