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Awareness and use of heated tobacco products among adult smokers in six European countries: findings from the EUREST-PLUS ITC Europe Surveys

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Background: The study assessed awareness and use of heated tobacco products (HTPs) and factors that influenced these issues among cigarette smokers from six European countries in 2016 (Wave 1) and 2018 (Wave 2). **Methods:** A survey was conducted among a nationally representative sample of cigarette smokers aged 18 years or older from Germany, Greece, Hungary, Poland, Romania and Spain in 2016 ($N=6011$) and 2018 ($N=6027$; 53% of smokers from the previous wave were retained, regardless of smoking status and dropouts were replaced by a replenishment sample of smokers). Data were collected through face-to-face interviews. Estimates were produced using weighted data. The study presents the cross-sectional results. **Results:** Awareness of HTPs increased from 8% to 17% between the two waves. At Wave 1, 1.1% of the smokers declared having used HTPs at least once during their lifetime; and at Wave 2, this increased to 1.9% (around 1% or less in four countries, except for Greece and Romania where it was around 4%). Factors associated with HTPs use among those who had ever heard about these products at Wave 1 were country of residence, being a daily cigarette smoker and ever use of electronic cigarettes. At Wave 2, ever use of HTPs was significantly higher among those who had tried to quit smoking combustible cigarettes in the last 12 months, had tried electronic cigarettes during lifetime and perceived HTPs as less dangerous than combustible cigarettes; the country of residence was also associated with HTPs use. **Conclusion:** This study offers insights into the behaviours and perceptions of European adult smokers regarding HTPs, an important emerging issue in the field of tobacco control.

Introduction

Heated tobacco products (HTPs) are battery-powered devices designed to heat tobacco at a lower temperature than traditional cigarettes that avoid combustion and produce a nicotine aerosol that

is inhaled.^{1–3} They are promoted by tobacco companies as a harm reduction strategy (with the assertion that these devices are safe and effective for smoking cessation), taking advantage of the fact that in several countries, there are little or no regulatory or marketing restraints.^{2–5} There are currently no studies that have examined

the safety and effectiveness of HTPs for complete substitution or smoking cessation.

Several studies underline the lack of knowledge about the toxicity and the public health impact of these products, which calls for independent research to elucidate the population-level impact of HTPs, with significant implications for product users, public health professionals and regulatory agencies.^{5–7} Moreover, despite the fact that the tobacco industry presents these products as a safer alternative to cigarettes and deceptively promotes these products as proof of their effort towards a smoke-free world, there are concerns that marketing strategies used to promote these products may result in undermining tobacco control measures and efforts to denormalize smoking.^{5–9} For instance, in Italy, rapid market penetration of HTPs led to an increase in their use and intent to use among non-smokers and long-term former smokers who might otherwise remain tobacco-free.^{9,10}

Since 2014, HTPs have been introduced in a growing number of international markets including European countries such as Germany, Spain, Greece, Romania, Hungary and Poland. Nevertheless, little is known about perceptions and behaviours related to these products among adults in Europe.

The present study focuses on awareness and use of HTPs among current and former adult cigarette smokers in six European Union Member States in 2016 and in 2018. The objective of the current study was to assess awareness, perceptions and use of HTPs, as well as to explore factors associated with awareness and ever-use of these products.

Methods

Sample and procedure for data collection

Data were collected during the two waves of the International Tobacco Control and Evaluation Project 6 European Country Surveys (ITC 6E Survey), which has been conducted as part of the larger Horizon 2020 project ‘European Regulatory Science on Tobacco: Policy Implementation to Reduce Lung Disease’ (EUREST-PLUS). The ITC 6E Survey respondents were sampled using an area probability sampling design, and interviewed face-to-face via computer-aided personal interviews.¹⁰

