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ORIGINAL PAPER

Prevalence and correlates of dual tobacco use in cancer survivors

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Abstract

Purpose Tobacco use in cancer survivors remains a significant problem, however, the use of non-cigarette tobacco products (NCTPs) in this population is less understood. This study examined prevalence and correlates of tobacco use among cancer survivors who were never, current, and former cigarette users. Tobacco-related behaviors and quitting attitudes were compared between survivors dually using cigarettes and electronic cigarettes (ECs) and cigarette-only users.

Methods In this cross-sectional study, patients at Mid-South cancer centers ($n=629$; 50.4% never, 17.8% current, and 31.8% former cigarette users) responded to an anonymous questionnaire about tobacco-related behaviors and quitting attitudes.

Results Among current cigarette users, 27.7% reported using two or more tobacco products. Most commonly, 15.2% of cigarettes users were using ECs. Compared to cigarette only use, dual use of tobacco products was associated with male gender ($p<0.0001$), being single ($p=0.009$), and a lung cancer diagnosis ($p<0.0001$). Dual users of cigarettes and ECs were more likely to report a readiness to quit cigarettes within 6 months ($p=0.0317$) and that a physician recommended ECs as a quit resource ($p=0.0361$) compared to cigarette-only users.

Conclusions Results suggest that using more than one tobacco product is common among cancer survivor cigarette users. Dual use of cigarettes and ECs was associated with an increased readiness for cigarette cessation and a physician recommendation of ECs. Targeting potential dual use of tobacco products, particularly cigarettes and ECs, might be beneficial for cigarette cessation among cancer survivors.

Keywords Non-cigarette tobacco use · Cigarette cessation · Dual tobacco use

Cigarette smoking accounts for 30% of all cancer deaths in the United States [1]. Although more than 90% of lung cancer mortality is attributable to cigarette smoking [1], smoking can also lead to numerous other types of cancer diagnoses as well (e.g., esophagus, larynx, stomach, bladder) [1, 2]. Importantly, smoking cessation, even after a cancer diagnosis, creates substantial health benefits. Specifically, cessation improves the effectiveness of cancer treatment, increases survival rates, and is associated with a decreased chance of second malignancy [1, 3–7]. Thus, cancer survivors, defined as those diagnosed with cancer from the time of initial diagnosis until death, are individuals with an increased need to quit cigarettes [8]. Given that approximately 15.5 million individuals in the US are cancer survivors, a critical need exists to develop smoking cessation interventions and resources that are effective and embraced by this community [9].

Approximately 50% of cancer survivors who smoke cigarettes continue to do so after a diagnosis; and among individuals able to quit, up to 33% eventually relapse back to smoking [3]. Cessation programs among cancer survivors, unlike interventions in the general population, have failed to improve cessation rates [10, 11]. Few studies have examined why behavioral and pharmacologic treatments are less effective in this population [12]. Although e-cigarettes (ECs) are not currently approved by the U.S. Food and Drug Administration (FDA) as a cessation tool, many health care providers recommend ECs to cancers survivors as a less harmful alternative to cigarette smoking [13, 14]. However, there is limited and conflicting evidence for the effectiveness

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and safety of ECs as a harm's reduction strategy in oncology settings [14–18]. Further, despite regularly screening for tobacco use, less than half of oncology physicians were found to provide advice and support for cessation services [14, 19, 20].

Although there has been an increase in assessing cigarette smoking among oncology patients, there has been less attention to the prevalence of non-cigarette tobacco products (NCTPs), for example, ECs, smokeless tobacco/snus, cigars, pipes, hookahs, and cigarillos [21, 22]. Although the use of ECs among never cigarette smokers is less common [17, 23], studies have found high rates of EC use among cancer survivors who smoke cigarettes (i.e., 15.6–25%) [15, 22, 24]. Although some findings suggest cancer survivor smokers use ECs as a means to quit cigarettes [22], less is known about the patterns and reasons leading to dual use (i.e., using two products) [23]. Further, less is understood about the prevalence of a wide variety of tobacco products, as well as dual and poly use (i.e., use of three or more products) among cancer survivors.

