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Trends in E-Cigarette Awareness, Trial, and Use Under the Different Regulatory Environments of Australia and the United Kingdom

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Abstract

Introduction: E-cigarettes (ECs) have gained significant attention in recent years. They have been introduced in jurisdictions with divergent existing laws that affect their legality. This provides the opportunity for natural experiments to assess effects of such laws in some cases independent of any formulated government policy. We compare patterns of EC awareness and use over a 3 year period in Australia where laws severely restrict EC availability, with awareness and use in the United Kingdom where ECs are readily available.

Methods: Data analyzed come from Waves 8 and 9 (collected in 2010 and 2013, respectively) of the International Tobacco Control surveys in Australia and the United Kingdom (approximately 1,500 respondents per wave per country).

Results: Across both waves, EC awareness, trial, and use among current and former smokers were significantly greater in the United Kingdom than in Australia, but all 3 of these measures increased significantly between 2010 and 2013 in both countries, and the rate of increase was equivalent between countries. Seventy-three percent of U.K. respondents reported that their current brands contained nicotine as did 43% in Australia even though sale, possession and/or use of nicotine-containing ECs without a permit are illegal in Australia. EC use was greater among smokers in both countries, at least in part due to less uptake by ex-smokers.

Conclusions: EC awareness and use have risen rapidly between 2010 and 2013 among current and former smokers in both Australia and the United Kingdom despite different EC regulatory environments. Substantial numbers in both countries are using ECs that contain nicotine.

Introduction

E-cigarettes (ECs), now the most common type of alternative nicotine delivery system in many countries,[1] have gained significant attention in the marketplace in recent years and have been rapidly adopted by smokers, despite little being known about their safety and long-term effects. The widespread distribution and use of ECs has huge potential for public health because ECs are almost certainly much safer than regular cigarettes,[2] but opinion on ECs is divided among the public health community[3–5] with some arguing that EC use could

have negative effects, even on cessation.[6,7] Evidence to date on EC effectiveness as a smoking cessation tool is limited and mixed, with quit rates of EC users either similar to,[8,9] higher,[10] or lower than,[11,12] non-users. Studies have also shown that EC use could substantially reduce consumption among smokers not intending to quit.[8,13,14]

To date, few governments have taken considered policy stances with respect to these products, so their status has been largely determined by the vagaries of existing laws which were originally designed to deal with other problems. This is the case in Australia where there are no laws specifically addressing the regulation of ECs, but a number of existing laws relating to poisons, therapeutic goods, and tobacco control that apply to ECs in some circumstances. If marketed for therapeutic purposes (e.g., as cessation aids), all ECs must be registered with the therapeutic goods Administration in order to be sold and used lawfully in all jurisdictions in Australia, although they can be imported if in possession of a prescription from a medical practitioner. If marketed without therapeutic claims, ECs containing nicotine cannot be legally sold, but non-nicotine containing ECs can be sold and used lawfully. In 2014, this situation was complicated by a decision of the Western Australian Supreme Court, which ruled that ECs were covered under legislation prohibiting products that looked like cigarettes (originally designed to prohibit cigarette look-alike confectionary). As similarly-worded legislation also exists in Queensland and South Australia, retail sales of non-nicotine ECs are effectively banned in these three states, although they can be freely imported from interstate or overseas.

By contrast, in the United Kingdom there are few restrictions on the marketing and sale of ECs. In May 2014, the EU tobacco products directive covering ECs came into force, which introduced controls on EC content and labeling and prohibited EC marketing when sold as consumer goods, but European Union (EU) countries have until mid-2016 to implement laws. The U.K. Medicines and Healthcare Products Regulatory Agency (MHRA) has also encouraged EC manufacturers to apply for medicinal licenses for their products similar to those provided for nicotine replacement therapies. England is the first in the United Kingdom, and also the first country in the world, to promote licensed nicotine-containing products, including any licensed ECs, for harm reduction in line with guidance from the National Institute for Health Care Excellence. Currently there is no formal policy for advising smokers on ECs, with the majority of Stop Smoking Services' staff telling smokers they are not yet approved by the MHRA.[15]

Representative national data collected in 2010 from the International Tobacco Control (ITC) Four-Country Survey indicates that among current and former smokers, awareness of ECs was relatively high in the United States and the United Kingdom where these products are legally sold and marketed (73% and 54%, respectively), but relatively low in Canada and Australia where the sale of ECs with nicotine is not allowed (40% and 20%, respectively).[8] About 8% of respondents overall reported having ever tried ECs and about 3% were currently using at least monthly. In the United Kingdom, about 10% had tried ECs and of these, about 4% were current users. In Australia, these proportions were lower at 2% and 1%, respectively. Recent British data show that EC awareness, trial, and current use increased between 2010 and 2012, with current use more than doubling from 2.7% to 6.7%.[16,17] Notably, there was very little evidence of EC use among never-smokers of all ages. In Australia, no published data on trends are currently available although anecdotal evidence indicates that despite the restrictive environment, sales of ECs are on the rise particularly over the Internet. These increases

show that smokers are embracing ECs without waiting for public health authorities to confirm that they are less harmful than cigarettes, even (in the case of Australia) where the sale of ECs with nicotine is illegal.