Waves 1 and 2 of the ITC 6E Survey were conducted from June to September 2016 (prior to the introduction of European Tobacco Products Directive) and from February to May 2018, respectively (after the introduction of European Tobacco Products Directive). At Wave 1, nationally representative samples of adult cigarette smokers aged 18 years or older were collected in Germany ($n = 1003$), Greece ($n = 1000$), Hungary ($n = 1000$), Poland ($n = 1006$), Romania ($n = 1001$) and Spain ($n = 1001$). At Wave 2, cohort members from the previous wave were re-contacted regardless of their smoking status, while respondents lost to attrition were replaced by a replenishment sample of current adult smokers. The retention rate at Wave 2 was 53% overall (70.5% for Germany, 41.3% for Greece, 35.7% for Hungary, 45.6% for Poland, 54.4% for Romania and 71.3% for Spain). More information about the procedure of data collection can be found elsewhere.^{11,12} Local ethics committees in each country approved the project, and all participants provided informed consent.

Measures

Socio-demographics and smoking behaviour

At both waves, socio-demographic characteristics including country of residence, age, gender and level of urbanization (urban/semi-urban/rural) were assessed. At Wave 1, smoking behaviour included the assessment of frequency of traditional cigarette smoking and a new variable was created (smoking daily/less than daily). At Wave 2, both the status of smoking (smokers/ex-smokers) as well as the

frequency of traditional cigarette smoking were assessed and a new variable was created with the categories: daily smoker/less than daily smoker/ex-smoker (the category of ex-smokers including those who declared quitting smoking in the last month, last 1–6 months or more than 6 months). At the same time, at both waves, participants were asked if they had made a quit attempt in the last 12 months. Participants were also asked at both waves if they had ever used an electronic cigarette (e-cigarette).

Awareness and behaviour related to use of HTPs

At both waves, participants were asked if they had ever heard of HTPs and if they had tried these products at least once during their lifetime. At Wave 2, participants were also asked if they currently used these products (daily; less than daily, but at least once a week; less than weekly, but at least once a month; less than monthly, but from time to time; not at all); participants were considered current users if they used HTPs at least monthly or less than monthly, but from time to time. Additionally, at Wave 2, participants were asked to rate how harmful they believe HTPs are in comparison with traditional tobacco cigarettes (much less harmful/somewhat less harmful/equally harmful/somewhat more harmful/much more harmful/do not know).

Analyses

Data were analyzed using the Complex Samples Package from SPSS to account for the complex sampling design. Data from both waves were weighted to ensure the respondents represented the population of adult smokers in all countries, while unweighted statistics were used to describe respondents’ baseline characteristics from each country.

Prevalence and confidence intervals (CIs) were estimated for awareness and use of HTPs at Wave 1 and Wave 2. Chi-square tests were used to assess the overall association between country and each outcome. At Wave 2, opinions regarding HTPs were also evaluated among participants who have heard about these products and chi-square test was used to assess country differences.

Separate weighted logistic regression models were estimated to assess factors associated with awareness of HTPs at each survey wave. The dependent variable was awareness at Wave 1 or Wave 2 (0: no, 1: yes), while independent variables were: country, age group, gender, smoking behaviour (daily smoker/occasional smoker at Wave 1 and daily smoker/occasional smoker/ex-smoker at Wave 2), attempts to quit traditional tobacco cigarettes in the last 12 months (yes/no) and ever use of e-cigarettes (yes/no). At Wave 2, the time of recruitment (at Wave 1 or Wave 2) was also included as an independent variable.

Weighted logistic regression was also used to assess factors associated with use of HTPs at Wave 1 and Wave 2 among participants who heard about these products, with the dependent variable being ever use at Wave 1 and Wave 2, respectively (0: no, 1: yes). The independent variables were country, age group, gender, smoking behaviour (daily smoker/occasional smoker at Wave 1 and daily smoker/occasional smoker/ex-smoker at Wave 2) and attempts to quit traditional tobacco cigarettes in the last 12 months (yes/no), ever use of e-cigarettes (yes/no). At Wave 2, the time of recruitment (at Wave 1 or Wave 2) as well as the opinions regarding the effects of HTPs in comparison with traditional cigarettes (much less harmful/somewhat less harmful than smoking traditional tobacco cigarettes vs. equally harmful/more harmful/much more harmful/I do not know) were also included.

