Cigarette and alternative tobacco product use among adult cancer survivors enrolled in 9 ECOG-ACRIN clinical trials

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Abstract

Background: While cigarette smoking has declined among the US general population, sale and use of non-cigarette alternative tobacco products (ATPs; e.g., e-cigarettes, cigars) and dual use of cigarettes/ATPs are rising. Little is known about ATP use patterns in cancer survivors enrolled in clinical trials. We investigated prevalence of tobacco product use, and factors associated with past 30-day use, among cancer patients in national trials.

Methods: Cancer survivors (N=756) enrolled in 9 ECOG-ACRIN clinical trials (2017-2021) completed a modified Cancer Patient Tobacco Use Questionnaire (C-TUQ) which assessed baseline cigarette and ATP use since cancer diagnosis and in the past 30-days (30d).

Results: Patients were on average 59 years old, 70% male, and the mean time since cancer diagnosis was 26 months. Since diagnosis, cigarettes (21%) were the most common tobacco product used, followed by smokeless tobacco use (5%), cigars (4%), and e-cigarettes (2%). In the past 30d, 12% of patients reported smoking cigarettes, 4% cigars, 4% using smokeless tobacco, and 2% e-cigarettes. Since cancer diagnosis, 5.5% of the sample reported multiple tobacco product use, and 3.0% reported multiple product use in the past 30d. Males (vs. females) (OR 4.33; p=0<.01) and individuals not living with another person who smokes (vs. living with) (OR 8.07; p=0<.01) were more likely to use ATPs only vs. cigarettes only in the past 30d.

Conclusions: Among cancer patients, cigarettes were the most prevalent tobacco product reported.

Impact: Regardless, ATPs and multiple tobacco product use should be routinely assessed in cancer care settings.

Keywords

INTRODUCTION

Cigarette smoking accounts for at least 30% of cancer deaths.[1] About 10% to 30% of cancer patients are smoking cigarettes at the time of cancer diagnosis and many of these patients continue to smoke following the diagnosis.[2] Smoking at the time of diagnosis is associated with greater risk of second tobacco-related primary cancers, increased all-cause mortality, and increased cancer-specific mortality.[3] Quitting smoking improves the prognosis of cancer patients.[3]

In the past decade, cigarette smoking prevalence has declined in the US adult population (in those with and without cancer),[3] however the sale and consumption of some non-cigarette alternative nicotine/tobacco products (ATPs; e.g., cigars, e-cigarettes) is on the rise in the general population.[4-6] Combustible ATPs such as cigars and little cigars (cigarillos) have been found in the general population to be associated with health harms including nicotine dependence, and cancers of the oral cavity, larynx, and esophagus.[7,8] However, some non-combustible ATPs (e.g., e-cigarettes, some smokeless tobacco products [i.e., snus]), are being evaluated as harm reduction products in the general adult population.[9]

Among patients with cancer in the US, evolving research from clinical trials demonstrates increasing prevalence of e-cigarette use, with higher rates of e-cigarette use seen among

cancer patients who also smoke cigarettes (dual use).(10,11) However, no prior work has quantified use of the broad spectrum of ATPs (e.g., cigars, smokeless tobacco) used by cancer patients in clinical trials nor factors associated with ATP use. This is an important scientific question given the growing number of ATPs available in the US(4,12) and the ongoing public health debate about tobacco harm reduction (9,13)

The aims of the present investigation were to estimate the prevalence of cigarette and ATP use since cancer diagnosis and in the past 30 days from study entry, and to identify sociodemographic, cancer diagnosis and psychosocial factors associated with current (past 30-day) product use, among adult cancer patients enrolled in multiple national cancer clinical trials.