This study extends the findings of Adkison et al.[8] by incorporating more recent Australian and U.K. data from the ITC Project to document the trajectory of change in EC awareness and use under two different regulatory environments. The specific aims of this study were to examine, among current and former smokers, (a) how levels of EC awareness and use have changed over time; (b) whether and how these trends have differed across these two countries; and (c) what are the correlates and predictors of change.

Methods

Samples

Data come from the 2010 and 2013 (Waves 8 and 9) waves of the ITC Surveys in Australia and the United Kingdom, a longitudinal cohort survey of adult smokers conducted in each country (originally recruited by phone) via phone interviews and web surveys. The Australian waves were collected from July 2010 to May 2011 and from February to May 2013, and in the United Kingdom from July 2010 to December 2010 and from February to September 2013. Details about the study design and sampling frames are described elsewhere.[18,19]

Briefly, survey respondents were aged 18 years and above, and had smoked at least 100 cigarettes in their life-time and at least once a month at the time of recruitment. The ITC cohort was constructed with probability sampling methods using random-digit dialing from the population of each country within strata defined by geographic region and community size. It was therefore designed to be broadly representative of its respective populations. The cohort was followed up approximately yearly and at each subsequent wave, those lost due to attrition were replenished (except in the United Kingdom in 2010) with smokers using the same sampling protocol as at initial study recruitment. Ex-smokers were retained in the study and thus, there are substantial numbers of recent ex-smokers in the samples. Details of sample size and characteristics are presented in Table 1.

Measures

Starting in 2010, specific questions on ECs were included, assessing awareness "Have you ever heard of electronic cigarettes or e-cigarettes?" (yes/no), trial among those aware, "Have you ever tried an electronic cigarette?" (yes/no), and current use among triers "How often, if at all, do you currently use an electronic cigarette?" with response options "Daily, Less than daily but at least once a week, Less than weekly but at least once a month, Less than monthly, or Not at all" (dichotomized into current use and non-current by combining any use responses vs. not at all). All respondents aware of ECs were asked whether or not they thought they were more harmful, less harmful, or equally harmful as regular cigarettes to one's health. In 2013, current users were also asked whether their current brands contained nicotine.

Data on age, gender, household income, education attainment, minority status (white or non-white in the United Kingdom and English or other as the main language spoken at home for Australia), wave recruited into the study, survey mode (web or phone survey), smoking status, duration of time quit among ex-smokers (coded as ≤1 year, and >1 year), and interest in quitting were also collected. In order to make income and education comparable across

Table 1. Sample Characteristics by Survey Wave, Country and Smoking Status

Variables	Wave 8 (2010)						Wave 9 (2013)					
	Australia			United Kingdom			Australia			United Kingdom		
	Smokers $n = 1,153$	Ex-smokers quit ≤ 12 months, $n = 157$	Ex-smokers quit > 12 months, $n = 245$	Smokers $n = 977$	Ex-smokers quit ≤ 12 months, $n = 119$	Ex-smokers quit > 12 months, $n = 229$	Smokers $n = 1,093$	Ex-smokers quit ≤ 12 months, $n = 122$	Ex-smokers quit > 12 months, $n = 277$	Smokers $n = 1,103$	Ex-smokers quit ≤ 12 months, $n = 77$	Ex-smokers quit > 12 months, $n = 223$
Age in years (%)												
18–24	4.6	7.0	7.3	4.3	5.9	2.2	3.2	7.4	6.5	5.5	3.9	3.1
25–39	25.9	32.5	26.5	19.9	26.9	22.3	20.9	27.1	27.1	24.4	32.5	20.6
40–55	44.2	42.7	39.2	41.6	33.6	37.6	43.6	45.9	41.9	40.3	44.2	37.2
55+	25.4	17.8	26.9	34.3	33.6	38.0	32.2	19.7	24.6	29.7	19.5	39.0
Gender (%)												
Male	46.6	41.4	48.2	44.3	41.2	51.1	46.4	49.2	44.8	49.1	49.4	44.4
Female	53.4	58.6	51.8	55.7	58.8	48.9	53.6	50.8	55.2	50.9	50.7	55.6
Education (%)												
Low	56.7	57.9	52.7	57.1	54.2	57.9	54.5	50.8	53.8	46.2	42.9	59.0
Moderate	26.6	19.1	25.3	26.8	23.7	21.9	28.7	22.9	23.8	28.7	31.2	22.9
High	16.7	22.9	22.0	16.1	22.0	20.2	16.9	26.2	22.4	25.1	25.9	18.0
Income (%)												
Low	27.1	17.2	19.2	33.2	27.7	32.3	29.8	19.7	19.9	31.4	16.9	31.4
Medium	28.5	28.7	24.9	31.0	31.1	23.1	26.3	24.6	24.2	30.4	36.4	26.5
High	38.3	48.4	48.2	27.0	30.3	35.4	35.6	49.2	46.6	30.4	38.9	30.9
No information	6.1	5.7	7.8	8.8	10.9	9.2	8.3	6.6	9.4	7.9	7.8	11.2
Identified minority group (%)												
Non-White/spoke non-English	8.7	7.0	10.2	3.2	8.4	4.4	7.5	13.5	8.7	8.8	3.9	3.6
White/spoke English only	91.3	93.0	89.8	96.8	91.6	95.6	92.5	86.6	91.3	91.2	96.1	96.4
Survey mode (%)												
Web	31.2	45.9	48.9	30.9	38.7	36.7	49.4	72.9	72.2	60.7	68.8	60.5
Phone	68.8	54.1	51.0	69.1	61.3	63.3	50.6	27.1	27.8	39.4	31.2	39.5