Results

Characteristics of study sample

At Wave 1, the study sample consisted of 6011 adults (47.2% women) with a mean age of 45.1 years. At Wave 2, there were

Table 1 Awareness and use of HTPs at both waves

	Total % (CI)	Germany % (CI)	Greece % (CI)	Spain % (CI)	Romania % (CI)	Hungary % (CI)	Poland % (CI)
Wave 1 (N = 6011)							
Have heard ^a	7.9 (6.9–9.1)	13.2 (10.1–17.0)	6.0 (4.0–8.8)	5.3 (3.5–7.9)	6.9 (4.9–9.6)	8.2 (5.6–11.9)	8.0 (5.5–11.6)
Have used at least once ^b	1.1 (0.8–1.5)	0.5 (0.2–1.2)	0.9 (0.4–1.9)	1.4 (0.7–2.7)	1.9 (1.0–3.7)	1 (0.4–2.2)	1 (0.5–2.2)
Wave 2 (N = 6027)							
Have heard ^a	17.2 (15.6–18.8)	24.9 (20.7–29.6)	32.8 (27.1–39)	10.8 (8.4–13.7)	17.2 (13.8–21.3)	9.3 (6.6–12.9)	7.8 (5.7–10.6)
Have used at least once ^a	1.9 (1.4–2.5)	1 (0.5–2)	4.4 (2.6–7.5)	0.9 (0.4–2.2)	4.2 (2.7–6.4)	0.2 (0–0.6)	0.7 (0.2–2.2)
Current use ^a	0.8 (0.5–1.2)	0.3 (0.1–1)	1.7 (0.9–3.3)	0.6 (0.2–0.8)	1.9 (1.1–3.4)	0	0.3 (0.2–1)

Note: Chi-square tests were performed to assess the overall association between country and each outcome.

a: Statistically significant differences between countries ($P < 0.05$ at chi-square test).

b: No statistically significant differences between countries ($P > 0.05$ at chi-square test).

6027 participants (48.7% women) with a mean age of 46.0 years. With regards to smoking behaviour, at Wave 1, 95.4% smoked daily and 4.6% less than daily, while at the Wave 2, 89.3% were daily smokers, 4.1% were less than daily smokers and 6.5% were ex-smokers. Among the whole study sample, the percentage of those who had made attempts to quit smoking in the last 12 months was 17.2% at Wave 1 and 17.6% at Wave 2. Regarding e-cigarette use, 20.5% declared having used them at least once during lifetime at Wave 1, while during Wave 2, 18% did so.

Awareness of HTPs

At Wave 1, 7.9% of smokers reported having heard of HTPs (see table 1). There were significant differences in the percentage of smokers who were aware of HTPs between countries, ranging from 5.3% in Spain to 13.2% in Germany. At Wave 2, 17.2% of current and former smokers were aware of these products and there were statistically significant differences between countries, with the highest percentage being found in Greece (32.8%) and Germany (24.9%), and the lowest rate was found in Hungary and Poland (<10%). In Poland and Hungary, awareness was similar across both waves, while in the other four countries, the percentages of those who had heard about these products by 2018 were at least twice as high as in 2016 (table 1).

Use of HTPs

At Wave 1, overall, only 1.1% of smokers reported having used HTPs at least once during their lifetime, with no statistically significant differences between countries. At Wave 2, 1.9% reported HTPs use at least once during their lifetime, with statistically significant differences observed between countries. In Germany, Poland and Hungary, HTPs use was <1%, while in Greece and Romania, it was around 4%.

At Wave 2, current HTPs use was reported by 0.8% of respondents. Statistically significant variations between countries were observed, in which <1% of respondents in Germany, Poland and Hungary reported current use, while in Greece and Romania, this percentage increased to 1.7 and 1.9%, respectively (table 1).

Perceived harmfulness of HTPs compared with combustible cigarettes

As presented in table 2, at Wave 2, almost half of current and former smokers reported that they considered HTPs to be just as harmful as traditional tobacco cigarettes, less than one-third considered them less harmful, 8.6% reported that they are more harmful and 14.8% responded that they did not know. Greece was the country with the highest prevalence of smokers (almost half) considering these products to be less harmful, while the lowest percentage was found in Hungary (13.4%).