MATERIALS & METHODS

Study Design

Data were obtained from cancer patients enrolled into 9 ECOG-ACRIN clinical trials (i.e., E1A11, EA1131, EA3163, EA4151, EA6134, EA6141, EA8153, EA8171, and EA9161; Supplemental Table 1) who completed an ancillary sub-study on postdiagnosis tobacco use (EAQ16T). All participants provided written informed consent following ethical guidelines in the The Declaration of Helsinki. The parent clinical trials were led by the ECOG-ACRIN Cancer Research Group and funded by the NCI's National Clinical Trials Network. Data collection for this ancillary tobacco study took place from June 2017 to October 2021. Participants in the ancillary study completed a modified version of the NCI Cancer Patient Tobacco Use Questionnaire (C-TUQ;Division of Cancer Control and Population Sciences, 2022) at baseline, 3-, and 6-month follow up. The research was approved by the institutional review boards at each site and the NCI Central Institutional Review Board. The present investigation focuses only on baseline survey data which was collected at the time patient's consented for the parent trials.

Baseline Measures

The baseline survey was participant self-administered using an online survey portal managed by ECOG-ACRIN (i.e., Easy Entry of Patient Reported Outcomes; EASEE-PRO). EASEE-PRO is a web-based system that patients log into to enter their survey responses.

Sociodemographic, psychiatric, and cancer characteristics—The baseline survey assessed education level (<4 year college degree, 4 year college degree) as well as age, gender (male/female), race (Asian/Black/White/multiple races), ethnicity (Hispanic/ non-Hispanic), zip code, and cancer diagnosis were extracted from the electronic health record.

Neighborhood socioeconomic status was summarized using the national Area Deprivation Index (ADI), a factor-based index of level of socioeconomic deprivation derived from participant's zip code.(14) The PROMIS-Anxiety and PROMIS-Depression short forms, which include 8 items rated on a 5-point Likert scale (ranging from 1 "never" to 5 "always"), were used to assess anxiety and depression symptoms (4 items for each symptom).(15) Participants were also queried on their cancer illness-related stigma using

a cancer stigma scale measure rated on a 4-point Likert scale ranging from 1 "strongly disagree" to 4 "strongly agree."(16-18)

Cigarette and alternative tobacco product use—The baseline survey assessed participants' cigarette and ATP use since cancer diagnosis (i.e., "Since you were first told you had cancer, which of the following tobacco products have you used regularly?") and in the past 30 days (i.e., "In the past 30 days, which of the following products have you used?"). Specifically, participants were queried on their use of cigarettes, cigars/cigarillos/filtered cigars, clove cigarettes or kreteks, hookah, pipes, bidis, e-cigarettes or other electronic nicotine delivery systems, smokeless tobacco like dip, chew or snuff, paan with tobacco, or snus (check all that apply). Individuals endorsing smoking were also asked about cigarette quit attempts in the past 30 days (yes/no).

Statistical Method

Participant characteristics and prevalence of cigarette and ATP use were examined using means (with standard deviations) and frequencies (with proportions), respectively, for continuous and discrete variables. For all statistical models, based on our low prevalence of certain ATP products (Table 1), we collapsed cigarette and ATP use in the past 30 days into a single outcome variable with 3 levels: Cigarettes only, ATPs only, or dual cigarette and ATP use. The associations of patient characteristics with cigarette/ATP use in the past 30 days were evaluated using univariate multinomial logistic regression. Fisher's exact test was used to explore the association of past 30d cigarette quit attempt versus no quit attempt with past 30d cigarette and cigarette/ATP use (i.e., cigarettes only vs. dual cigarette and ATP use) among those currently smoking cigarettes. All tests were two-sided with statistical significance set at $p<0.05$. All analyses were conducted in SAS 9.4 (SAS Institute, Cary, NC).

Data availability

Data will be made available through a data request submitted to the ECOG-ACRIN Cancer Research Group for review (https://ecog-acrin.org/).

RESULTS

Response rate

Of the 1124 participants who consented to participate in the ancillary sub-study on tobacco use, 756 (67%) completed the baseline survey.

Participant characteristics

Participant characteristics are presented in Table 1. Briefly, on average, participants were 59 years of age, 70% male, and the mean time from cancer diagnosis to completion of baseline survey was 25.6 months (SD=39.9). The most common types of cancer diagnosis were leukemia (35.8%), lymphoma (19.2%) and prostate (17.6%), which are not considered smoking-related cancers.

