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How do Europeans quit using tobacco, e-cigarettes and heated tobacco products? A cross-sectional analysis in 28 European countries

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ABSTRACT

Objectives: While smoking tobacco remains a substantial cause of harm in Europe, novel products such as e-cigarettes (EC) and Heated Tobacco Products (HTP) have entered the market in recent years. While debate still persists over the role of these novel products, they are now in widespread use. The aim of this study was to explore prevalence and methods of attempts to quit EC and HTP.

Setting: We analysed the 2020 Eurobarometer survey which collected data in 27 European Union Member States and the UK.

Participants: A representative sample of individuals residing in these countries aged ≥15 years.

Primary and secondary outcome measures: Multi-level regression analyses were performed to assess differences in quit attempts and cessation methods among tobacco smokers and exclusive EC/HTP users separately.

Results: 51.1% of current tobacco smokers and 27.1% of exclusive EC or HTP users reported having ever made a quit attempt. The majority of former and current smokers (75.8%) who made a quit attempt did so unassisted, with 28.8% reporting at least one attempt with the use of a cessation aid. The most popular cessation aids were NRT or other medication (13.4%) and e-cigarettes (11.3%). 58.8% of exclusive EC or HTP users who had made a quit attempt did so unassisted, with 39.5% reporting the use of a cessation aid.

Conclusions: Most EC and HTP users in Europe try to quit unassisted, although more of them report use of a cessation aid compared to tobacco smokers. Cessation support services should take into consideration the increasing numbers of users of EC and HTP who may be trying to quit.

What this paper adds

- 51.1% of current tobacco smokers and 27.1% of exclusive e-cigarette or heated tobacco product users reported having ever made a quit attempt across 20 European countries in 2020.

- The majority of users of smoking tobacco (75.8%) and of e-cigarette/heated tobacco users (58.8%) have tried to quit unassisted.

- There were substantial differences in past use of cessation methods by age and financial difficulties, with younger people more likely to have used e-cigarettes, heated tobacco products or smokeless tobacco when trying to quit using e-cigarettes/heated tobacco products.

Strengths and limitations of the study

- This is the first study to analyse quitting behaviours among e-cigarette and heated tobacco products users and compare them with smoking cessation in multiple European countries.
- Samples were nationally representative and the questionnaire consistent across countries.
- Sample sizes in individual countries were relatively small, so we pooled data from 28 countries. Hence, findings may not reflect the situation in each individual country.
- Dual users (who also smoked cigarettes) were not assessed in this analysis.

MAIN TEXT

INTRODUCTION

Tobacco continues to kill millions of people in Europe and globally [1]. While the prevalence of tobacco smoking has been declining in the European Union (EU) [2, 3], the popularity of Heated Tobacco Products (HTPs) and other nicotine products, such as electronic cigarettes (e-cigarettes, EC) is increasing [2, 4]. Overall, the prevalence of tobacco smoking, as well as e-cigarette and HTP use in Europe are among the highest in the world.

Despite their differences in technical design, e-cigarettes and HTP share many common characteristics such as their appealing packaging, variety of flavours, and novelty that make them popular among adolescents and young adults [5, 6]. Furthermore within the framework of the European Union (EU) Tobacco Products Directive (TPD) they are not subject to the same regulations as cigarettes and other tobaco products with regard to packaging, flavourings, labelling and taxation [7]. A key component of their promotion is the tobacco industry's claim that they are both products of 'reduced harm' compared to cigarettes although the evidence on their health effects is far from conclusive [8]. Within this context, e-cigarettes have become very popular among European smokers who are trying to quit smoking and recent data suggest that HTP are following a similar trajectory [2, 9, 10].

The public health community is divided over the role of novel tobacco and nicotine products. Public Health England, for example, has largely embraced a harm reduction approach in which e-cigarettes play a key role [11], whereas the European Respiratory Society has not endorsed harm reduction in tobacco control [12]. This discrepancy is a reflection of the conflicting evidence base, especially for e-cigarettes. For instance, there is mounting evidence that e-cigarettes may help some smokers to quit in clinical settings [13, 14], but not at the population level [14]. Daily use seems to increase the chances to quit

smoking, but non-daily use actually hinders cessation [14, 15]. The picture is further complicated by the fact that many of those who attempt to quit with e-cigarettes become dual or long-term users [16]. Regardless of perceptions on harm reduction and concerns around e-cigarette and HTP use among youth, it is widely accepted that none of these products is harmless. Therefore, from a public health perspective, the optimal outcome for all never and former smokers who use e-cigarette or HTP would be to eventually stop using them and become nicotine-free.