Factors associated with awareness and use of HTPs

At both waves, awareness of HTPs was higher among younger ages, men, people living in urban areas, as well as those who reported having ever used e-cigarettes; country of residence was also a factor associated with awareness (table 3). Factors associated with ever-use of an HTPs (among those who had ever heard of HTPs) at Wave 1 were country of residence, being a daily smoker and ever use of e-cigarettes. At Wave 2, ever use of HTPs was higher among those who had tried to quit smoking traditional tobacco cigarettes within the last 12 months, had tried e-cigarettes at least once during lifetime and reported that HTPs are less harmful compared with combustible cigarettes; country of residence was also associated with the use of these products (table 4).

Discussion

The study shows that in 2018, in the six participating countries, around 17% of the cigarette smokers were aware of the existence of HTPs, 2% had ever-used them and only <1% reported currently using them. Both awareness and ever-use increased among the study sample between 2016 and 2018, which follows the manufacturer's increasing launch and advertising of these products during this time period in several countries.⁵ Studies from other countries also support this trend.⁸

There were significant country differences regarding HTPs awareness both at Waves 1 and 2, while regarding ever use, country differences were statistically significant only at Wave 2. Current use was investigated only at the second wave and we noticed statistically significant differences between countries. In Poland and Hungary, awareness remained similar at both waves, while ever use remained <1%. In Germany and Spain, awareness doubled between the two waves, while the ever use remained below 1%. In Romania and Greece, the awareness increased by three and five times, respectively, while the prevalence of ever use increased at Wave 2 to around 4% in both countries. Current use at Wave 2 was also more frequent in Romania and Greece in comparison with the other four countries. Other studies also underlined that cultural factors as well as prices and relative cost of other tobacco products, strategic decisions of tobacco industry to target certain markets, prevalence of smoking in the country appeared to affect the appeal of HTPs products and the messages of their promotion, suggesting a possible explanation for cross-country variance in HTPs prevalence and uptake.^{3–5}

With regards to perceptions about the harm of HTPs compared with combustible cigarettes, less than one-third of those who have heard about HTPs consider them less dangerous than combustible cigarettes. In our study, Greece was the country with the highest percentage of smokers considering HTPs less dangerous (one out of two smokers who had heard about these products) followed by Spain and Poland, while for the other countries, the percentage was 21% or lower. Reduced harm perceptions may be explained by the fact that many tobacco companies are promoting HTPs as harm reduction products. In 2017, Japan Tobacco International

Table 2 Wave 2-perceptions among persons who have heard about HTPs

Perceptions about the harm of HTPs	Total (N = 979) % (CI)	Germany (N = 244)% (CI)	Greece (N = 319)% (CI)	Spain (N = 97)% (CI)	Romania (N = 141)% (CI)	Hungary (N = 86)% (CI)	Poland (N = 92)% (CI)
Much less harmful/somewhat less harmful than smoking traditional tobacco cigarettes	30.2 (25.8–35.0)	21.8 (14.2–31.9)	46.8 (37.1–56.0)	31.4 (19.2–46.8)	20.7 (12.2–32.8)	13.4 (6.3–26.5)	28.2 (16.1–44.6)
Equally harmful to smoking traditional tobacco cigarettes	46.4 (41.7–51.1)	57.9 (49.0–66.4)	34.7 (24.6–46.3)	40.5 (29.8–52.2)	44.7 (34.2–55.6)	65.5 (54.0–75.4)	48.3 (36.9–59.9)
Somewhat more harmful/much more harmful	8.6 (6.3–11.7)	7.7 (4.8–12.2)	7.7 (3.5–16.3)	2.4 (0.6–9.1)	17.0 (10.2–28.7)	9.8 (4.5–15.9)	3.9 (1.1–13.0)
Do not know	14.8 (12.0–18.1)	12.6 (8.1–19.0)	11.2 (6.6–18.4)	25.7 (18.7–34.3)	17.6 (10.4–28.2)	11.3 (5.8–20.8)	19.5 (12.6–29.0)

Note: Chi-square test was performed to assess the overall association between country and perceptions regarding harmful of HTPs (much less harmful/somewhat less harmful than smoking traditional tobacco cigarettes vs. equally harmful/more harmful/much more harmful/I do not know) and statistically significant difference was found between countries ($P < 0.05$).

