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Electronic Nicotine Delivery Systems:

International Tobacco Control Four-Country Survey

Sarah E. Adkison, MA, **Richard J. O'Connor, PhD**, **Maansi Bansal-Travers, PhD**, **Andrew Hyland, PhD**, **Ron Borland, PhD**, **Hua-Hie Yong, PhD**, **K. Michael Cummings, MPH, PhD**, **Ann McNeill, PhD**, **James F. Thrasher, PhD**, **David Hammond, PhD**, and **Geoffrey T. Fong, PhD**

Department of Health Behavior (Adkison, O'Connor, Bansal-Travers, Hyland), Roswell Park Cancer Institute, Buffalo, New York; The Cancer Council Victoria (Borland, Yong), Carlton, Victoria, Australia; Department of Psychiatry and Behavioral Sciences (Cummings), Medical University of South Carolina, Charleston; Department of Health Promotion, Education, and Behavior (Thrasher), University of South Carolina, Columbia, South Carolina; Division of Epidemiology and Public Health (McNeill), University of Nottingham, United Kingdom; School of Public Health & Health Systems (Hammond), and Department of Psychology (Fong), University of Waterloo, Waterloo, Ontario, Canada

Abstract

Background—Electronic nicotine delivery systems (ENDS) initially emerged in 2003 and have since become widely available globally, particularly over the Internet.

Purpose—Data on ENDS usage patterns are limited. The current paper examines patterns of ENDS awareness, use, and product-associated beliefs among current and former smokers in four countries.

Methods—Data come from Wave 8 of the International Tobacco Control Four-Country Survey, collected July 2010 to June 2011 and analyzed through June 2012. Respondents included 5939 current and former smokers in Canada (n=1581); the U.S. (n=1520); the United Kingdom (UK; n=1325); and Australia (n=1513).

Results—Overall, 46.6% were aware of ENDS (U.S.: 73%, UK: 54%, Canada: 40%, Australia: 20%); 7.6% had tried ENDS (16% of those aware of ENDS); and 2.9% were current users (39% of triers). Awareness of ENDS was higher among younger, non-minority smokers with higher incomes who were heavier smokers. Prevalence of trying ENDS was higher among younger, nondaily smokers with a high income and among those who perceived ENDS as less harmful than traditional cigarettes. Current use was higher among both nondaily and heavy (≥20 cigarettes per day) smokers. In all, 79.8% reported using ENDS because they were considered less harmful than traditional cigarettes; 75.4% stated that they used ENDS to help them reduce their smoking; and 85.1% reported using ENDS to help them quit smoking.

Address correspondence to: Richard O'Connor, PhD, Associate Professor of Oncology, Department of Health Behavior, Roswell Park Cancer Institute, Buffalo, NY 14263. Richard.oconnor@roswellpark.org.

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Conclusions—Awareness of ENDS is high, especially in countries where they are legal (i.e., the U.S. and UK). Because trial was associated with nondaily smoking and a desire to quit smoking, ENDS may have potential to serve as a cessation aid.

Introduction

Electronic nicotine delivery systems (ENDS; also called e-cigarettes) initially emerged in China in 2003 and have since become widely available globally, particularly over the Internet. ENDS heat and vaporize a solution containing nicotine, and many are designed to resemble traditional tobacco cigarettes. Some advocates of tobacco harm reduction have pointed to these products as viable substitutes for cigarettes because they produce fewer toxins in the vapor delivered to the user.[1–5] However, concerns exist regarding unknown long-term safety, inadequate data on contents and emissions, especially with long-term use, and unsupported product claims as a smoking cessation aid.[6–9]

There may also be unintended consequences associated with ENDS use, including the potential to induce nicotine addiction in nonsmokers or maintain addiction in current smokers who might otherwise quit. Additionally, concerns have been raised that ENDS may undermine comprehensive indoor smoking restrictions and smokefree air policies.[10] Because of these concerns, ENDS have been banned in Canada (www.hc-sc.gc.ca/ahc-asc/media/advisories-avis/_2009/2009_53-eng.php) and Australia (www.tga.gov.au/consumers/ecigarettes.htm); however, they are legal in the U.S. and the United Kingdom (UK). Despite bans on retail sale, access is difficult to control because the products are heavily marketed over the Internet.

