E-Cigarette Use *Among U.S. Adults* May Have Plateaued, but *Many Users Are Nonsmokers*

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ABSTRACT

Background: While the prevalence of e-cigarette use increased steadily from 2010 through 2013, some sales projections find market growth to be leveling off.

Design/Methods: Respondents were recruited from cross-sectional nationally representative dual frame samples in 2010 through 2015. US adults were asked about e-cigarette use and cigarette smoking, as well as about many other social climate indictors.

Results: Overall, current e-cigarette use was rare in 2010 (0.3%), but increased each subsequent year from 2010 to 2013. Although current use increased slightly in 2014 (7.3%), this change was not statistically significant. Overall use did not change in 2015 (7.2%). This pattern was consistent across never smokers, former smokers, and current smokers. Furthermore, the prevalence of current use did not increase across region, race, age, sex, or education from 2013 to 2015. Importantly, while increases in current use appear to have stalled, never and former smokers continue to represent a large portion of e-cigarette users. Even though the prevalence of current use is much lower among never smokers (2.6%) and former smokers (7.4%) than current smokers (28.1%) (p <.05), 22.0% of current users are never smokers and 13.8% are former smokers who "e-lapsed" from nonsmoking status to e-cigarette use.

Conclusion: Current e-cigarette use increased steadily from 2010 to 2013, for both smokers and nonsmokers, and has reached a plateau among US adults. These findings are consistent with recent projections from Nielsen and the Wall Street Journal that sales of some e-cigarette models have fallen in late 2015. Despite this, there is cause for concern because 36% of e-cigarette users are neither dual-users nor former smokers who chose these products to help them quit smoking cigarettes. These otherwise nontobacco users (never smokers and "e-lapsed" former smokers) are exposed to nicotine and are at increased risk for cigarette smoking as well as any health consequences caused by e-cigarette use. Regulatory action is needed to ensure that these products do not attract users who would otherwise not be smoking.

INTRODUCTION

E-cigarettes entered the U.S. market in 2007. In the absence of regulation, the affordability, availability, and marketing of these products has increased in recent years. To date, the growing research on the social penetration of e-cigarettes indicates annual growth in both awareness and use of e-cigarettes. A recent CDC study found substantial increases in past 30 day use of e-cigarettes among both U.S. middle and high school students from 2011 to 2014.

Our recent study in Nicotine and Tobacco Research demonstrated rapid growth in e-cigarette use among U.S. adults from 2010 to 2013. Although the magnitude varied across demographic groups, we observed statistically significant increases from 2010 to 2013 across all levels of smoking status, region, race, age, sex, and education. Consistent with previous research, we found the use of e-cigarettes varied by cigarette smoking status. Current smokers were more likely than never and former smokers to use e-cigarettes. Although smokers are most likely to use these products, more than a third of current users were non-smokers.

The purpose of this study is to assess trends in use of e-cigarettes among U.S. adults, demographic predictors of use, and smoking status of current e-cigarette users. Results from this study can inform regulatory decisions about these products, while the identification of potential high risk demographic groups can guide clinical counseling efforts regarding the risks of any tobacco or nicotine use.

METHODS

Data are from the 2010-2015 Social Climate Surveys of Tobacco Control (SCS-TC). The SCS-TC in an annual, cross-sectional dual-frame survey administered to national probability samples of U.S. adults. The design included a Random Digit Dialing (RDD) frame and an internet panel frame developed from a probability sample of U.S. adults, in order to reduce non-coverage issues arising from wireless substitution. Data were weighted to adjust for age, race, sex, and region.

Self-Reported Use of E-cigarettes

Respondents were asked "The next questions are about e electronic cigarettes, also known as e-cigarettes, vaping devices, or hookah pens. E-cigarettes look like regular cigarettes, but are battery-powered and produce vapor instead of smoke. Have you ever heard of an e-cigarette before this survey?" Respondents who had heard of e-cigarettes were asked, "Have you ever used an e-cigarette, even one or two times?" Those who reported yes were asked "How often do you now vape or use e-cigarettes? Every day, some days, rarely, or not at all". Respondents who reported using these products every day, some days, or rarely were considered to be current e-cigarette users.