Table 3 Factors associated with awareness of HTPs—results of logistic regression analyses

	Wave 1 (N = 6011)		Wave 2 (N = 6027)	
	OR (CI)	Tests of model effects (P value)	OR (CI)	Tests of model effects (P value)
Country				
Germany	1.48 (0.88–2.47)	<0.001	3.05 (1.91–4.86)	<0.001
Greece	0.59 (0.32–1.09)		4.84 (2.97–7.89)	
Spain	0.51 (0.28–0.92)		0.99 (0.61–1.58)	
Romania	0.64 (0.37–1.10)		1.82 (1.12–2.94)	
Poland	0.90 (0.50–1.60)		0.83 (0.50–1.39)	
Hungary	Ref		Ref	
Wave of recruitment				
At wave 1	–		0.99 (0.81–1.23)	NS
At wave 2			Ref	
Age (years)				
18–24	2.00 (1.38–2.90)	<0.01	2.95 (2.07–4.20)	<0.001
25–39	1.30 (0.92–1.83)		2.36 (1.82–3.05)	
40–54	1.21 (0.87–1.90)		1.97 (1.51–2.57)	
>54	Ref		Ref	
Gender				
Male	1.77 (1.39–2.25)	<0.001	1.61 (1.36–1.91)	<0.001
Female	Ref		Ref	
Residence				
Urban	1.61 (1.05–2.46)	<0.05	1.65 (1.18–2.31)	<0.05
Intermediate	1.86 (1.22–2.83)		1.38 (1.01–1.90)	
Rural	Ref		Ref	
Smoking status				
Ex-smoker	–		0.94 (0.58–1.53)	NS
Occasional smoker	0.91 (0.54–1.55)	NS	1.08 (0.63–1.83)	
Daily smoker	Ref		Ref	
Quit attempts				
No	0.76 (0.56–1.03)	NS	0.88 (0.69–1.12)	NS
Yes	Ref		Ref	
Ever use of e-cigarettes				
Yes	2.52 (1.97–3.21)	<0.001	2.39 (1.87–3.04)	<0.001
No	Ref		Ref	

Note: NS, non-significant; Ref, the reference group.

claimed in a press release a 99% reduction of tobacco product constituents that have been identified as harmful by World Health Organization's (WHO) Tobacco Product Regulation Expert Group. British American Tobacco (BAT) made a similar claim for its HTPs, glo, in Romania, saying that the new product was aligned with the WHO's recommendations for regulating tobacco products content, but the WHO stated that the organization was 'in no way endorsing BAT's product nor the company's claims concerning the product'.^{13,14} Such harm perceptions might influence usage behaviour; in our sample ever use of HTPs was more frequent among people who believed the products to be less harmful than traditional tobacco cigarettes.

Awareness about the existence of these products was higher at both waves among younger ages and people living in urban areas as well as people who have used e-cigarettes in their lifetime; all these groups are known to be more exposed to advertisement and promotion, as well as more prone to be attracted by experimenting with new products.^{9,10,15–17} Men were also more aware about these products.