Because ENDS are relatively new, data on usage patterns are sparse.[11] Surveys of self-selected ENDS users suggest that many are former or current cigarette smokers who use the products to reduce or quit smoking.[2,12,13] A survey of a broader U.S. population showed that awareness of ENDS increased from 16.4% in 2009 to 32.2% in 2010, concurrent with a rise in ever-use (0.6% in 2009 to 2.7% in 2010).[14] Ever-use was primarily concentrated among tobacco users. A nationally representative sample of U.S. adults found that 40.2% were aware of ENDS, and awareness and use was highest among current smokers (ever use: 11.4% current smokers, 2.0% former smokers, 0.8% never smokers).[15] An online survey of approximately 2500 smokers in England in 2010 found that around 60% were aware of ENDS, 9% had tried them, and 3% were current users.[16] The current authors are not aware of any studies to date that have examined cross-national patterns of ENDS use, and no studies have examined use in markets where ENDS are nominally banned. The current paper examines patterns of ENDS awareness, use, and product-associated beliefs among current and former cigarette smokers in the U.S., Canada, Australia, and the UK.

Methods

Data come from Wave 8 of the International Tobacco Control (ITC) Four-Country Survey conducted July 2010 to June 2011 in the U.S., Canada, Australia, and the UK via telephone interviews and web surveys. Additionally, where available, data from Wave 7 (conducted October 2008 to July 2009) were analyzed to explore changes in smoking behavior between ENDS users and non-users. Details about the study design, sampling frames, and overall aims of the project are described elsewhere.[17,18]

At initial enrollment, respondents included adult smokers aged ≥18 years who smoked at least 100 cigarettes in their lifetime and at least 1 cigarette in the past 30 days at the time of recruitment. Probability sampling methods were used to recruit the sample using random-digit dialing. If multiple adult smokers were present in the home, the next-birthday method was used to select the respondent. Those who quit smoking remained in the sample for

follow-up interviews. Respondents who were lost at each wave were replenished using the same procedures as the original recruitment except in the UK. Data were collected for 5939 respondents across the four countries at Wave 8: U.S. (n=1520); Canada (n=1581); Australia (n=1513); UK (n=1325).

Measures

In addition to the main tobacco use questions asked in previous waves, the Wave-8 survey included additional questions regarding awareness and use of ENDS. These include: *Have you ever heard of electronic cigarettes or e-cigarettes?; Have you ever tried an electronic cigarette?*; and *How often, if at all, do you currently use an electronic cigarette?* Current ENDS users were asked four questions regarding their reasons for use (*yes/no*). These include: (1) electronic cigarettes may not be as bad for your health, (2) easier to cut down on the number of cigarettes you smoke, (3) can smoke in places where smoking regular cigarettes is banned, and (4) might help you quit. All respondents aware of ENDS were asked whether or not they thought electronic cigarettes were more harmful than, less harmful than, or equally harmful as regular cigarettes to one's health.

Data Analysis

Data were analyzed using SPSS 16.0. Differences in demographic and smoking-related variables of respondents who were aware of, tried, and used ENDS compared to those who were not were evaluated with chi-square tests. Logistic regression was used to evaluate the independent influence of the predictors of awareness, trial, and use. The entire sample was used to estimate prevalence; however, the analytic samples for the logistic regression models varied by dependent variable. For models predicting awareness, the entire sample was analyzed; for models predicting ever-use, only participants who were aware of ENDS were analyzed; for models predicting current use, only participants who had ever used ENDS were analyzed. Each analysis was adjusted with sample weights that accounted for sampling probability and the known distribution of gender, age, and race within the smoker population for each country.

Results

Prevalence of Awareness, Trial, and Usage

Across countries, nearly half (46.6%, n=2757) of respondents reported having heard of ENDS. Analyses revealed differences in ENDS awareness by country (χ^2 (3, n=5921)=932.5, p<0.001). Greatest awareness was reported in countries where the use of ENDS is mostly permitted; nearly three quarters (73.4%) of respondents in the U.S. and over half (54.4%) of respondents in the UK indicated awareness of these devices. Where ENDS were banned, awareness was lower, but still substantial, with 39.5% and 20.0% reporting awareness in Canada and Australia, respectively (Table 1).

Overall, 7.6% (n=450) of respondents had tried ENDS (16.3% of those aware). Among those aware, trial was more prevalent in some countries (χ^2(3, n=2755)=38.2, p<0.001): 20.4% in the U.S. and 17.7% in the UK reported trying ENDS, while 10.1% in Canada and 10.9% in Australia reported doing so. Approximately 3% of respondents (38.7% of triers) reported current use at the time of the survey. Current use was not different across the four countries (χ^2(3, n=450)=5.96, p=0.114).