Prevalence of cigarette and ATP use since cancer diagnosis and in past 30d

Since Cancer Diagnosis: Cigarettes were the most commonly used tobacco product since cancer diagnosis (20.5%). 4.8% of the sample used smokeless tobacco since cancer diagnosis, 3.6% used cigars, 2.4% reported e-cigarette use and 1.2% reported pipe use since cancer diagnosis. Of note, 5.3% of the sample used more than one tobacco product since cancer diagnosis and of those participants, 4.7% used cigarettes in combination with an ATP since cancer diagnosis.

In Past 30 Days: In the past 30 days 11.7% of participants used cigarettes, 3.6% used smokeless tobacco products, 4.3% used cigar products, 2.4% of participants reported use of e-cigarettes, and 1.2% reported pipe use in the past 30d. (Table 2). 3.0% reported multiple product use in the past 30 days. with 2.0% of these participants reporting use of cigarettes plus ATP(s) in the past 30 days (see Table 2 footnote for product combinations).

Bivariate correlates of past 30-day ATP vs. cigarette use

Bivariate associations between participant characteristics and past 30 day tobacco product use are summarized in Table 3. Males (OR 4.33, 95% CI 1.63, 11.51, p<0.01) and individuals not living with another smoking household member (OR 8.07, 95% CI 2.28, 28.60, p<0.01) were more likely to use ATPs vs. cigarettes only. The effects of race, education, and ADI on tobacco product use were all non-significant (all p values >0.05; Table 3). In additional bivariate analyses, age, anxiety and depression, illness-related stigma scores, and time since cancer diagnosis were each not associated with past 30d tobacco product use (all p values >0.10; Supplemental Table 2). Descriptively, individuals with exclusive cigarette smoking tended to be older and report higher anxiety, depression and illness-related stigma scores compared to exclusive ATP use or dual cigarette/ATP use.

In an exploratory bivariate analysis of individuals currently smoking, individuals dually using cigarettes and ATPs were (non-significantly) less likely to report a past 30d cigarette quit attempt (2/7, 29%) versus no quit attempt, compared to individuals exclusively using cigarettes in the past 30d (36/53, 68%)(p=0.09).

DISCUSSION

Little is known about alternative tobacco product use, including multiple product use, among those diagnosed with cancer. We investigated the prevalence of cigarette and ATP use, and bivariate factors associated with current exclusive and multiple product use, among cancer survivors enrolled in cancer clinical trials. In unadjusted analyses, males and individuals not living with another individual who smokes were more likely to report use of ATPs only in the past 30 days. Our exploratory analysis suggests that among cancer patients reporting current smoking, dual users of ATPs and cigarettes were less likely to report a past 30d cigarette quit attempt compared to individuals only using cigarettes.

The prevalence of past 30-day cigarette and e-cigarette use observed among cancer survivors (11.7% and 2.4%, respectively) enrolled in these trials was lower than recent (2020) national estimates of current use of these products (12.5% and 3.7%, respectively) among the adult general population in the U.S.(19) This lower prevalence could also be due to the specific

cancer disease sites represented in our trials (e..g, no lung cancer patients and few head/neck cancer patients represented). Our prevalence of past 30-day cigar (4.3%) and smokeless tobacco use (3.6%) is slightly higher than the national estimates of use in the general adult population (3.5% and 2.3%, respectively).(19) It is possible that patients with cancer hold different harm perceptions of products than those without cancer (e.g., perceive cigars and smokeless products as less harmful than cigarettes and e-cigarettes) – an area to explore in future work. A cancer diagnosis represents a teachable moment for delivery of evidence-based cigarette and ATP cessation intervention.(20)

Our findings suggest that, in addition to cigarette smoking, men and women with cancer should be screened for ATP use and referred for ATP cessation treatment. There is a continued need for research focusing on the implementation of evidence-based treatments to promote smoking cessation and prevent smoking relapse to reduce cancer incidence and improve cancer outcomes for patients with dependence on cigarettes and other tobacco products.(21)