Self-Reported Cigarette Smoking Status Among E-Cigarette Users

Respondents were identified as never smokers, former smokers who "e-lapsed" from nonsmoking status to e-cigarette use, former smokers who did not "e-lapse," and current smokers.

- Never Smokers
  - Have not smoked at least 100 cigarettes during their entire life
- Former smokers who "e-lapsed" from nonsmoking status to e-cigarette use
  - Have smoked at least 100 cigarettes during their entire life & do not currently smoke
  - Quit smoking cigarettes prior to 2010
- Former smokers who did not "e-lapse"
  - Have smoked at least 100 cigarettes during their entire life & do not currently smoke
  - Quit smoking cigarettes within the past 5 years
  - Reported using e-cigarettes because "using e-cigarettes can help me to quit smoking traditional cigarettes"
- Current smokers
  - Have smoked at least 100 cigarettes during their entire life
  - Currently smoke every day or some days

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TABLE 1. WEIGHTED SAMPLE CHARACTERISTICS

	2010 Unweighted N=3,240	2011 Unweighted N=3,097	2012 Unweighted N=3,101	2013 Unweighted N=3,245	2014 Unweighted N=3,030	2015 Unweighted N=3,070
Smoking Status						
Never Smokers	56.9%	56.9%	59.6%	59.9%	60.9%	60.8%
Former Smokers	24.8%	25.0%	24.8%	24.6%	25.6%	24.3%
Non-daily Smokers	4.6%	3.4%	3.8%	4.3%	3.5%	1.6%
Daily Smokers	13.7%	14.7%	11.8%	10.1%	10.0%	13.2%
Region						
Northeast	12.6%	12.9%	17.8%	17.3%	18.3%	18.3%
Midwest	18.4%	18.9%	21.7%	22.1%	21.4%	21.2%
South	37.6%	37.2%	37.5%	37.8%	36.9%	37.3%
West	31.4%	31.0%	23.0%	22.2%	23.4%	23.2%
Race						
White	74.2%	69.5%	71.5%	70.3%	67.5%	65.7%
Black	11.5%	11.3%	11.4%	11.3%	11.9%	11.8%
Other	14.3%	19.2%	17.1%	17.5%	20.7%	22.6%
Age						
18-24	13.7%	9.3%	11.4%	10.7%	12.5%	11.7%
25-44	38.8%	39.7%	38.3%	37.3%	35.0%	34.4%
45-64	33.3%	34.9%	34.7%	34.3%	34.7%	36.3%
65+	14.2%	16.1%	15.6%	16.2%	17.8%	17.5%
Sex						
Males	47.6%	48.3%	48.1%	47.4%	48.3%	48.2%
Females	52.4%	51.7%	51.9%	52.6%	51.7%	51.7%
Education						
Less than HS	9.2%	10.5%	9.9%	9.0%	12.4%	7.4%
High School	28.5%	27.3%	28.8%	26.9%	29.5%	19.6%
Some College	29.3%	29.6%	28.1%	28.9%	28.8%	28.9%
College Degree	33.0%	32.6%	33.4%	34.9%	29.2%	44.1%