Sociodemographic and Smoking-Related Correlates of Awareness

Younger, higher-income, well-educated respondents were more likely to report ENDS awareness overall and in each country. Daily smokers, those who smoked menthol cigarettes, men, and respondents who took the survey over the Internet were more likely to

be aware of ENDS overall. In the U.S., greater awareness was also reported among white respondents, English-speaking respondents, and among those who had a complete ban on smoking within the home. In the UK, men were more likely to be aware of ENDS (Table 2).

Logistic regression was used to evaluate independent correlates of ENDS awareness across the four countries (Table 3). Across-country analysis was chosen because model fit was superior to that for within-country analysis (across: Nagelkerke R^2=0.25; receiver operating characteristics [ROC]=0.76; Hosmer-Lemeshow (H-L) statistic for across-country analysis insignificant, p=0.25; −2 log-likelihood showed improved fit with the inclusion of the country variable (without: 7146.50; with: 6243.78; within-country analysis: Nagelkerke R^2 range: 0.07–0.11; ROC range: 0.64–0.68, H-L: significant in Canada, U.S., UK). To assess how smoking behavior influenced awareness, a five-level smoking status measure was constructed, comprising two daily use categories (0–20 cigarettes per day [cpd], and ≥21 cpd); a nondaily use category; and two quitter categories (recent [<12 months], and long-term [>12 months]).

Respondents in the U.S. (OR: 4.86, CI=4.09, 5.77) and the UK (OR: 2.090, CI=1.77, 2.47) had greater odds of having heard of ENDS than those in Canada, while Australian respondents had lower odds (OR: 0.37, CI=0.31, 0.44). Heavy smokers (≥20 cpd; OR: 1.24, CI=1.04, 1.48) had the greatest, and long-term quitters had the lowest odds (OR: 0.83; CI=0.69, 1.00) of awareness. Consistent with the chi-square analysis, young, well-educated, higher-income, male smokers, and those who responded via the Internet, had greater odds of ENDS awareness.

Sociodemographic and Smoking-Related Correlates of Trial

Chi-square analyses showed that, among those aware, younger, female respondents were more likely to try ENDS. Current rather than former smokers and current nondaily smokers were more likely to try ENDS. Those who smoked menthol cigarettes were more likely to try ENDS than respondents who smoked nonmenthol cigarettes. Survey mode was related to having tried these devices; however, unlike the association for awareness, telephone respondents were most likely to have tried ENDS.. Within-country chi-square tests showed this association was only significant in the U.S.

In the U.S., greater ENDS trial was reported among younger, white, nondaily, higher-income smokers. In the UK, trial was more common among younger and higher-income smokers, and among women and minority populations. In Australia and Canada, where ENDS were banned, few demographic characteristics were associated with having tried ENDS, although nondaily smokers in Australia were more likely to have tried ENDS (32%).

Among those aware, independent correlates of those who tried ENDS were assessed (Table 3). Across-country analysis was employed consistent with the model for awareness. Model fit statistics were similar for the across- and within-country analysis (across: Nagelkerke R^2=0.179, ROC=0.786, H-L insignificant, p=0.152; model fit improved with the inclusion of the country variable (−2 log-likelihood: without: 1929.37; with: 1893.67). For within-country analysis, Nagelkerke R^2 range=0.177–0.265, ROC range=0.729–0.837, H-L significant in Australia).

Respondents in the U.S. and UK had approximately two times greater odds of trying ENDS than Canadians. Consistent with awareness, younger (aged 18–24 years) and high-income respondents had greater odds of trying ENDS. Of particular interest, ENDS trial was associated with respondent smoking status and perceptions of harm. Nondaily smokers had nearly two times greater odds of reporting ever-use than respondents who smoked ≤20 cpd.

Those who reported that ENDS were less harmful than traditional cigarettes had nearly four times greater odds of trying ENDS.

Sociodemographic and Smoking-Related Correlates of Current Use

Correlates of continued ENDS use among those who have tried ENDS included education and frequency of smoking. Half (51%) of those in the highest education bracket reported continued use ($\chi^2(2, n=451)=10.72$, $p=0.005$). Additionally, current nondaily smokers (58%) were more likely than daily smokers (35.9%; $\chi^2(1, n=402)=8.998$, $p=0.003$) to continue use.

Logistic regression of independent correlates of use among triers was employed across country (across: Nagelkerke $R^2=0.175$, ROC=0.726, H-L $p=0.03$; model fit improved with inclusion of the country variable: −2 log-likelihood: without: 484.71; with 475.39). This analysis showed that among triers, odds of continuing ENDS use did not vary by country (Table 3). Additionally, well-educated, nondaily smokers had greater odds of continued use and heavier (≥20 cpd) and nondaily smokers had greater odds of continued use than quitters. Additional logistic regression analyses among current smokers showed that heaviness of smoking was not associated with trial or continued use of ENDS.