Our study was limited in that our data were cross-sectional and causality cannot be inferred from associations. Our data were self-reported which may have influenced disclosure of cigarette and ATP use. The top three cancer types in our participants (lymphoma, leukemia and prostate) were not smoking-related cancers which may have affected the prevalence of smoking and ATP use we observed. Thus, our results likely conservatively reflect cigarette and ATP use prevalence among cancer survivors with cancers that have limited association with tobacco use. We found low prevalence of some ATPs and thus were unable to examine the associations between participant factors and specific use of ATPs, or non-combustible vs. combustible ATPs, and instead collapsed all ATPs into an 'ATP' category for analyses. Future research should examine associations between participant characteristics and individual ATPs in patients with cancer. The C-TUQ assessed all cigar product types using a single item; thus, we were unable to distinguish the prevalence and covariates of use for cigar product types (e.g., little cigar vs. conventional cigar vs. premium cigar). The comparisons of product use with the literature in the general population do not account for demographic differences between the trial participants and the general population. Finally, enrollment for this ancillary study took place between June 2017 and October 2021 during which time the e-cigarette landscape shifted with the rise of e-cigarette or vaping associated lung injury (EVALI), subsequent e-cigarette bans in some states, and the COVID-19 pandemic, which all could have impacted reported use of e-cigarettes.

Limitations notwithstanding, this is the first comprehensive investigation of ATP use, including multiple product use, among individuals with cancer using data from a large clinical trial network. Although cigarette smoking was the most common form of tobacco use, the findings suggest that ATPs and multiple tobacco product use should also be routinely assessed in cancer care settings.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1:

Participant characteristics at study entry

	Total (N=756)	
	N	**%**
Age (in years) (mean [SD])	58.8 (9.0)	
Gender		
Female	228	30.2
Male	528	69.8
Race[a]		
White	678	93.9
Black	35	4.8
Asian	7	1.0
Endorsed multiple races	2	0.3
Ethnicity[b]		
Hispanic	19	2.6
Non-Hispanic	716	97.4
Education Level[c]		
< 4-year college degree	346	45.8
>= 4-year college degree	409	54.2
National Area Deprivation Index[d]		
Low	347	49.9
High	348	50.1
Cancer Diagnosis		
Breast	80	10.6
Head and Neck	4	0.5
Leukemia	271	35.8
Lymphoma	145	19.2
Melanoma	70	9.3
Myeloma	53	7.0
Prostate	133	17.6
Time since initial cancer diagnosis to date of completing baseline survey (in months) (mean [SD])[e]	25.6 (39.9)	
Cigarette Smoking Status[f]		
Current past 30day cigarette smoking	81	11.0
Former cigarette smoking	257	34.7
Never cigarette smoking	402	54.3

Note: This table includes patients who completed the baseline survey.

Notations: SD=standard deviation.

[a] 34 participants had missing data for race and are not included

[b] 21 participants had missing data on ethnicity and are not included

[c] 1 participant had missing data on education and is not included

[d] 61 participants had missing data on the ADI value

[e] 170 participants had missing data on this variable (mainly because two parent trials [EA3163 and EA4151] did not collect the date of initial diagnosis)

[f] 16 participants had missing smoking status

Table 2.

Prevalence of cigarette and alternative tobacco product since cancer diagnosis and in the past 30 days

Category	Product Use	N (%)	
		Since Cancer Diagnosis (N=750)[1]	In Past 30 days (N=745)[2]
	Any Product Use	200 (26.7%)	145 (19.5%)
Combustible	Cigarettes	154 (20.5%)	87 (11.7%)
	Cigars, cigarillos, filtered cigars	27 (3.6%)	32 (4.3%)
	Pipes	9 (1.2%)	9 (1.2%)
	Clove cigarettes or kreteks	3 (<1%)	3 (<1%)
	Hookah	1 (<1%	2 (<1%)
	Bidis	1 (<1%)	0 (0%)
Electronic nicotine delivery	E-cigarettes	18 (2.4%)	18 (2.4%)
Smokeless[3]	Smokeless tobacco (e.g., chew, snuff, dip)	36 (4.8%)	27 (3.6%)
	Snus	1 (<1%)	0 (0%)
Multiple product use (>1 product)	*Combination Product Use*	41 (5.5%)	22 (3%)
	Cigarettes + ATP(s)	35 (4.7%)[4]	15 (2.0%)[5]
	Other combinations of ATPs	6 (<1%)[6]	7 (<1%)[7]

[1] Missing data for 6 patients on this item

[2] Missing data for 11 patients on this item

[3] Pann w/ tobacco, gutka, zarda, khaini was not listed here as no patient was using it.