Thus, the purpose of the current study was to examine the prevalence and correlates of NCTP use in a cross-sectional sample of cancer survivors who were never, current, and former cigarette users. Additionally, we sought to compare sub-populations (i.e., cigarette users vs. never cigarette users, cigarette and EC dual users vs. cigarette-only users) in relation to tobacco-related behaviors and quitting attitudes.

Methods

Procedure

The study was approved by approved by the UTHSC Institutional Review Board. Participants were recruited and surveyed at four cancer centers located in the United States Mid-South region. Individuals were eligible if they were ≥ 18 years of age and currently receiving cancer treatment (i.e., chemotherapy, radiation). Interested patients were referred to a University of Tennessee Health Science Center (UTHSC) staff member to assess eligibility. After having the study explained to them, participants could complete the anonymous survey individually or have UTHSC staff member read the survey to them.

Survey

Demographics

Participants identified their age, gender, race, ethnicity, marital status, and highest level of education.

Cancer diagnosis

Participants reported their type of cancer (i.e., breast, prostate, lung and/or bronchus, colon and/or rectum, pancreatic, uterine, bladder, lymphoma, other).

Readiness to quit

Based on the Transtheoretical Model of Stages of Change, participants were categorized as ready to quit or not within the next 6 months [25]. Participants responded *yes* or *no* to, "Are you seriously considering quitting smoking cigarettes within the next 6 months?"

Confidence to quit

Participants were asked, "How confident are you that you will quit smoking some day?" Responses included: *not at all, slightly* (1), *moderately* (2), *very much* (3), and *extremely* (4). Scores were measured on a continuous scale.

Tobacco-related behaviors

Current cigarette users were defined as having smoked at least 100 cigarettes in their lifetime and reported currently smoking. Former users were defined as those who smoked at least 100 cigarettes in their lifetime and reported, "I quit cigarettes." Never cigarette users were those who had not smoked 100 cigarettes in their lifetime and reported, "I have never smoked."

Use of NCTPs (i.e., ECs, smokeless tobacco/snus, cigars, pipes, hookah, cigarillos) was assessed by endorsement of the use of that product regularly and at least monthly. Nicotine dependence was assessed with the Fagerström Test for Nicotine Dependence [26]. Additionally, to measure previous quit attempts, participants were asked, "How many times have you quit smoking 24 hours or more in your life (including now if you are currently attempting to quit?)." All participants, regardless, of quit history, who responded, "*yes*" to the question, "Did your doctor provide you with any stop smoking resources?" were asked to identify the resources from these options: advice on how to quit, referral to a quit line, referral to a stop smoking clinic, pharmacotherapy (e.g., varenicline, bupropion), nicotine replacement therapy (e.g., gum, patch, lozenge, inhaler, nasal spray), or EC.

Data analysis

Analyses were conducted using SAS/STATv14.1 (SAS Institute Inc., Cary, NC). Descriptive statistics including means and standard deviations, or frequencies and proportions of key demographic and tobacco variable were computed for the overall study population, and by smoking history (i.e.,

never smoker, current smoker, former smoker). Differences in means between the respective groups were tested using two-sample *t* test and differences in proportions were compared using a χ^2 test or Fisher's Exact test, respectively. Univariate analyses compared dual users of cigarettes and ECs, cigarette-only users, and former cigarette users in relation to nicotine dependence, readiness to quit, confidence to quit, previous quit attempts, and report of physician-recommended quit resources. These comparisons were conducted using one-way analysis of variance for comparison of means, and χ^2 test or Exact χ^2 test for the comparison of proportions. Finally, a multivariable logistic regression model determined the relative odds with which demographic variables and other factors (i.e., diagnosis, treatment status, smoking history, readiness to quit, confidence to quit) were associated with dual NCTP use among current cigarette users. The model was reduced to retain only significant variables and all associations were considered significant at the alpha level of 0.05.