Perceptions of Risk

All respondents who were aware of ENDS were asked about their perceptions of risk associated with use. The vast majority of respondents who were aware of ENDS reported that ENDS were less harmful than traditional cigarettes (all: 70.3%; Canada: 63.9%; U.S.: 65.9%; UK: 82.2%; Australia: 71.0%). Chi-square analyses revealed that these cross-country differences were significant ($\chi^2(2, n=2746)=71.464$, $p<0.001$). Perceptions of harm were higher in the U.S. than the UK ($\chi^2(2, n=1825)=58.155$, $p<0.001$) where ENDS are legal, and perceptions of harm in Canada were higher than they were in Australia ($\chi^2(2, n=921)=4.522$, $p=0.03$), where ENDS are banned.

Reduction in Cigarettes Per Day and in Quitting Over Time

Current ENDS users were asked questions regarding their reasons for use (Figure 1). The majority of respondents indicated that they used ENDS to reduce the harm of, or to help themselves quit using, traditional cigarettes. Three quarters of users reported use to help them reduce the number of cigarettes they smoke.

To evaluate claims of reduction in cigarette use, change in cpd was assessed between Wave 7 and Wave 8. A repeated-measures ANOVA, among smokers at Wave 7 with wave (Wave 7 and 8) as the within-subjects factor and user status (ENDS user vs non-user) as the between-subjects factor, showed an interaction between user status and Wave. ENDS users were more likely to have reduced their cpd between waves than non-users ($F(1, 4092)=4.65$, $p<0.05$. For users in Wave 7: M=20.10, SD=12.36; for those in Wave 8: M=16.32, SD=12.35. For non-users in Wave 7: M=16.86, SD=9.95; for those in Wave 8: M=15.01, SD=10.83). Notably, 85% ($n=146$) of current ENDS users stated that they used ENDS as a tool to help them quit smoking, although only 11% of current ENDS users report having quit since Wave 7. Quitting did not differ between users and non-users ($\chi^2(2, n=4136)=0.422$, $p=0.516$).

Discussion

Nationally representative samples of current and former smokers surveyed in the four largest English-speaking countries showed substantial awareness of ENDS, ranging from 73% in the U.S. to 20% in Australia. Among those aware, 16% had tried ENDS (7.6% of the total

sample), and among those who had tried ENDS, 39% (2.9% of the sample) were current users. Across countries, awareness of these relatively new products was higher among younger, non-minority populations with higher incomes. Trial and use of ENDS was associated with smoking status and frequency of smoking, with nondaily smokers being the most likely to try ENDS, although there were few nondaily smokers in the sample. Current use was associated with a greater reduction in cpd over time, compared to non-ENDS users (among cohort participants, where data were available); however, users were not more likely to quit smoking than non-users.

The relatively higher prevalence of ENDS use among nondaily smokers may have multiple explanations. First, nondaily smokers may supplement their nicotine intake from other sources, as smoking is restricted in public places and cigarettes are increasingly expensive. As more data become available it will be important to evaluate whether ENDS use is related to supplementing due to smoking restrictions at home, in the workplace, or other public spaces with smokefree policies. The available data for this sample did not show a difference in trial of ENDS between respondents who did versus those who did not have complete smoking bans in the home, although continued use was more likely among respondents in the U.S. who did not have home smoking bans. Second, the use of ENDS may have driven smokers to reduce their overall cigarette smoking to a nondaily pattern.

Consistent with previous research,[12,13,19] the majority of survey participants indicated that they used ENDS to reduce the harm of traditional cigarettes, or to help them quit traditional cigarettes. This association between trial and intention to quit smoking reflects on the potential for ENDS as cessation tools, as reported by many self-selected ENDS users.[2,4,12,13] However, in the absence of a clinical RCT to evaluate the efficacy of ENDS as a stop-smoking aid, it is hard to judge claims about the effectiveness of these products as treatments for nicotine addiction.

To date, one study has assessed ENDS as a harm reduction and cessation aid with promising results.[19] However, nearly three quarters (70.4%) of this sample reported that they used ENDS as a way to obtain nicotine in smokefree spaces, indicating that ENDS are also being used to satisfy nicotine addiction during periods of temporary abstinence. With the addition of future International Tobacco Control survey waves, it will be possible to track whether those self-selecting to use ENDS compared to those not using ENDS are more or less successful with their efforts to abstain from smoking.

