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Patterns of E-cigarette Use Frequency—National Adult Tobacco Survey, 2012–2014

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Abstract

Introduction—Accounting for occasional or intermittent e-cigarette use has yielded higher estimates of current use among U.S. adults. However, frequency of e-cigarette use by population subgroups is not well described. This study assessed e-cigarette use frequency by sociodemographic characteristics and other tobacco product use among U.S. adults.

Methods—This study analyzed combined data from the 2012–2013 ($n = 60,192$) and 2013–2014 ($n = 75,233$) National Adult Tobacco Survey, a telephone-based survey of U.S. adults aged 18 years, to assess frequency of e-cigarette use (daily, some days, rarely) by sex, age, race/ethnicity, education, annual household income, U.S. region, marital status, sexual orientation, and cigarette smoking and other tobacco product use (cigars, cigarillos, little filtered cigars; traditional pipes; water pipes; and chewing tobacco, snuff, dip, snus, and dissolvable tobacco products). Analyses took place in 2016.

Results—Among current e-cigarette users, 19.3% used daily, 29.3% used some days, and 51.4% used rarely. Daily use was lowest among younger adults, Hispanics, and those who were single, never married, or not living with a partner; and greatest among non-Hispanic Asians ($p < 0.0001$). Among current e-cigarette users, 25.3% were cigarette-only smokers, 52.8% smoked cigarettes and used other tobacco products, 5.5% used other tobacco products only, 6.5% were former cigarette-only smokers, 6.7% were former users of cigarettes and other tobacco products, 1.3% were former other tobacco product users only, and 1.8% never used cigarettes or other tobacco products.

Conclusions—E-cigarette use frequency varies by sociodemographic characteristics and other tobacco use. Further surveillance, particularly related to frequency of e-cigarette use and its impact on cigarette cessation, could inform public health policy, planning, and practice.

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INTRODUCTION

Electronic cigarettes (e-cigarettes) are battery-operated devices that simulate smoking a cigarette and produce heated aerosol often containing nicotine.¹ E-cigarette use increased among U.S. adults in recent years, primarily among current and former cigarette smokers.^{2,3} E-cigarette use is associated with cigarette smoking among adults.⁴ In 2014, a total of 15.9% of current cigarette smokers and 22.0% of recent former cigarette smokers currently used e-cigarettes, compared with 2.3% of long-term former cigarette smokers and 0.4% of never cigarette smokers.⁴ In 2015, 58.8% of e-cigarette users currently smoked cigarettes.²

Variations exist in frequency of e-cigarette use. Accounting for occasional or intermittent use yields higher estimates of e-cigarette use; during 2013–2014, every day or some days 3.3% of adults used e-cigarettes, whereas 6.6% of adults used e-cigarettes every day, some days, or rarely.⁵ However, variations in e-cigarette use frequency by population group is not well described, most notably by use of other tobacco products (OTP). It is important to monitor patterns of use to inform public health strategies to maximize any potential benefits and minimize potential risks of e-cigarettes at the population level. Similar to conventional tobacco product use, knowledge of disparities is also important to inform public health practice. To address these gaps, this study assesses e-cigarette use frequency by sociodemographic groups and OTP use.

METHODS

Study Sample

Data came from the National Adult Tobacco Survey, a nationally representative landline and cellular telephone cross-sectional survey of non-institutionalized civilian adults aged 18 years in the U.S.⁶ Analyses used combined data from the two most recent National Adult Tobacco Survey waves for more stable estimates. Overall sample sizes were 60,192 (2012–2013) and 75,233 (2013–2014); response rates were 44.9% and 36.1%, respectively. Data were weighted to account for the differential probability of selection and nonresponse. This secondary analysis of de-identified data was exempt from IRB review.

Measures

Current e-cigarette use categorized as daily, some days, or rarely originated from the question: *Do you now use electronic cigarettes every day, some days, rarely, or not at all?*

Cigarette smoking and OTP use (cigars, cigarillos, little filtered cigars; traditional pipes; water pipes; and chewing tobacco, snuff, dip, snus, and dissolvable tobacco products) informed seven mutually exclusive categories: (1) current cigarette-only smokers, (2) current users of cigarettes and OTP, (3) current OTP-only users, (4) former cigarette-only smokers, (5) former users of cigarettes and OTP, (6) former OTP-only users, and (7) e-cigarette-only users. Current users reported using tobacco products every day or some days for cigarettes; or every day, some days or rarely for OTP. Former users met a lifetime use threshold, but reported not currently using the product.⁵ Assessed sociodemographic characteristics were sex, age, race/ethnicity, education, annual household income, U.S. Census region, marital status, and sexual orientation.⁵

Statistical Analysis

Analyses performed during 2016 using SAS, version 9.3 and SAS-callable SUDAAN, version 11.0 applied sampling weights to adjust for survey design and nonresponse. Among current e-cigarette users (N=5,312), the study assessed point estimates and 95% CIs of e-cigarette use frequency by sociodemographics and OTP use. The not missing completely at random option was applied to missing data. Chi-square tests assessed differences across groups, and pairwise *t*-tests assessed differences within groups. Significance level at $p<0.001$ accounted for multiple comparisons in all analyses.