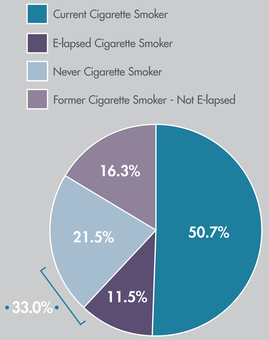
TABLE 2. PREVALENCE OF ELECTRONIC CIGARETTE CURRENT USE

	2010	2011	2012	2013	2014	2015
Overall	0.3% (0.1%-0.5%)	0.8% (0.5%-1.1%)	2.6% (2.0%-3.2%)	6.8% (5.9%-7.7%)	7.3% (6.4%-8.2%)	6.9% (6.0%-7.8%)
Smoking Status						
Never Smokers	0.1% (0.0%-0.2%)	0.1% (0.0%-0.2%)	0.1% (0.0%-0.2%)	1.4% (0.9%-1.9%)	2.3% (1.6%-3.0%)	2.4% (1.7%-3.1%)
Former Smokers	0.3% (0.0%-0.7%)	0.1% (0.0%-0.3%)	1.1% (0.4%-1.8%)	5.4% (3.8%-7.0%)	5.9% (4.2%-7.6%)	7.2% (5.4%-9.0%)
Non-daily Smokers	1.4% (0.0%-3.3%)	1.0% (0.0%-2.9%)	3.1% (0.0%-6.5%)	34.1% (26.0%-42.2%)	34.3% (25.2%-43.4%)	23.9% (16.0%-31.8%)
Daily Smokers	1.4% (0.3%-2.5%)	5.0% (3.0%-7.0%)	10.8% (7.5%-14.1%)	30.3% (25.2%-35.4%)	31.9% (26.6%-37.2%)	27.6% (22.4%-32.8%)
Region						
Northeast	0.5% (0.0%-1.2%)	0.3% (0.0%-0.8%)	1.5% (0.5%-2.5%)	5.5% (3.6%-7.4%)	5.9% (3.9%-7.9%)	3.6% (2.0%-5.2%)
Midwest	0.3% (0.0%-0.7%)	0.5% (0.0%-1.1%)	2.3% (1.2%-3.4%)	6.3% (4.5%-8.1%)	7.0% (5.0%-9.0%)	7.8% (5.7%-9.9%)
South	0.2% (0.0%-0.5%)	0.4% (0.0%-0.8%)	1.4% (0.7%-2.1%)	8.3% (6.7%-9.9%)	8.0% (6.4%-9.6%)	8.3% (6.7%-9.9%)
West	0.3% (0.0%-0.6%)	1.7% (0.9%-2.5%)	2.0% (0.9%-3.1%)	6.0% (4.2%-7.8%)	7.8% (5.8%-9.8%)	6.3% (4.5%-8.1%)
Race						
White	0.3% (0.1%-0.5%)	0.8% (0.4%-1.2%)	1.9% (1.4%-2.4%)	6.7% (5.6%-7.8%)	8.0% (6.8%-9.2%)	6.8% (5.7%-7.9%)
Black	0.3% (0.0%-0.9%)	0.6% (0.0%-1.4%)	0.3% (0.0%-0.9%)	4.3% (2.2%-6.4%)	5.7% (3.3%-8.1%)	7.8% (5.7%-7.9%)
Other	0.4% (0.0%-1.0%)	1.0% (0.2%-1.8%)	2.1% (0.7%-3.5%)	8.9% (6.5%-11.3%)	5.3% (3.5%-7.1%)	6.4% (4.6%-8.2%)
Age						
18-24	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	3.4% (0.8%-6.0%)	14.2% (10.4%-18.0%)	12.5% (9.1%-15.9%)	15.8% (12.2%-19.4%)
25-44	0.4% (0.0%-0.8%)	1.3% (0.6%-2.0%)	1.7% (0.8%-2.6%)	8.6% (7.0%-10.2%)	10.5% (8.6%-12.4%)	8.1% (6.4%-9.8%)
45-64	0.6% (0.1%-1.1%)	0.5% (0.1%-0.9%)	1.9% (1.1%-2.7%)	5.5% (4.1%-6.9%)	5.2% (3.8%-6.6%)	5.7% (4.3%-7.1%)
65 +	0.0% (0.0%-0.0%)	0.4% (0.0%-1.0%)	0.7% (0.1%-1.3%)	1.2% (0.2%-2.2%)	1.5% (0.5%-2.5%)	0.6% (0.0%-1.3%)
Sex						
Males	0.2% (0.0%-0.4%)	1.2% (0.6%-1.8%)	1.8% (1.1%-2.5%)	7.1% (5.8%-8.4%)	8.9% (7.4%-10.4%)	9.1% (7.6%-10.6%)
Females	0.5% (0.2%-0.8%)	0.4% (0.1%-0.7%)	1.7% (1.1%-2.3%)	6.6% (5.4%-7.8%)	5.7% (4.5%-6.9%)	4.7% (3.7%-5.7%)
Education						
Less than HS	0.3% (0.0%-0.9%)	1.9% (0.4%-3.4%)	0.8% (0.0%-1.9%)	10.7% (7.0%-14.4%)	16.8% (13.0%-20.6%)	13.3% (8.9%-17.7%)
High School	0.4% (0.0%-0.8%)	0.4% (0.0%-0.8%)	1.3% (0.5%-2.1%)	7.7% (5.9%-9.5%)	7.3% (5.6%-9.0%)	8.6% (6.3%-10.9%)
Some College	0.4% (0.0%-0.8%)	0.7% (0.2%-1.2%)	3.3% (2.1%-4.5%)	10.6% (8.6%-12.6%)	7.6% (5.8%-9.4%)	9.4% (7.5%-11.3%)
College Degree	0.2% (0.0%-0.5%)	0.9% (0.3%-1.5%)	1.0% (0.4%-1.6%)	2.2% (1.3%-3.1%)	3.0% (1.9%-4.1%)	3.4% (2.4%-4.4%)