Levels of awareness, trial, and use were surprisingly high in two countries where the products are nominally illegal (Canada, Australia), which may demonstrate the importance of the Internet in promoting the product,[20] the ease with which products can be imported for personal use, and illegal sales. Indeed, those who responded via a computer-based survey, which may indicate greater use of and familiarity with the Internet, were more likely to report awareness of these devices. These findings demonstrate how easily product restrictions can be evaded in the Internet age, and this should be of importance to regulators. Future studies should investigate how ENDS users obtain their device, determine the market share of various ENDS products in use, and how product delivery and marketing influences usage patterns.

Limitations

A limitation of the current study is inclusion of only current and former cigarette smokers. Understanding the awareness, trial, and use of ENDS among nonsmokers, in particular adolescents, is of great importance to understanding their potential impact on public health. Some research shows that adolescents not otherwise susceptible to cigarette smoking were less likely to be aware of or use ENDS (J Delmerico, Roswell Park Cancer Institute,

unpublished observations, 2012). Research among adults also shows that ever-use of ENDS among never-smokers is low.[14,15] Additionally, the limited set of questions touched only on awareness, trial, use, and selected reasons for use, and did not address issues related to ENDS marketing, product characteristics, or pricing.

Conclusion

This study represents a snapshot in time of the use of ENDS from mid-2010 to mid-2011. As the market evolves, awareness, trial, and use of ENDS is likely to increase. The association of trial and current use with beliefs about the relative safety of ENDS highlights the importance of marketing in shaping public perceptions around the product. Should regulatory authorities approve direct claims about reduced harm, one might expect greater adoption of these products, at least among current cigarette smokers. If credible evidence can be provided that ENDS reduces the number of cigarette smokers and does not attract use among nonsmokers, then the net public health effect is likely to be positive.

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References

1. Cahn Z, Siegel M. Electronic cigarettes as a harm reduction strategy for tobacco control: A step forward or a repeat of past mistakes? J Public Health Policy. 2011; 32(1):16–31. [PubMed: 21150942]
2. Siegel MB, Tanwar KL, Wood KS. Electronic cigarettes as a smoking-cessation tool: results from an online survey. Am J Prev Med. 2011; 40(4):472–5. [PubMed: 21406283]
3. Borland R. Electronic cigarettes as a method of tobacco control. Br Med J. 2011; 343:1238.
4. Foulds J, Berg A, Veldheer S. Electronic cigarettes (e-cigs): views of aficionados and clinical/public health perspectives. Int J Clin Pract. 2011; 65(10):1037–42. [PubMed: 21801287]
5. Wagener TL, Siegel M, Borrelli B. Electronic cigarettes: achieving a balanced perspective. Addiction. 2012; 107:4. E-pub 4/4/2012. [PubMed: 22151313]
6. Williams M, Talbot P. Variability among electronic cigarettes in the pressure drop, airflow rate, and aerosol production. Nicotine Tobacco Res. 2011; 13(12):1276–83.
7. Trtchounian A, Talbot P. Electronic nicotine delivery systems: is there a need for regulation? Tob Control. 2010; 20:47–52. [PubMed: 21139013]
8. Cobb NK, Abrams DB. E-cigarette or drug-delivery device? Regulating novel nicotine products. N Engl J Med. 2011; 365(3):193–5. [PubMed: 21774706]
9. McCauley L, Markin C, Hosmer D. An unexpected consequence of electronic cigarette use. Chest. 2012; 141(4):1110–3. [PubMed: 22474155]
10. Henningfield JE, Zaatari GS. Electronic nicotine delivery systems: emerging science foundation for policy. Tob Control. 2010; 19(2):89–90. [PubMed: 20378582]
11. Etter J-F, Bullen C, Flouris AD, Laugesen M, Eissenberg T. Electronic nicotine delivery systems: a research agenda. Tob Control. 2011; 20(3):243–8. [PubMed: 21415064]
12. Etter J-F, Bullen C. Electronic cigarette: users profile, utilization, satisfaction and perceived efficacy. Addiction. 2011; 106(11):2017–28. [PubMed: 21592253]
13. Etter J-F. Electronic cigarettes: a survey of users. BMC Public Health. 2010; 10:231–7. [PubMed: 20441579]

14. Regan, AK.; Promoff, G.; Dube, SR.; Arrazola, R. Electronic nicotine delivery systems: adult use and awareness of the 'e-cigarette' in the US Tob Control. 2011. E-pub 10/27/2011

15. Pearson JL, Richardson A, Niaura RS, Vallone DM, Abrams DB. e-cigarette awareness, use, and harm perceptions in U.S. adults. Am J Public Health. 2012; 19:19.