Note. Percentages are based on unweighted data.

countries, responses for these two variables were recoded into low (income: under $30,000 for Australia and £15,000 or less for United Kingdom; education: completed high school or less for Australia and secondary/vocational or less for the United Kingdom), moderate (income: $30,000–$59,999 and £15,001–£30,000, respectively; education: completed technical/trade/some university but no degree in Australia and college/some university but no degree in the United Kingdom) and high (income: $60,000 and over and £30,001 and over, respectively; education: completed university or postgraduate for both countries) with no information as an additional category for income to capture missing data.

Data Analysis

Analyses were conducted using Stata 12.1. Prevalence estimates and 95% confidence intervals were computed for EC awareness, trial, and current use among both smokers and ex-smokers stratified by country and survey wave. Estimates were adjusted with sampling weights to account for sampling probability and the known distribution of gender, age, and identified minority group within the smoker population for each country. Changes over time in EC awareness, trial, and use were evaluated using generalized estimating equations (GEE). A test of differential trends as a function of country and smoking status was conducted using GEE models by testing for significant interactions of survey wave with country and smoking status. All GEE models controlled for age group, gender, education, income, minority status, survey mode, and wave of recruitment. Logistic regression models were employed to examine correlates of EC awareness, trial, and use in 2013 and also factors predicting awareness and uptake of ECs by the 2013 survey among those respondents who had not tried them in 2010. Small numbers precluded multivariate analyses of current use in the latter.

Results

Trend in EC awareness, Trial, and Use

Table 2 shows changes in EC awareness and use by country. EC awareness among current and ex-smokers increased markedly between 2010 and 2013 in both Australia and the United Kingdom. Overall levels of awareness increased from 20.0% to 64.8% in Australia and from 54.4% to 90.5% in the United Kingdom. Levels of ever trying ECs also increased markedly in both countries. Overall, current use of ECs among Australian respondents increased from 0.6% in 2010 to 6.6% by 2013. In the United Kingdom, current use increased from 4.5% to 18.8%.

Our GEE modeling of the change over time in EC awareness (results not shown in table) reveals a significant country main effect with the odds ratio indicating that averaged across the two waves, the level of EC awareness was significantly greater in the United Kingdom than in Australia ($OR = 5.53$, $p < .001$). However, neither the wave by country interaction nor the wave by smoking status interaction was significant ($p = .09$ and .36, respectively) indicating that the change over time in EC awareness was not significantly different between countries, or between smokers, recent and long-term ex-smokers. GEE modeling also confirmed greater EC trial in the United Kingdom ($OR = 3.52$, $p < .001$) and a significant increase between waves in trial of ECs ($OR = 8.32$, $p < .001$) but no significant wave by country interaction ($p = .10$) nor a wave by smoking status interaction ($p = .82$). When analyzed among those who had heard of ECs, U.K. participants trialed more ($OR = 2.16$, $p < .001$),

and the increase in EC trial between waves remained significant ($OR = 4.18$, $p < .001$), but again no evidence of significant interactions with country or smoking status were found ($p = .23$ and .72, respectively).