Results

The sample included 629 cancer survivors, of which 317 (50.4%) were never cigarette users, 200 (31.8%) were former cigarette users and 112 (17.8%) were current cigarette users. The majority of the overall sample was female (63.9%), White (60.0%), non-Hispanic (99.5%), with an average age of 60.8 years (SD = 14.2). Approximately 54.3% were married and more than half (57.4%) had greater than a high school education (Table 1). Current cigarette users were significantly more likely to be male ($p < 0.0001$), not married ($p = 0.0455$), and have a lower educational level ($p = 0.0002$) compared to never cigarette users (Table 1).

Prevalence of tobacco product use

The lowest prevalence of NCTP use was found among never cigarette users ($n = 317$) as compared to former ($n = 200$) and current cigarette users ($n = 112$) (Table 1). The most

Table 1 Participant characteristics by tobacco product use among a sample of cancer survivors

	Overall sample ($n = 629$)	Never cigarette users ($n = 317$)	Former cigarette users ($n = 200$)	Current cigarette users ($n = 112$)	*p* value
Age M (SD)	60.8 (14.2)	59.0 (15.5)	64.5 (12.4)	58.9 (12.1)	< 0.0001
Gender (% female)	63.9	76.2	51.3	51.8	< 0.0001
Race/ethnicity (%)					0.0683
Caucasian	60.0	55.4	68.2	58.6	
African American	38.3	42.4	30.8	39.6	
Other	1.7	2.2	1.0	1.8	
Hispanic	0.5	0.3	1.0	0.0	
Married (%)	54.3	57.8	54.3	44.1	0.0455
Education (%)					0.0002
< HS	10.3	7.4	10.6	18.0	
HS/GED	32.3	27.8	34.9	40.5	
> HS	57.4	64.9	54.5	41.5	
NCTP use (%)					
Smokeless tobacco/snus	5.1	1.3	7.5	11.6	< 0.0001
Cigar	1.4	0.6	2.5	1.8	0.2061
Pipe	1.0	0.3	1.5	1.8	0.2442
Hookah	1.3	0.3	1.5	3.6	0.0286
Cigarillo	1.0	0.3	0.0	4.5	0.0001
E-cigarette	4.1	0.3	4.0	15.2	< 0.0001
Lung cancer diagnosis (%)	16.1	4.7	26.5	29.5	< 0.0001
Number of tobacco products using (%)					< 0.0001
0	76.1	97.5	85.5	0.0	
1	17.4	2.2	13.0	72.3	
2	4.0	0.0	1.0	16.1	
3+	2.5	0.3	0.5	11.6	

Mean (SD) = mean (standard deviation); % = percent; HS = high school; GED = general education development; NCTP = non-cigarette tobacco product

common, among never cigarette users, was smokeless tobacco/snus (1.3%). Among current cigarette users, the most common NCTP used was ECs ($n=17$; 15.2%), followed by smokeless tobacco/snus ($n=13$; 11.6%), cigarillos ($n=5$; 4.5%), hookah ($n=4$; 3.6%), cigars ($n=2$; 1.8%), and pipes ($n=2$; 1.8%). Among former cigarette users, the most common NCTP used was smokeless tobacco/snus ($n=15$; 7.5%) and the least common was cigarillos (0.0%) (Table 1). Univariate comparisons indicated that current cigarette users were more likely to use ECs ($p<0.0001$), smokeless tobacco/snus ($p<0.0001$), cigarillos ($p=0.0001$), and hookah ($p=0.0286$) compared to never cigarette users and former cigarette users (Table 1). These populations did not significantly differ on their use of cigars or pipes.

Of current cigarettes users, specifically 16.1% reported currently using two tobacco products and 11.6% reported using three or more tobacco products. Of dual use combinations, the most frequently reported included cigarettes and ECs (72.2%), followed by cigarettes and smokeless tobacco/snus (22.2%), and cigarettes and hookah (5.6%).