RESULTS

Overall, 5.4% of respondents were current e-cigarette users. Among current e-cigarettes users, 19.3% used e-cigarettes daily, 29.3% used on some days, and 51.4% used rarely.

Frequency of current e-cigarette use ($p<0.0001$) varied by age, race/ethnicity, and marital status. The proportion of current e-cigarette users who used e-cigarettes daily was lowest among adults aged 18–24 years (12.2%) compared with adults aged 25–44 years (19.9%), 45–64 years (24.3%), and 65 years (26.2%). Daily e-cigarette use was greatest among non-Hispanic Asians (33.4%). By marital status, 14.4% of current e-cigarette users who were single/never married/not living with a partner used e-cigarettes daily, compared with 21.0% of those who were married or living with a partner and 23.2% of those who were widowed, divorced, or separated (Table 1).

Among current e-cigarette users, 25.3% were current cigarette-only smokers, 52.8% smoked cigarettes and used OTP, 5.5% used OTP only, 6.5% were former cigarette-only smokers, 6.7% were former users of cigarettes and OTP, 1.3% were former OTP-only users, and 1.8% never used cigarettes or OTP. Former cigarette-only users and former users of cigarettes and OTP reported the highest proportions of daily e-cigarette use ($p<0.001$). Current OTP-only users reported the lowest proportion of daily e-cigarette use ($p<0.001$; Table 2).

DISCUSSION

Among current e-cigarette users during 2012–2014, approximately half used e-cigarettes rarely, whereas one in five used e-cigarettes daily. Variations in frequency of use were apparent by population groups and OTP use. Current cigarette smokers, regardless of OTP use, had lower proportions of daily e-cigarette use, whereas former smokers reported higher proportions of daily e-cigarette use. These findings underscore the importance of accounting for e-cigarette use frequency, particularly in the context of OTP use.

These findings are consistent with previous research on experimentation and continuity of e-cigarette use among current and former smokers.^{7–13} Observed patterns may reflect different reasons for e-cigarette use among smokers. Studies have reported that more intense and continuous e-cigarette use is associated with intention to quit smoking, whereas infrequent use is associated with experimentation and reasons other than smoking cessation.^{7,10,13–18} Current OTP-only and e-cigarette-only users had the highest proportion of using e-cigarettes rarely. Concurrent use of cigarettes and e-cigarettes may represent a subgroup of

cigarette smokers with greater likelihood of nicotine dependency, underlying health conditions, and concurrent use of OTP.^{16,19} These findings highlight the importance of enhanced surveillance that includes e-cigarette use frequency, in addition to further research on the impact of e-cigarette use frequency on cigarette cessation.

This study is the first to report differences in e-cigarette use frequency by subpopulations. Groups with lower e-cigarette use prevalence,⁵ including older adults and non-Hispanic Asians, had higher proportions of daily use. Reasons for use (e.g., cessation), the use of OTPs, and social factors may explain these patterns.^{20–22} Further examination of social norms, perceptions, and motivation for e-cigarette use by sociodemographic characteristics and frequency of use may help understand these variations.

Limitations

These findings are subject to at least four limitations. First, cross-sectional data do not allow for timing of e-cigarette use relative to cigarette and OTP use to be assessed. Second, the relatively low response rate could introduce bias. However, findings were consistent with data from other nationally representative population-based surveys.¹³ Third, limited sample size resulted in wide variability of estimates for certain subgroups (e.g., former OTP-only users). Finally, the National Adult Tobacco Survey did not assess a more detailed measure of frequency of use (e.g., number of times per day).

CONCLUSIONS

E-cigarette use frequency varies by sociodemographic characteristics and OTP use. Current cigarette smokers, regardless of OTP use, more commonly use e-cigarettes some days or rarely. These patterns may reflect the potential impact of intermittent e-cigarette use on cigarette smoking among adults, including prolonged dual use of both. In contrast, daily e-cigarette use is more common among former cigarette smokers, which may reflect the potential impact of more routine use on smoking cessation. These findings highlight the importance of further surveillance and research to inform public health practice, particularly related to the frequency of use of various types of e-cigarette products and its impact on cigarette cessation.