For current use of ECs, GEE modeling revealed that overall level of current use was greater in the United Kingdom than in Australia ($OR = 3.93$, $p < .001$) and the odds of current use of ECs in 2013 were significantly greater than in 2010 ($OR = 6.37$, $p < .001$). However, neither the wave by country interaction nor the wave by smoking status interaction were statistically significant ($p = .30$ and .94, respectively) indicating no differential trend in increase of current use of ECs between countries or between smokers, recent and long-term ex-smokers. When analyzed among triers only, level of current use was greater in the United Kingdom ($OR = 1.68$, $p < .01$) but the change in current use between waves as well as the interactions with country and smoking status were all not statistically significant ($p = .62$, .22, and .30, respectively).

Prevalence of Nicotine-Containing ECs (2013 Survey)

Among current EC users in 2013, 42.5% in Australia reported that their current brand contained nicotine compared to 73.1% in the United Kingdom. The proportion of those in Australia who did not know whether their brand contained nicotine was more than twice that of the United Kingdom (21.1% vs. 9.0%).

Correlates of EC Awareness, Trial, and Use (2013 Survey)

Table 3 presents the logistic regression results on correlates of EC awareness, trial, and use using 2013 data, stratified by country for awareness and current use because of significant by country interactions. It should be stressed that on all these measures, levels were significantly higher in the United Kingdom than Australia. In 2013, EC awareness was associated with older age in the United Kingdom but with younger age in Australia (age group by country interaction significant at $p < .001$), with non-English speaking background in Australia but not in the United Kingdom (minority status by country interaction significant at $p < .05$), with greater interest in quitting in the United Kingdom but not in Australia (quit intention by country interaction significant at $p < .05$), and with female gender in the United Kingdom, but not in Australia. In Australia, moderate education and higher income were also associated with greater awareness, while current smokers displayed greater awareness than long-term ex-smokers.

Among those aware in 2013, U.K. respondents were significantly more likely to have tried ECs than their Australian counterparts ($OR = 1.85$, $p < .001$). Correlates of EC trial were similar across the two countries and included being aged between 25 and 39 years, female gender, interest in quitting, and not being a long-term ex-smoker. Those who perceived ECs as being less harmful than ordinary cigarettes were also more likely to have tried them whereas those who did not know were significantly less likely to have done so. Among those who had tried ECs, U.K. respondents who were interested in quitting were more likely to report current use, whereas the opposite trend was observed for Australian respondents (quit intention by country interaction significant at $p < .05$). Those aged 18–24 years in the United Kingdom were also significantly less likely to have continued to use ECs than their older counterparts. Also, long-term ex-smokers in the United Kingdom were significantly

Table 2. Awareness, Ever and Current Use of E-Cigarettes by Country, Survey Wave, and Smoking Status