16. Dockrell, M. What smokers tell us about e-cigarettes. UK National Smoking Cessation Conference; June; UK. 2010.

17. Fong GT, Cummings KM, Borland R, et al. The conceptual framework of the International Tobacco Control (ITC) Policy Evaluation Project. Tob Control. 2006; 15(suppl 3):iii3–iii11. [PubMed: 16754944]

18. Thompson ME, Fong GT, Hammond D, et al. Methods of the International Tobacco Control (ITC) Four Country Survey. Tob Control. 2006; 15(suppl 3):iii12–iii8. [PubMed: 16754941]

19. Polosa R, Caponnetto P, Morjaria JB, Papale G, Campagna D, Russ C. Effect of an electronic nicotine delivery device (e-Cigarette) on smoking reduction and cessation: a prospective 6-month pilot study. BMC Public Health. 2011; 11(1):786–97. [PubMed: 21989407]

20. Ayers JW, Ribisl KM, Brownstein JS. Tracking the rise in popularity of electronic nicotine delivery systems (electronic cigarettes) using search query surveillance. Am J Prev Med. 2011; 40(4):448–53. [PubMed: 21406279]

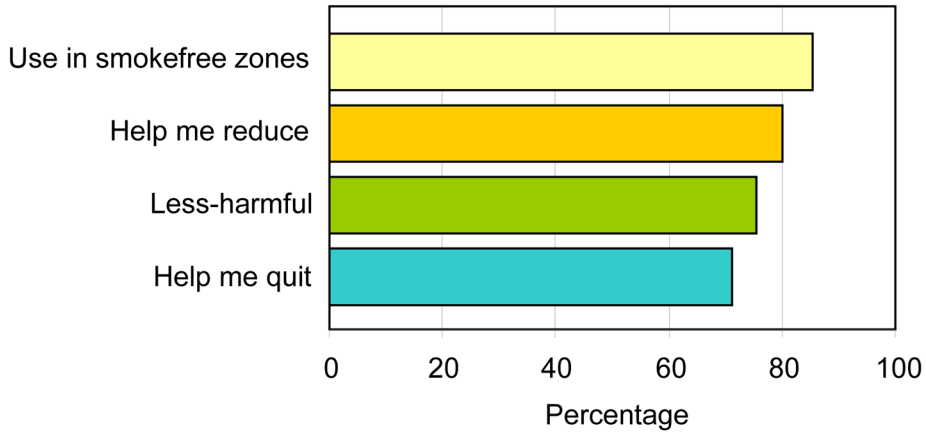

Figure 1.
Percentage of current ENDS users who stated that they used ENDS for various reasons
ENDS, electronic nicotine delivery systems

Table 1

Prevalence of ENDS awareness, trial, and use among current and former tobacco users, % yes (SE)

	Aware of ENDS (Overall)	Tried ENDS (Overall)	Tried ENDS (Among Aware)	Current ENDS User (Overall)	Current ENDS User (Among Tried)
All Countries	46.56 (.6)	7.6 (0.3)	16.3 (0.7)	2.9 (0.2)	38.7 (2.3)
n	5921	5939	2755	5939	450
Canada	39.53 (1.2)	4 (0.5)	10 (1.2)	1 (0.3)	33 (6.0)
n	1571	1581	621	1581	63
U.S.	73.43 (1.1)	14.9 (0.9)	20.4 (1.2)	6 (0.6)	37 (3.2)
n	1517	1520	1113	1520	227
United Kingdom	54.42 (14.0)	9.6 (0.8)	17.7 (1.4)	4 (0.6)	46 (4.4)
n	1323	1325	719	1325	127
Australia	20.00 (1.0)	2 (0.4)	11 (1.8)	1 (0.2)	27 (7.9)
n	1510	1513	302	1513	33