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Saida Sharapova conceptualized and designed the study, performed data analyses and results interpretation, wrote the article and revised it for important intellectual content. Tushar Singh made a substantial contribution to conception and design of the study and data interpretation, and revised the article for important intellectual content. Israel Agaku made a substantial contribution to conception and design of the study and data interpretation and revised the article for important intellectual content. Sara Kennedy made a substantial contribution to conception and design of the study and data interpretation, contributed to the writing of the article, and revised the article for important intellectual content. Brian King made a substantial contribution to data analyses and interpretation and writing of the article, and revised the article for important intellectual content. All authors read and approved the final version of the submitted manuscript.

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Table 1
Sociodemographic Characteristics of Current E-cigarette Users, National Adult Tobacco Survey, 2012–2014

Sociodemographic characteristics	Current e-cigarette users ^d			
	n	% (95% CI) ^c	Daily	Rarely
Overall	5,312	5.4 (5.2, 5.6)	19.3 (17.9, 20.6)	29.3 (27.7, 30.9)
Sex				
Male (ref)	2,640	6.3 (6.0, 6.6)	20.6 (18.6, 22.5)	28.3 (26.0, 30.5)
Female	2,543	4.5 (4.3, 4.8)	17.7 (15.9, 19.6)	31.0 (28.6, 33.4)
Age group (years) ^d				
18–24 (ref)	985	10.8 (10.0, 11.6)	12.2 (9.8, 14.7)	23.7 (20.3, 27.1)
25–44	1,924	7.0 (6.6, 7.4)	19.9 (17.7, 22.0)^e	28.8 (26.2, 31.3)
45–64	1,847	4.1 (3.8, 4.3)	24.3 (21.8, 26.8)^e	34.4 (31.5, 37.3)^e
65	514	1.3 (1.1, 1.4)	26.2 (21.2, 31.1)^e	40.7 (34.9, 46.4)^e
Race/ethnicity ^d				
White only, non-Hispanic (ref)	3,814	5.7 (5.5, 5.9)	21.0 (19.3, 22.6)	29.1 (27.2, 31.0)
Black only, non-Hispanic	283	3.0 (2.5, 3.4)	13.1 (8.4, 17.8)	37.7 (30.7, 44.6)
Asian only, non-Hispanic	98	3.6 (2.7, 4.5)	33.4 (21.3, 45.4)	27.1 (15.3, 38.9)
Other race only, non-Hispanic	479	8.8 (7.7, 9.8)	18.4 (14.0, 22.8)	31.2 (25.2, 37.2)
Hispanic	475	4.9 (4.3, 5.4)	12.1 (8.6, 15.7)^e	26.5 (21.6, 31.4)
Education				
Less than high school diploma (ref)	457	5.2 (4.6, 5.8)	15.0 (11.2, 18.7)	33.1 (27.6, 38.5)
High school diploma or equivalent	1,617	7.0 (6.6, 7.5)	19.0 (16.6, 21.3)	30.6 (27.6, 33.5)
Some college, certificate, or associate degree	2,063	6.7 (6.4, 7.1)	21.0 (18.8, 23.2)	28.2 (25.8, 30.6)
Bachelor degree	744	2.8 (2.6, 3.1)	19.8 (16.1, 23.4)	23.7 (19.8, 27.6)
Masters, professional, or doctoral degree	286	1.4 (1.2, 1.6)	17.7 (12.5, 22.9)	31.2 (24.2, 38.2)
Annual household income				
<\$50,000 (ref)	2,266	6.5 (6.1, 6.8)	18.4 (16.4, 20.3)	28.6 (26.1, 31.1)
\$50,000–\$99,999	1,292	5.4 (5.1, 5.8)	20.0 (17.2, 22.9)	31.7 (28.3, 35.1)