	Wave 8 (2010)			Wave 9 (2013)		
	n/*N*	%	95% CI	*n*/*N*	%	95% CI
Awareness						
Australia						
Current smokers	212/1,109	20.5	17.7–23.6	695/1,093	68.4	64.6–71.9
Ex-smokers quit ≤ 12 months	31/157	20.8	13.9–30.0	73/122	58.2	46.4–69.2
Ex-smokers quit > 12 months	36/245	17.2	11.8–24.5	148/277	54.7	47.1–62.1
Total	279/1,511	20.0	17.6–22.6	916/1,492	64.8	61.5–68.0
United Kingdom						
Current smokers	513/975	55.9	51.9–59.9	988/1,103	89.4	87.2–91.3
Ex-smokers quit ≤ 12 months	63/118	58.5	46.1–69.9	73/77	94.9	84.1–98.5
Ex-smokers quit > 12 months	94/229	45.2	37.1–53.6	209/223	94.1	89.3–96.8
Total	670/1,322	54.4	50.9–57.9	1,270/1,403	90.5	88.6–92.1
Ever use						
Australia						
Overall						
Current smokers	25/1,109	2.5	1.6–3.9	219/1,093	23.7	20.3–27.5
Ex-smokers quit ≤ 12 months	5/157	2.4	1.9–6.0	19/122	15.5	9.3–24.7
Ex-smokers quit > 12 months	1/245	0.6	0.1–4.4	13/277	6.8	3.3–13.5
Total	31/1,511	2.2	1.5–3.2	251/1,492	19.7	17.0–22.7
Among those aware						
Current smokers	25/212	12.4	8.1–18.3	219/695	34.7	29.8–39.8
Ex-smokers quit ≤ 12 months	5/31	11.6	4.4–27.2	19/73	26.6	16.0–40.7
Ex-smokers quit > 12 months	1/36	3.7	0.5–22.3	13/148	12.5	6.1–23.6
Total	31/279	11.0	7.6–15.8	251/916	30.4	26.4–34.7
United Kingdom						
Overall						
Current smokers	94/975	10.9	8.3–14.2	473/1,103	43.3	39.6–46.9
Ex-smokers quit ≤ 12 months	13/118	13.8	5.4–30.9	40/77	62.0	46.5–75.4
Ex-smokers quit > 12 months	5/229	1.3	0.5–3.3	33/223	14.0	9.4–20.5
Total	112/1,322	9.6	7.4–12.5	546/1,403	39.9	36.6–43.3
Among those aware						
Current smokers	94/513	19.5	15.1–24.9	473/987	48.5	44.5–52.4
Ex-smokers quit ≤ 12 months	13/63	23.6	9.6–47.2	40/73	65.3	49.6–78.3
Ex-smokers quit > 12 months	5/94	2.9	1.1–7.4	33/209	14.9	9.9–21.7
Total	112/670	17.7	13.7–22.5	546/1,269	44.2	40.6–47.8
Current use						
Australia						
Overall						
Current smokers	10/1,109	0.8	0.4–1.5	81/1,093	8.9	6.6–11.9
Ex-smokers quit ≤ 12 months	1/157	0.4	0.1–2.6	3/122	2.1	0.6–6.7
Ex-smokers quit > 12 months	0/245	0.0	–	2/277	0.4	0.1–1.8
Total	11/1,511	0.6	0.3–1.1	86/1,492	6.6	5.0–8.8
Among triers						
Current smokers	10/25	31.4	15.3–53.5	80/219	37.0	29.0–45.8
Ex-smokers quit ≤ 12 months	1/5	15.5	1.9–63.8	3/19	13.3	3.8–37.1
Ex-smokers quit > 12 months	0/1	0.0	–	2/13	6.3	1.3–25.3
Total	11/31	28.0	14.1–47.8	85/250	33.2	26.0–41.3
United Kingdom						
Overall						
Current smokers	42/975	4.9	3.2–7.4	241/1,103	20.7	17.8–23.8
Ex-smokers quit ≤ 12 months	4/118	8.3	1.8–30.8	19/77	34.7	19.5–53.7
Ex-smokers quit > 12 months	1/229	0.3	0.0–1.8	9/223	2.7	1.3–5.3
Total	47/1,322	4.5	2.9–6.9	269/1,403	18.8	16.2–21.7
Among triers						
Current smokers	42/94	44.8	31.1–59.2	238/470	47.5	41.8–53.3
Ex-smokers quit ≤ 12 months	4/13	60.4	20.7–89.9	19/40	55.9	34.6–75.2
Ex-smokers quit > 12 months	1/5	19.7	2.4–71.2	9/33	19.1	9.2–35.4
Total	47/112	46.5	32.7–60.8	266/543	46.8	41.3–52.3

Note. Percentages are based on weighted data; – estimates cannot be computed because of small cell size.

Table 3. Correlates of Awareness, Trial, and Current Use of E-Cigarettes (ECs) at Wave 9 (2013)