[4] combinations of products since cancer diagnosis were: cigarettes with e-cigarettes (n=9), cigarettes with e-cigarettes and cigars (n=1), cigarettes with e-cigarettes and cloves/kreteks (n=2), cigarettes with e-cigarettes and smokeless tobacco (n=1), cigarettes with cigars (n=9), cigarettes with cigars and pipes (n=1), cigarettes with cigars and pipes and smokeless (n=1), cigarettes with pipes (n=3), cigarettes with pipes and bidis (n=1), cigarettes with cloves/kreteks (n=1), cigarettes with smokeless (n=5), cigarettes with smokeless and snus (n=1)

[5] combinations of products in the past 30 days were: cigarettes with e-cigarettes (n=3), cigarettes with e-cigarettes, cigars, pipes, and hookah (n=1), cigarettes with e-cigarettes and smokeless (n=1), cigarettes with e-cigarettes and smokeless (n=1), cigarettes with cigars (n=2), cigarettes with cigars and pipes (n=1), cigarettes with cigars, cloves/kreteks, and smokeless (n=1), cigarettes with cigar, pipes, cloves/kreteks, and smokeless (n=1), cigarettes and pipes (n=3), cigarettes and smokeless (n=1)

[6] combinations of products since cancer diagnosis were: e-cigarettes and smokeless (n=2), cigars and pipes (n=3), and cigars and smokeless (n=1)

[7] combinations of products in the past 30 days were: e-cigarettes and cigars (n=1), e-cigarettes and smokeless (n=2), cigars and pipes (n=2), cigars and hookah (n=1), and cigars and smokeless (n=1)

Table 3.

Bivariate associations of baseline participant characteristics with past 30-day tobacco product use reported at baseline (N=145)

	Tobacco product use						Overall p-value (from the univariate model)	Unadjusted Odds Ratio (95% CI) (p-value)
	Cigarettes only[1] (n=72; 10%)		ATP only (i.e., other combustible products,[2] smokeless[3] or e-cigarettes) (n=58; 8%)		Combined cigarette and ATP use (both) (n=15; 2%)			
	N	%	N	%	N	%		
Gender							**<0.01**	
Male	48	42.5	52	46.0	13	11.5		**ATPs vs. Cigarettes: 4.33 (1.63, 11.51) (<0.01)** Both vs. Cigarettes: 3.25 (0.68, 15.58) (0.14)
Female	24	75.0	6	18.8	2	6.2		**Reference group**
Race							0.60	-
White	62	49.2	52	41.3	12	9.5		
Other	10	52.6	6	31.6	3	15.8		
Education[4]							0.52	-
<4-year college degree	48	53.3	33	36.7	9	10.0		
>=4-year college degree	24	44.4	25	46.3	5	9.3		
Household smoking status							**<0.01**	
Lives with another person who smokes	22	81.5	3	11.1	2	7.4		Reference group
Does not live with another person who smokes	50	42.4	55	46.6	13	11.0		**ATP vs. Cigarettes: 8.07 (2.28, 28.60) (<0.01)** Both vs. Cigarettes: 2.86 (0.59, 13.76) (0.19)
National Area Deprivation Index[5]							0.08	-
Low	21	37.5	27	48.2	8	14.3		
High	47	56.6	29	35.0	7	8.4		

Note: Tabled percentages are row percentages. Bolded values represent p<0.10 from the univariate analysis. The overall p-value presents the p value for the overall association of the factor with the outcome variable (i.e., across all levels of the target factor and all levels of the outcome variable). CI, confidence interval. ATP, alternative tobacco products.

[1] The group "Cigarettes only" served as the reference group for the outcome variable for all analyses (i.e., exclusive cigarette use [referent] vs. exclusive ATP use and exclusive cigarette use vs. dual ATP and cigarette use ['both']

[2] Other combustible products include pipes, cigars, cigarillos, hookah, bidis, cloves, and kreteks.

[3] Smokeless products include smokeless tobacco and snus.

[4] 1 patient excluded due to missing data in education

[5] 6 patients excluded due to missing data in ADI