Ever use of HTPs was more frequent among people who believed the products to be less dangerous, have tried to quit smoking in the last 12 months and ever used e-cigarettes, suggesting that these products are used sometimes by cigarette smokers as a harm reduction strategy or as a smoking cessation aid, while together with e-

Table 4 Factors associated with ever using HTPs among participants who ever heard about these products—results of logistic regression analyses

	Wave 1 (N = 455)		Wave 2 (N = 979)	
	OR (CI)	Tests of model effects (P value)	OR (CI)	Tests of model effects (P value)
Country				
Germany	0.18 (0.05–0.68)	<0.001	1.92 (0.40–9.14)	<0.001
Greece	1.12 (0.42–2.93)		5.05 (1.15–22.20)	
Spain	2.08 (0.81–5.35)		3.40 (0.54–21.17)	
Romania	1.31 (0.40–4.26)		13.70 (3.20–58.64)	
Poland	0.70 (0.20–2.43)		4.35 (0.60–31.22)	
Hungary	Ref		Ref	
Wave of recruitment				
At wave 1	–		1.14 (0.63–2.06)	NS
At wave 2			Ref	
Age (years)				
18–24	2.36 (0.83–6.68)	<0.05	1.04 (0.49–2.17)	NS
25–39	1.63 (0.68–3.92)		1.05 (0.52–2.12)	
40–54	0.75 (0.34–1.63)		0.90 (0.45–1.78)	
>54	Ref		Ref	
Gender				
Male	0.98 (0.61–1.59)	NS	1.29 (0.82–2.02)	NS
Female	Ref		Ref	
Residence				
Urban	0.89 (0.40–1.99)	NS	2.50 (0.95–6.58)	NS
Intermediate	0.54 (0.25–1.19)		1.63 (0.65–4.07)	
Rural	Ref		Ref	
Smoking status				
Ex-smoker	–		0.56 (0.20–1.60)	NS
Occasional smoker	0.31 (0.13–0.70)	<0.01	0.24 (0.04–1.38)	
Daily smoker	Ref		Ref	
Quit attempts				
No	0.92 (0.50–1.16)	NS	0.41 (0.22–0.79)	<0.01
Yes	Ref		Ref	
Ever use of e-cigarettes				
Yes	3.57 (1.96–6.48)	<0.001	2.89 (1.65–5.07)	<0.001
No	Ref		Ref	
Heated products less dangerous				
No/I do not know	–		0.35 (0.20–0.63)	<0.001
Yes			Ref	

Note: NS, non-significant; Ref, the reference group.

cigarettes might be a way of appealing to cigarette smokers who concurrently use these types of products.

This study is subject to several limitations. The sample attrition might lead to selection bias, but at Wave 2, it was included a replenishment sample that was sampled in the same way as Wave 1, while weights were used to assure samples are representative. Similar with other studies in the field of tobacco research, all the information relies on self-reports of smokers. Because of the main focus on cigarette smoking and e-cigarette use, the questionnaire included only a few questions regarding HTPs. The limited sample of people who have used HTPs might limit the potential to detect some associations. Furthermore, the sample only included adult cigarette smokers, and therefore findings may not be generalized to other populations, such as non-smokers. Future studies should continue to investigate opinions and behaviours regarding HTPs as well as factors which influence them.

Despite these limitations, this study offers insights into the behaviours and perceptions of European adult smokers regarding HTPs, a subject which is an important emerging issue in the field of tobacco control, while there is a paucity of published studies with regard to this. Moreover, to the best of our knowledge, this is the first study published until 2019 which has presented cross-country comparisons, as well as an assessment of trends of HTPs use in Europe.^{3,9,10} It shows that, despite the efforts of the tobacco industry to promote HTPs, awareness was still relatively limited in the six countries in 2018, with current use below 1%, suggesting that the market share of HTPs is still very low. However, we found an increase in both

awareness and ever use in <2 years and greater awareness and penetration among younger adults, which raises concerns regarding the future of these products in Europe.

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Key points

- This study offers insights into the behaviours and perceptions of European adult smokers from six countries regarding heated tobacco products (HTPs), presenting cross-country comparisons, as well as an assessment of trends of HTPs use in Europe between 2016 and 2018.
- Awareness and ever use was still relatively limited in the six countries in 2018, with current use below 1%, suggesting that the market share of HTPs is still very low.
- The study found an increase in both awareness and ever use of HTPs among European cigarette smokers in <2 years and greater awareness and penetration among younger adults, which raises concerns regarding the future of these products in Europe.
- There were noticed several country differences, with Greece and Romania being the countries with the highest ever use and current use of HTPs in 2018.

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