Variables	Awareness of ECs OR (95% CI) United Kingdom, n = 1,380	Awareness of ECs OR (95% CI) Australia, n = 1,480	Ever use of ECs (among aware) OR (95% CI) Combined, n = 2,160	Current use of ECs (among triers) OR (95% CI) United Kingdom, n = 536	Current use of ECs (among triers) OR (95% CI) Australia, n = 248
Country					
Australia	NA	NA	1.00	NA	NA
United Kingdom	NA	NA	1.85 (1.52–2.26)***	NA	NA
Age group (years)					
18–24	0.48 (0.22–1.02)	3.99 (2.06–7.70)***	1.38 (0.87–2.18)	0.22 (0.08–0.60)**	0.31 (0.08–1.18)
25–39	0.57 (0.34–0.97)*	2.50 (1.58–3.97)***	1.33 (1.01–1.75)*	0.71 (0.42–1.18)	0.51 (0.22–1.17)
40–55	1.02 (0.61–1.70)	2.08 (1.41–3.06)***	1.11 (0.87–1.40)	0.87 (0.56–1.37)	0.53 (0.24–1.14)
55+	1.00	1.00	1.00	1.00	1.00
Gender					
Male	1.00	1.00	1.00	1.00	1.00
Female	1.51 (1.03–2.22)*	1.17 (0.94–1.47)	1.23 (1.01–1.49)*	1.32 (0.91–1.91)	1.07 (0.59–1.96)
Education					
Low	1.00	1.00	1.00	1.00	1.00
Moderate	0.98 (0.61–1.57)	1.32 (1.02–1.72)*	1.10 (0.88–1.38)	1.85 (0.55–1.31)	0.89 (0.46–1.74)
High	0.72 (0.45–1.17)	1.02 (0.75–1.39)	1.00 (0.77–1.29)	1.41 (0.86–2.31)	1.02 (0.47–2.23)
Income					
Low	1.00	1.00	1.00	1.00	1.00
Medium	1.32 (0.56–2.17)	1.41 (1.04–1.91)*	1.06 (0.83–1.37)	1.21 (0.76–1.93)	1.74 (0.75–3.99)
High	1.26 (0.77–2.08)	1.81 (1.34–2.45)***	1.02 (0.79–1.32)	1.10 (0.68–1.81)	1.37 (0.59–3.17)
No information	0.88 (0.43–1.78)	1.47 (0.96–2.26)	1.02 (0.70–1.49)	1.12 (0.53–2.39)	2.92 (0.89–9.57)
Identified minority group					
Non-White/spoke non-English	1.00	1.00	1.00	1.00	1.00
White/spoke English only	1.60 (0.89–2.87)	0.66 (0.43–0.99)*	0.89 (0.62–1.26)	0.58 (0.29–1.17)	0.57 (0.21–1.50)
Smoking status					
Smokers	1.00	1.00	1.00	1.00	1.00
Ex-smokers ≤ 12 months	1.32 (0.45–3.92)	0.71 (0.46–1.08)	0.94 (0.64–1.37)	0.69 (0.34–1.41)	0.29 (0.07–1.20)
Ex-smokers > 12 months	0.90 (0.45–1.80)	0.60 (0.43–0.83)**	0.19 (0.13–0.27)***	0.22 (0.09–0.53)**	0.33 (0.06–1.69)
Interested in quitting					
No	1.00	1.00	1.00	1.00	1.00
Yes/quit	1.97 (1.29–3.01)**	1.02 (0.78–1.33)	1.30 (1.04–1.62)*	1.90 (1.24–2.89)**	0.77 (0.40–1.46)
Perceptions of harm					
Equally/more harmful than cigarettes	NA	NA	1.00	1.00	1.00
Less harmful than cigs	NA	NA	1.55 (1.11–2.17)*	1.39 (0.72–2.69)	2.49 (0.64–9.58)
Don't know	NA	NA	0.57 (0.39–0.83)**	0.87 (0.38–2.01)	1.11 (0.25–4.92)

Note. NA = not applicable; OR = odds ratios, adjusted for other variables in the table and also survey mode (web vs. phone) and wave of recruitment.
*p < .05; **p < .01; ***p < .001.

less likely to be current users than smokers with a similar trend in Australia.

Predictors of Change in EC Awareness and Trial

Logistic regression analyses of reported awareness of ECs in 2013 among the subset of current and former smokers who were not aware in 2010 indicate that there was a significant age group by country interaction ($p < .01$). In the United Kingdom, those aged 18–24 years were significantly less likely to become aware of ECs than those aged 25 and above, whereas in Australia it was those aged 55 and older who were less likely to become aware (Table 4). Those in Australia with moderate education were also more likely to have become aware of ECs than those lower in education ($OR = 1.70$, $p < .01$), as were smokers from minority groups (non-English speaking) ($OR = 0.50$, $p < .05$).

No significant interactions between predictor variables and country were found for EC trial by 2013 among non-triers in 2010 who were aware by 2013 and hence, results reported in Table 4 were based on pooled analyses. Trial was almost two and a half times more common in the United Kingdom ($OR = 2.31$, $p < .001$). Other significant independent predictors of EC trial by 2013 included younger age, female gender, not having quit smoking and not perceiving ECs as being equally or more harmful than ordinary cigarettes.

Discussion

Between 2010 and 2013, awareness, trial, and current use of ECs increased markedly among adult current and former smokers in both Australia and the United Kingdom, albeit reaching much higher absolute levels in the United Kingdom by 2013. To interpret these

Table 4. Logistic Regression Analyses of Awareness and Trial of E-Cigarettes (ECs) by Wave 9 (2013) Among Those not Aware or had Never Tried in Wave 8 (2010)