TABLE 3. LOGISTIC REGRESSION, PREVALENCE OF ELECTRONIC CIGARETTE USE, 2015

	Current Use Overall N=3,070
Smoking Status	
Never Smokers	REF
Former Smokers	4.7 (3.0-7.3)
Non-daily Smokers	10.3 (5.9-18.2)
Daily Smokers	16.5 (10.6-25.8)
Region	
Northeast	REF
Midwest	1.7 (1.0-3.0)
South	2.2 (1.3-3.8)
West	1.8 (1.0-3.3)
Race	
White	0.9 (0.5-1.4)
Black	REF
Other	0.6 (0.9-1.1)
Age	
18-24	52.6 (14.6-189.8)
25-44	19.2 (5.5-67.3)
45-64	10.9 (3.1-38.2)
65+	REF
Sex	
Males	1.8 (1.3-2.4)
Females	REF
Education	
Less than HS	1.3 (0.7-2.3)
High School	1.5 (0.9-2.4)
Some College	1.8 (1.2-2.7)
College Degree	REF

CURRENT E-CIGARETTE USERS



RESULTS

Overall, 3,070 adults completed the survey. Sample characteristics are presented in Table 1. Current e-cigarette use was rare in 2010 (0.3%), but increased each subsequent year from 2010 to 2013. Although current use increased slightly in 2014 (7.3%), this change was not statistically significant. Overall use did not change in 2015 (7.2%). This pattern was consistent across never smokers, former smokers, and current smokers. Furthermore, the prevalence of current use did not increase across region, race, age, sex, or education from 2013 to 2015 (See Table 2).

Current e-cigarette use is highest among daily smokers (29.6%) and nondaily smokers (24.8%), compared to former smokers (7.4%) and never-smokers (2.6%). Younger adults were more likely than older adults, adults in Census regions other than the Northeast, adults without a college degree were more likely than adults with a college degree, and males were more likely than females to use electronic cigarettes (See Table 2). In multivariable analysis, smoking status remained significant predictors of current use, as did region, sex, age, and education (See Table 3).

While increases in current use appear to have stalled, never and former smokers continue to represent a large portion of e-cigarette users. Even though the prevalence of current use is much lower among never smokers and former smokers than current smokers, 22.0% of current users are never smokers and 13.8% are former smokers who "e-lapsed" from nonsmoking status to e-cigarette use (See Figure 1).

DISCUSSION

Current e-cigarette use increased steadily from 2010 to 2013, for both smokers and nonsmokers, and has reached a plateau among US adults. These findings are consistent with recent projections from Nielsen and the Wall Street Journal that sales of some e-cigarette models have fallen in late 2015. Despite this, there is cause for concern because 36% of e-cigarette users are neither dual-users nor former smokers who chose these products to help them quit smoking cigarettes. These otherwise nontobacco users (never smokers and "e-lapsed" former smokers) are exposed to nicotine and are at increased risk for cigarette smoking as well as any health consequences caused by e-cigarette use. Regulatory action is needed to ensure that these products do not attract users who would otherwise not be smoking.

In conclusion, there has been rapid growth in ever and current e-cigarette use from 2010 to 2013, but growth in current use slowed down from 2013 to 2015. Although smokers are most likely to use these products, almost a third of current users are nonsmokers, undermining potential public health benefits cigarette smokers possibly switching to e-cigarettes.

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