Comparisons of cigarette and e-cigarette dual users, cigarette-only users, and former cigarette users

Dual users of cigarettes and ECs ($n=17$) were more likely to indicate a readiness to quit within the next 6 months compared to cigarette-only users ($n=95$) (88.2%, $n=15$ vs. 61.3%, $n=58$, $p=0.0317$, respectively) (Table 2). Survivors using both cigarettes and ECs were also more likely to list ECs as a physician-recommended quit resource compared to cigarette-only users and former cigarette users ($n=200$) (75.0%, $n=7$ vs. 28.6%, $n=10$, and 24.0%, $n=13$, $p=0.0361$, respectively). Cigarette-only users, former cigarette users, and e-cigarette and cigarette dual users did not significantly differ in the percent receiving a physician-recommended quit resource, nor in report of other-recommended quit resources [i.e., nicotine replacement therapy (NRT), quit line, physician advice, cessation clinic, cessation medication]. Additionally, current cigarette-only users and dual users of cigarettes and ECs did not significantly differ by confidence to quit, number of previous quit attempts, or nicotine dependence (Table 2).

Correlates of NCTP Use

In the final multivariate model, among current cigarette users, a lung cancer diagnosis (OR = 6.1; 95% CI 3.06–12.18; $p<0.0001$) and male gender (OR = 3.35; 95% CI 2.06–5.45; $p<0.0001$) were significantly associated with increased odds of any NCTP use; and, married status (OR = 0.53; 95% CI 3.06–12.18; $p<0.0001$) was associated with decreased odds of any NCTP use.

Discussion

We observed that the current use of NCTPs among cancer survivors who had never smoked cigarettes was rare (i.e., up to 1.3%), was higher among former cigarette smoker (i.e., up to 7.5%), and was the highest among current cigarette users (i.e., up to 15.2%). Specifically, the rate of using smokeless tobacco/snus in the entire sample was slightly

Table 2 Comparisons of tobacco users among a sample of cancer survivors

	E-cigarette and cigarette dual users ($n=17$)	Cigarette-only users ($n=95$)	Former cigarette users ($n=200$)	p-value
Ready to quit within 6 months (%)	88.2	61.3	–	0.0317
Quit attempts *M (SD)*	6.9 (8.9)	4.6 (3.9)	–	0.3681
Nicotine Dependence *M (SD)*	4.2 (2)	3.7 (2)	–	0.4135
Physician-recommended quit resources (% Yes)	58.8	40.0	26.4	0.1505
Quit resource provided (among those that received recommendation)				
NRT (%)	80	64.5	67.9	0.4577
Quit line (%)	22.2	29.0	26.1	0.6871
Physician advice (%)	50.0	51.5	56.0	0.9331
Cessation clinic (%)	0.0	12.9	26.9	0.5573
E-cigarettes (%)	75.0	28.6	24.0	0.0361
Cessation medication (%)	60.0	58.1	50.0	0.9140
Confidence in quit ability *M (SD)*	3.5 (1.3)	3.5 (1.2)	–	0.9037

Cigarette-only users are individuals that do not use e-cigarettes, but some use other NCTPs; E-cigarette and cigarette dual users and cigarette-only users correspond with current cigarette users in Table 1

M (SD) = mean (standard deviation), NRT = nicotine replacement therapy, E-cigarettes = electronic cigarettes

higher compared to a previous sample of cancer survivors (i.e., 5.1 vs. 3%) [21]. However, to our knowledge, rates of ECs, cigars, pipes, hookahs, and cigarillos among populations of cancer survivor current, former, and never cigarette users are less commonly explored. Given the potential for dual and poly tobacco use to impede cigarette cessation efforts [15, 27–29], it is important for health care providers to understand the prevalence and reasons for use of specific NCTP products among cancer survivors. If cancer survivors are using NCTPs to aid in cigarette cessation, these individuals might benefit from more resources and education about FDA-recommended cessation aids (e.g., nicotine replacement therapy) [30]. Perhaps, the use of NCTPs may contribute to the difficulty in promoting effective cessation treatments for this population [10, 11].