Wave 8 variables	Wave 9 awareness (among non-aware at Wave 8), *OR* (95% CI)		Wave 9 ever use (among non-triers in Wave 8)[a], *OR* (95% CI)
	United Kingdom, $n = 411$	Australia, $n = 765$	Combined, $n = 1,590$
Country			
Australia	NA	NA	1.00
United Kingdom	NA	NA	2.31 (1.75–3.03)***
Age group (years)			
18–24	0.14 (0.03–0.74)*	4.32 (1.83–10.19)**	1.50 (0.80–2.79)
25–39	0.97 (0.35–2.71)	2.50 (1.58–3.97)***	1.46 (1.02–2.08)*
40–55	0.72 (0.33–1.54)	2.08 (1.41–3.06)***	1.13 (0.82–1.55)
55+	1.00	1.00	1.00
Gender			
Male	1.00	1.00	1.00
Female	1.14 (0.59–2.19)	1.23 (0.91–1.67)	1.34 (1.04–1.71)*
Education			
Low	1.00	1.00	1.00
Moderate	1.69 (0.72–3.97)	1.70 (1.17–2.48)**	1.16 (0.87–1.55)
High	1.12 (0.39–3.23)	1.33 (0.88–2.02)	1.08 (0.77–1.50)
Income			
Low	1.00	1.00	1.00
Medium	1.25 (0.56–2.79)	1.34 (0.88–2.03)	0.88 (0.64–1.22)
High	2.29 (0.79–6.65)	1.43 (0.95–2.16)	1.07 (0.77–1.48)
No information	0.51 (0.19–1.37)	1.19 (0.61–2.33)	0.76 (0.43–1.31)
Identified minority group			
Non-White/spoke non-English	1.00	1.00	1.00
White/spoke English only	2.21 (0.55–8.86)	0.50 (0.29–0.89)*	0.92 (0.55–1.56)
Smoking status			
Smokers	1.00	1.00	1.00
Ex-smokers ≤ 12 months	1.27 (0.34–4.81)	0.76 (0.46–1.26)	0.52 (0.34–0.82)**
Ex-smokers > 12 months	1.27 (0.49–3.24)	0.70 (0.46–1.07)	0.17 (0.10–0.27)***
Interested in quitting			
No	1.00	1.00	1.00
Yes/quit	1.28 (0.59–2.78)	0.95 (0.63–1.43)	1.16 (0.86–1.56)
Perceptions of harm			
Equally/more harmful than cigarettes	NA	NA	0.41 (0.20–0.83)*
Less harmful than cigarettes	NA	NA	1.00
Don't know	NA	NA	0.58 (0.32–1.04)
Not aware, skipped question	NA	NA	1.58 (1.19–2.07)**

Note. NA = not applicable; *OR* = odds ratios, adjusted for other variables in the table and also survey mode (web vs. phone) and wave of recruitment. Interactions between age group and country for EC awareness significant at $p < .01$.

[a]Include those not aware at Wave 8 but became aware at Wave 9.

*$p < .05$; **$p < .01$; ***$p < .001$.

findings properly, the potential confounding of country and regulatory environment warrants some discussion. We acknowledge that the observed country differences in EC awareness and use could be due to differences between the United Kingdom and Australia other than the regulatory environment with regards to ECs. However, given that the two countries are otherwise similar with regard to tobacco control policy and the fact that our models controlled for socio-demographic characteristics of participants, we consider the EC regulatory environment to be the most plausible explanation for the observed differences. Indeed, the higher prevalence observed in the United Kingdom is consistent with the less restrictive regulatory environment for ECs in the United Kingdom and the higher base rate of awareness and use observed in 2010.[8] The high levels of EC awareness, trial and use and the increasing trends in use observed in Australia are especially remarkable in light of the restrictive regulatory environment which limits the marketing of nicotine-containing ECs and prohibits their sale and possession without an approved license.

The increase in EC awareness and use in the United Kingdom is also consistent with findings from other U.K. studies.[16,17,20] It is notable that despite the different EC regulatory environments between the United Kingdom and Australia, there was no evidence of a differential trend in the rate of increase in awareness, trial or current use of ECs between the two countries across the three year study period.

More than 40% of current users of ECs in Australia and almost three-quarter in the United Kingdom reported using a brand containing nicotine in the 2013 survey. The large number using nicotine-containing products in Australia suggests a substantial black market, which demonstrates a demand by some for nicotine-containing ECs even in a context of greater barriers to access than for smoking. While existing laws in Australia do not permit retail sale and marketing of nicotine-containing ECs, enforcement can be difficult especially if the activity occurs over the internet.

Given the different regulatory environments for ECs in Australia and in the United Kingdom, it is not surprising to find that different factors influence awareness and use of ECs in the two countries. In Australia, EC awareness was higher among younger respondents whereas the opposite appears to be the case in the United Kingdom. The latter finding is unusual as young people are generally more aware of innovations than older people. Since conducting the survey, we have become aware that some of these products are being marketed to youth in ways designed to minimize associations with cigarettes, using such names as e-shisha, and vape-pens. It is possible that some young respondents assumed that these were different products and thus we might have some false negatives. Alternatively, as our sample under-represents younger smokers, particularly the longitudinal sub-sample, it could be that the younger smokers in our study were atypically less engaged with societal trends than other young adults. In both countries, younger people were more likely to have tried ECs than their older counterparts, consistent with our previous finding,[8] but fewer of the triers among younger people were current users. It will be important to find out why. It could be because these products are not satisfying enough, and it is only when smokers get old enough to really worry about the onset of adverse effects that they are prepared to accept the compromise of using a less harmful, but less satisfying product, or it could be that ECs are still less socially acceptable than cigarettes, so young people are reluctant to switch.