ENDS, electronic nicotine delivery systems

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Table 2

Correlates of ENDS awareness overall and by country and sample demographics, %

		All Countries		Canada		U.S.		United Kingdom		Australia	
		aware	sample	aware	sample	aware	sample	aware	sample	aware	sample
Age (years)	18–24	67.8	5.1	36	2	95	6	63	4	55	9
	25–39	52.5	33.2	48.5	31.4	79.0	32.1	61.4	33.8	24	39
	40–54	43.8	33.9	37.1	37.2	73.4	34.5	53.7	31.1	16	29
	≥55	41.7	27.8	35.7	29.5	64.7	27.2	48.0	29.6	16	22
	χ^2	**(*n*=5920)=86.40******		**(*n*=1571)=18.45******		**(*n*=1517)=42.03******		**(*n*=1321)=16.65******		**(*n*=1510)=53.36******	
Gender	Female	44.9	44.8	38.5	44.8	72.2	44.2	51.1	46.4	18.8	43.0
	Male	48.0	55.2	40.5	55.2	74.4	55.8	57.7	53.6	21.0	57.0
	χ^2	**(*n*=5920)=5.72*****		(*n*=1570)=0.68		(*n*=1517)=0.89		**(*n*=1322)=5.72*****		(*n*=1510)=1.07	
Race	White	46.5	88.9	39.4	90.8	75.8	83.2	55.0	95.7	19.8	89.8
	Non-White	47.5	11.1	42	9	64.6	16.8	44	4	21	10
	χ^2	(*n*=5877)=0.22		(*n*=1571)=0.34		**(*n*=1501)=14.98******		**(*n*=1323)=3.50***		(*n*=1486)=0.07	
Income	Low	43.1	25.2	29	16	66.3	32.7	47.3	26.7	13	14
	Moderate	47.6	33.6	42.3	40.3	77.3	33.6	53.0	29.6	20	30
	High	47.8	41.1	42.1	43.8	77.9	33.8	62.6	43.7	23.5	55.9
	χ^2	**(*n*=5443)=9.38*****		**(*n*=1439)=16.47******		**(*n*=1378)=20.75******		**(*n*=1200)=20.24******		**(*n*=1426)=13.78******	
Education[a]	Low	41.9	42.5	35.5	36.9	68.8	37.9	54.1	54.4	16.0	43.4
	Moderate	50.3	35.0	44.1	43.2	78.7	39.4	50.1	23.6	21	29
	High	51.5	22.4	38.8	19.9	73.5	22.7	60.6	22.0	30	27
	χ^2	**(*n*=5904)=47.30******		**(*n*=1566)=9.73*****		**(*n*=1515)=14.51******		**(*n*=1315)=6.52****		**(*n*=1509)=25.31******	
Smoking Frequency	Smoker	47.7	77.5	39.5	76.7	73.6	80.3	55.9	75.4	20.5	74.5
	Quitter	43.2	22.5	39.7	23.3	72.5	19.7	50.1	24.6	19	25
	χ^2	**(*n*=5920)=8.82*****		(*n*=1570)=0.01		(*n*=1516)=0.16		**(*n*=1322)=3.50***		(*n*=1509)=0.62	
Smoking Frequency	Daily	47.8	71.7	39.4	70.4	73.7	73.9	56.3	72.3	20.0	65.2

		All Countries		Canada		U.S.		United Kingdom		Australia	
		aware	sample	aware	sample	aware	sample	aware	sample	aware	sample
	Nondaily	45.9	5.8	41	6	73	6	9	3	25	9
	Quitter	43.2	22.5	39.7	23.3	72.5	19.7	50.1	24.6	19	26
	χ^2	**(*n*=5921)=9.26** ***		(*n*=1571)=0.16		(*n*=1515)=0.18		(*n*=1322)=4.44		(*n*=1510)=1.93	
Plan to quit	Yes/Quit	46.7	81.1	40.3	83.4	74.3	82.3	54.8	74.4	20.8	88.4
	No	46.0	18.9	35.9	16.6	70.3	17.7	53.8	25.6	16.1	11.6
	χ^2	(*n*=5854)=0.15		(*n*=1552)=1.87		(*n*=1486)=1.86		(*n*=1319)=0.09		(*n*=1498)=2.48	
Smoke Menthol Cigarettes	Yes	57.1	16.0	45	6	69.8	29.2	61	6	20	9
	No	46.3	84.0	38.9	93.8	76.1	70.8	55.6	94.4	20.8	90.6
	χ^2	**(*n*=4436)=24.17** ****		(*n*=1193)=0.84		**(*n*=1195)=5.26** **		(*n*=965)=0.60		(*n*=1083)=0.08	
Home Smoking Ban	Yes	45.0	47.1	40.3	47.7	77.3	50.9	52.3	36.5	19.0	57.6
	No	48.1	52.9	39.0	52.3	69.7	49.1	55.8	63.5	21.5	42.4
	χ^2	**(*n*=5912)=5.50** **		(*n*=1568)=0.26		**(*n*=1513)=11.16** ****		(*n*=1322)=1.55		(*n*=1509)=1.44	
Survey Mode	Telephone	44.1	60.5	32.7	49.7	72.7	69.9	50.5	59.4	16.5	50.3
	Web	51.0	39.5	50.0	50.3	75.1	30.1	61.2	40.6	25.5	49.7
	χ^2	**(*n*=5920)=25.88** ****		**(*n*=1572)=47.35** ****		(*n*=1517)=0.91		**(*n*=1322)=14.03** ****		**(*n*=1509)=17.95** ****	

Note: Boldface indicates significance.