Compared to never users, current cigarette users were more likely to use NCTPs (i.e., ECs, smokeless tobacco/snus, cigarillos, hookah). Similarly, to the general population, more than half of dual users reported using specifically cigarettes and ECs [31]. While the current sample's prevalence of cigarette and EC dual use (15.2%) was slightly lower than that observed in the US general population (20.7%) [31] and a sample of cancer survivors enrolled in a cessation trial (19.0%) [22], results were comparable to a previous nationally representative sample of cancer survivors [24]. These differences could be due to the fact that Kalkhoran and colleagues [23] sample consisted of survivors enrolled in a cessation trial, and most reported cessation as the primary reason for EC use. Specific motivations for NCTP use were not assessed, thus, it cannot be determined how many participants in the current study were using ECs specifically for cigarette cessation or harm reduction. However, compared to Kalkhoran and colleagues [23], our findings might more accurately reflect the prevalence of ECs among cancer survivor users, overall, with varying attitudes about quitting.

In our sample, current dual users of cigarettes and ECs compared to cigarette-only users did not differ in nicotine dependence as has been found in previous research [15]. Although these groups did not differ in their confidence to quit, dual users of cigarettes and ECs were more likely to indicate a readiness to quit cigarettes within 6 months. Similarly found in previous studies of cancer survivors [13, 14], some of these dual users of cigarettes and ECs in the current sample received physician recommendation to use ECs as a cigarette cessation tool. Despite these individuals being more motivated to quit cigarettes, unfortunately, they still reported current dual use. Although our current sample size of cigarette and e-cigarette users was small ($n = 17$), and it is unknown if ECs were recommended by an oncology or other specialty physician, results provide implications for oncology settings. Specifically, it might be important for oncology providers to screen and assess the reasons for patients using both cigarettes and ECs. This population might be particularly motivated to quit cigarettes and could benefit from education and resources for other cessation tools (e.g., nicotine replacement therapy) [30].

Although ECs are not currently recommended by the FDA as cigarette cessation aids [30], it appears that cancer survivors who smoke are increasingly attempting cessation using ECs. Currently, debate exists in the literature as to whether ECs promote cessation or are less harmful than traditional cigarettes [14–18]. In the meantime, it will be beneficial for researchers to longitudinally measure the specific reasons for EC use in cancer survivors, in order to determine the prevalence of individuals having difficulty with both cigarette and EC cessation. Perhaps, future treatment models might need to target cancer survivors unable to quit both cigarettes and ECs [12, 14–18].

In this sample, we observed that survivors with a lung cancer diagnosis were six times more likely to be a dual user of NCTPs compared to those with other diagnoses. Cessation after a lung cancer diagnosis is even more critical for improving prognostic outcomes and preventing recurrence and mortality compared to other cancer diagnoses [5]. Thus, tailored interventions to address dual or poly NCTP use could be most important within lung cancer populations.

Several limitations exist to our current study. Measures are cross-sectional; thus, the impact of NCTP use on long-term quitting attitudes and cigarette cessation outcomes is unknown in the current sample. It will be important for future studies to use longitudinal designs to explore how long-term use of NCTPs, specifically ECs, impacts cigarette cessation outcomes among cancer survivors. Because we only assessed monthly use of NCTP, differences among individuals using NCTPs daily versus weekly are unexplored in the current study. Data were collected in only one region of the United States, which might limit generalizability to other populations. Additionally, it is unknown if other cessation resources were recommended to participants other than those listed in the current survey. Further, the current sample size ($n = 17$) of dual cigarette and EC users is small; thus, future studies should replicate findings in larger samples.

Conclusions

Our findings extend the literature by highlighting the prevalence of dual and poly use of tobacco products in this population, particularly in regard to the dual use of cigarettes and ECs. Dual users of cigarettes and ECs might be especially motivated to quit cigarettes, and thus, could be a population that is important to identify in order to provide FDA-recommended cessation aids. Oncology cessation services might be more effective if tailored to meet the specific barriers of dual and poly tobacco users, particularly among lung cancer populations.

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Compliance with ethical standards

Conflict of interest The authors declares no conflict of interest.

Ethics approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

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