Sociodemographic characteristics	Current e-cigarette users ^d E-cigarette use frequency among current users, ^b % (95% CI)				
	<i>n</i>	% (95% CI) ^c	Daily	Some days	Rarely
\$100,000	642	3.8 (3.4, 4.2)	19.6 (15.8, 23.5)	28.8 (24.3, 33.3)	51.6 (46.5, 56.6)
U.S. Census region ^f					
Northeast (ref)	785	4.2 (3.8, 4.6)	17.5 (13.8, 21.2)	28.7 (24.2, 33.2)	53.8 (48.9, 58.8)
Midwest	1,148	5.6 (5.2, 6.0)	17.0 (14.3, 19.7)	31.4 (27.9, 34.9)	51.6 (47.9, 55.3)
South	1,901	5.7 (5.4, 6.1)	20.2 (18.0, 22.3)	29.7 (27.1, 32.3)	50.1 (47.2, 53.0)
West	1,478	5.6 (5.2, 5.9)	20.9 (18.2, 23.6)	26.9 (23.9, 30.0)	52.1 (48.6, 55.7)
Marital status ^d					
Married or living with partner (ref)	2,433	4.5 (4.2, 4.7)	21.0 (19.0, 23.1)	31.3 (28.9, 33.7)	47.7 (45.1, 50.3)
Widowed, divorced, or separated	1,235	5.5 (5.0, 5.9)	23.2 (20.0, 26.4)	31.5 (27.9, 35.2)	45.3 (41.3, 49.2)
Single/never married/not living with partner	1,508	7.6 (7.1, 8.1)	14.4 (12.3, 16.5)^e	25.5 (22.6, 28.4)	60.1 (56.9, 63.3)^e
Sexual orientation					
Straight	4,407	5.2 (5.0, 5.4)	19.5 (18.0, 21.0)	29.7 (27.9, 31.5)	50.8 (48.8, 52.7)
Gay, lesbian, or bisexual	344	12.1 (10.5, 13.7)	15.0 (10.1, 20.0)	31.5 (25.1, 37.9)	53.5 (46.5, 60.5)

Note:

Boldface indicates statistical significance ($p < 0.05$).

^aCurrent users defined as those who reported using e-cigarettes every day, some days, or rarely.

^bDenominator: current e-cigarette users (N = 5,312).

^cPercentage of current e-cigarette users in each subpopulation. Denominator for overall percentage: all survey respondents (N = 135,425).

^dCharacteristic significantly associated with the frequency of e-cigarette use ($p < 0.0001$) using chi-square test for independence.

^ePoint estimates significantly different from the reference point estimate based on pairwise *t*-tests within categories of e-cigarette use frequency ($p < 0.001$ used as a measure of significance to account for multiple comparisons).

^fNortheast U.S. Census Region: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. Midwest U.S. Census Region: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. South U.S. Census Region: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. West U.S. Census Region: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Table 2
Tobacco Product Use Among Current Adult E-cigarette Users, National Adult Tobacco Survey, 2012–2014

Tobacco product use	Current e-cigarette users				E-cigarette use frequency among current users, ^a % (95% CI)			
	n	% (95% CI) ^b	Daily	Some days	Rarely			
Current cigarette-only smokers (ref)	1,581	25.3 (23.8, 26.8)	13.1 (10.9, 15.2)	34.9 (31.7, 38.1)	52.0 (48.6, 55.3)			
Current users of cigarettes and OTP	2,503	52.8 (51.0, 54.6)	14.4 (12.7, 16.1)	30.8 (28.4, 33.1)	54.8 (52.3, 57.4)			
Current OTP-only users	265	5.5 (4.7, 6.3)	9.0 (4.1, 13.9)	20.8 (14.3, 27.2)^c	70.3 (63.0, 77.5)^c			
Former cigarette-only smokers	441	6.5 (5.7, 7.3)	51.5 (45.2, 57.7)^c	20.9 (15.9, 25.9)^c	27.6 (21.7, 33.5)^c			
Former users of cigarettes and OTP	365	6.7 (5.9, 7.6)	59.6 (53.5, 65.7)^c	15.7 (11.3, 20.2)^c	24.7 (19.4, 30.0)^c			
Former OTP-only users	53	1.3 (0.8, 1.8)	– ^d	– ^d	60.1 (42.3, 77.8)			
E-cigarette-only users	90	1.8 (1.3, 2.3)	– ^d	22.5 (11.3, 33.6)	67.9 (55.6, 80.1)			

Note:

Boldface indicates statistical significance ($p < 0.05$).

^a Current users defined as those who reported using e-cigarettes every day, some days, or rarely (N = 5,312).

^b Column percentage.

^c Point estimates significantly different from the reference (ref) point estimate based on pairwise t-tests within categories of e-cigarette use frequency ($p < 0.001$ used as a measure of significance to account for multiple comparisons).

^d Estimates with relative SE > 0.3 not reported.

OTP, other tobacco products (included use of cigars, cigarillos, little filtered cigars, traditional pipes, water pipes, chewing tobacco, snuff, dip, snus, and/or dissolvable tobacco products).