Another factor that operates differently in the two countries is minority status. The greater awareness of ECs among non-English speaking background respondents in Australia and the greater

increases in awareness over time in this group are again consistent with the more restrictive environment for ECs in Australia whereby exposure to these products may occur via overseas social networks among this subgroup. Unfortunately we could not verify this as no data were collected on how respondents came to know about ECs.

Interest in quitting is another factor that influences awareness and use of ECs differently across the two countries. Interest in quitting was a strong predictor of greater awareness, trial, and use of ECs in the United Kingdom but only predicted greater trial in Australia, suggesting that there were greater opportunities for smokers interested in quitting in the United Kingdom to explore ECs as a cessation aid than their Australian counterparts, reflecting the less restrictive policy environment. The limited availability of nicotine-containing ECs in Australia may be inhibiting smokers from using them as a means of stopping smoking. It is notable that EC use in both countries and also EC awareness in Australia were considerably lower among longer term ex-smokers (quit for more than a year) as compared to current smokers. This finding suggests that once smokers have quit for some time, they may be less interested in using new nicotine-containing products.

Consistent with past studies,[1,8,21] our finding also suggests that ECs appeal more to females than males, although it is unclear if this gender difference in appeal comes from the fact that these emerging products are cleaner with no ash compared to ordinary cigarettes, because of the attractive design and packaging, or other reasons. Further investigation of possible reasons is warranted.

Our findings also demonstrate that relative risk perception is an important factor influencing whether people will try ECs. The fact that those who are either ill-informed or ignorant of the risk of ECs relative to ordinary cigarettes are less likely to try them is not surprising, and could easily be remedied with public education.

Strengths and Limitations

This study has both strengths and limitations. The strengths include broad representative samples with replenishment to reduce biases due to attrition, longitudinal cohort design to study change, and separate findings for long-term ex-smokers. A study limitation is the small number of current users, which precluded subsample analyses of uptake of ECs. As new brands and models of ECs appear regularly, our results cannot provide insights on possible implications of product innovation, which we believe to be substantial. Thus, it will be important to monitor how this phenomenon develops. Finally, in this paper we have not focused on possible impacts on smoking cessation. This requires a different way of approaching the data, and given interactive effects between country and patterns of use, and the small numbers of users in Australia, we are separately exploring the possible effects focusing on the U.K. sample.

Policy Implications

Given the significant rise in EC awareness and use in both countries, there is a clear need for regulatory oversight to ensure maximum public health benefits and minimum adverse consequences of this new emerging product. In the United Kingdom, ECs are currently marketed as consumer products but there are plans to regulate them as medicines or tobacco products by 2016 to help ensure their safety and efficacy and also prevent misleading advertising. By contrast, in Australia there are no clear plans to regulate ECs in the near future and public health authorities are divided in their opinions on ECs. The current legal status of ECs is complex as different existing laws may

apply depending on whether they contain nicotine, whether therapeutic claims are being made by manufacturers, and whether they are designed to mimic a tobacco product. At least with regards to smokers and recent ex-smokers, we have found nothing in the United Kingdom that would give any cause for alarm about the more liberal regulatory regime there, and some admittedly weak evidence that the more restrictive regulatory environment in Australia might be inhibiting some of the potential positive effects of these products, not just leading to overall lower levels of use. From a public health perspective, the question at a population level is whether the potential benefits of ECs outweigh their drawbacks. While we await research findings on the efficacy and public health impact of ECs, smokers who are unwilling and/or unable to quit should be encouraged to try them where they are allowed on the basis that they are less harmful than continuing to smoke. In our view, a case is continually building for Australia to find a regulatory mechanism to allow access to these products for smokers who may be interested in trying them as an alternative to smoking, if not as an alternative smoking cessation strategy.

Conclusions

In the last three years, EC awareness and use among both current and former smokers have rapidly raised both in the United Kingdom where such products are readily available and also in Australia where they are restricted. A substantial number of current EC users in both countries are using an EC that contains nicotine. What drives awareness and uptake of ECs in the two countries is largely reflective of the different regulatory environments. There is a need for continued and extended longitudinal studies of ECs on trial and use (as well as measurements of transitions between products, including dual use) across jurisdictions with different policy and regulatory environments. Such studies will provide much-needed empirical foundation for understanding how policy and regulatory environments influence patterns of use.

Declaration of Interests

None declared.

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