[a] Education Level: Low=high school or less, Moderate=some technical school or some university, High=University degree or more

* $p<0.10$;

** $p<0.05$;

*** $p<0.01$;

**** $p<0.001$

ENDS, electronic nicotine delivery systems

Table 3

Logistic regression of awareness, trial, and current use of ENDS

		Heard of ENDS		Tried ENDS		Current ENDS User	
		OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Country	Canada	ref		ref		ref	
	U.S.	**4.86******	4.09, 5.77	**2.24******	1.59, 3.16	1.08	0.52, 2.12
	United Kingdom	**2.09******	1.77, 2.47	**1.86******	1.30, 2.68	**2.07***	0.96, 4.45
	Australia	**0.37******	0.31, 0.44	0.84	0.51, 1.39	0.58	0.19, 1.78
Smoking Frequency	Daily 1–20 cpd	ref		ref		ref	
	Daily 20+ cpd	**1.24****	1.04, 1.48	0.96	0.69, 1.35	**2.36****	1.22, 4.57
	Nondaily smoker	0.97	0.75, 1.26	**1.85*****	1.23, 2.78	**3.02*****	1.4, 6.52
	Recent Quitter	0.88	0.71, 1.10	1.07	0.71, 1.62	1.91	0.83, 4.40
	Long-Term Quitter	**0.83****	0.69, 1.00	**0.13******	0.06, 0.27	0.10	0.01, 1.62
Ethnicity	Nonwhite / Non–English	ref		ref		ref	
	White / English	**1.30*****	1.07, 1.59	1.35	0.91, 2.02	1.75	0.76, 4.07
Gender	Male	ref		ref		ref	
	Female	**0.82******	0.73, 0.93	**1.22***	0.97, 1.54	1.26	0.79, 2.00
Age (years)	18–24	Ref		ref		ref	
	25–39	**0.52******	0.36, 0.76	**0.53*****	0.33, 0.84	0.73	0.32, 1.68
	40–54	**0.36******	0.25, 0.53	**0.34******	0.21, 0.55	1.07	0.47, 2.47
	55-Max	**0.35******	0.24, 0.51	**0.35******	0.21, 0.57	1.19	0.50, 2.83
Education	Low	ref		ref		ref	
	Moderate	**1.22*****	1.06, 1.40	1.00	0.77, 1.31	0.72	0.43, 1.22
	High	1.09	0.92, 1.29	0.90	0.66, 1.24	**2.14****	1.13, 4.05
Income	Low	ref		ref		ref	
	Moderate	**1.47******	1.25, 1.72	1.17	0.85, 1.60	0.96	0.51, 1.80
	High	**1.57******	1.34, 1.85	**1.57*****	1.15, 2.14	1.28	0.69, 2.35
Perceptions of Harm	Less Harmful than	—	—	**3.74******	2.64, 5.30	1.78	0.81, 3.91

		Heard of ENDS		Tried ENDS		Current ENDS User	
		OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
	Equally or more harmful[a]	—	—	ref		ref	
Plan to Quit Smoking	Yes/Already Quit	ref		ref		ref	
	No	0.95	0.80, 1.11	1.10	0.82, 1.47	1.10	0.62, 1.95
Cohort	Wave of recruitment	**1.06******	1.03, 1.09	**1.07****	1.01, 1.13	**1.14****	1.01, 1.28
Survey Mode	Telephone	ref		ref		ref	
	Web	**1.60******	1.40, 1.83	0.87	0.68, 1.12	0.95	0.57, 1.58
n		5307		2321		335	
−2 Log-Likelihood		6243.77		1893.67		475.39	

Note: Boldface indicates significance.

[a]Response options include more harmful, equally harmful, and don't know.

$^{*}p<0.10$,

$^{**}p<0.05$,

$^{***}p<0.01$,

$^{****}p<0.001$

cpd, cigarettes per day; ENDS, electronic nicotine delivery systems