However, little is known about cessation of e-cigarette and HTP use, especially among people who do not concurrently use cigarettes. These products remain quite popular in Europe, although many users are trying to quit within an environment of strong tobacco control policies. Hence, Europe is a unique setting to explore quitting behaviours of e-cigarette or/and HTP users. The aim of our secondary dataset analysis was to assess factors associated with attempts to quit and the use of cessation aids among HTP and e-cigarette users, as well as tobacco smokers in the 27 EU Member States (MS) and the United Kingdom (UK).

METHODS

Data source

All data come from the Eurobarometer survey, wave 93.2, which were collected in August-September 2020. Eurobarometer surveys collect data from the 27 EU MS and the UK) through a multi-stage sampling design in which primary sampling units (PSU) are selected from each region within each country, proportional to population size. Within each PSU, starting addresses are selected randomly and a standard random route is followed to systematically select participating households. Data are then collected through a face-to-face interview with a randomly selected person aged ≥15 years in each household. This approach was modified in some of the countries due to COVID-19 restrictions. Thus, all interviews were conducted online in Estonia, Finland, Ireland, Luxembourg, Sweden and the United Kingdom, while data were collected through a mix of online and face-to-face interviews in Belgium, Denmark, Spain, Netherlands. In all cases, the online samples were selected through a probabilistic design [2]. Post-stratification and population size weighting is applied to ensure that samples are nationally representative in terms of age, sex, and area of residence. The total sample was 28,300 participants across the 28 countries.

Measures

Tobacco Smoking, HTP and e-cigarette use

Interviewees were asked “Regarding smoking cigarettes, cigars or a pipe, which of the following applies to you?”. Responses included “You currently smoke” (current smokers); “You used to smoke but you have stopped” (former smokers); and “You have never smoked” (never smokers).

All participants were asked “Thinking about the following products [heated tobacco products; e-cigarettes], which of the following applies to you?”. Responses were given separately for HTP and e-

cigarettes and included “You currently use it” (current users); “You used to use it but you have stopped” (former users); “You have tried only once or twice”; “You have never used it”; “Don’t Know”.

Quitting

Former and never smokers who reported current use of HTP or e-cigarettes (‘exclusive HTP or e-cigarette users’) were asked if they had ever tried to stop using e-cigarettes or HTPs. Those who responded “Yes, in the last 12 months” or “Yes, more than a year ago” were considered to have made a quit attempt, although it was not specified if this referred to e-cigarettes or HTP. Similarly, current tobacco smokers were asked if they had ever tried to quit smoking with the same response options.

E-cigarette or HTP users who did make a quit attempt, as well as all former users of e-cigarettes and HTP were further asked what they used to stop or to try to stop using e-cigarettes or HTP. They could select multiple answers from the following: “Nicotine replacement medication (like nicotine gum, patch or inhaler) or other medication”; “Oral tobacco (snus), chewing tobacco or nasal tobacco (snuff)”; “Medical support or stop smoking services (such as a quitline)”; “You stopped or you tried to stop without assistance”; “Electronic cigarettes or any similar device”; and “Heated tobacco products”. The e-cigarette option was not presented to current e-cigarette users and the HTP option was not presented to current HTP users. All former smokers as well as current smokers who reported a past quit attempt were asked what they used to stop or to try to stop smoking and were given the same options.

Socio-demographic data

The survey collected data on age (15-24; 25-39; 40-54; and ≥55 years), sex (male; female), education: (up to lower secondary; upper secondary; tertiary up to bachelor; masters degree or above), difficulties

to pay bills during the last twelve months (almost never/never; and from time to time/most of the time) and area of residence (rural; and urban).

Statistical analysis

We fitted two-level multivariable logistic regression models with random intercepts, which accounted for clustering of observations within countries to explore factors associated with i) having tried to quit e-cigarettes or HTP among current exclusive e-cigarette or HTP users and ii) having tried to quit smoking among current smokers. The independent variables included in the models were sex, age, difficulty paying bills, area of residence and education.

We used similar, two-level models to identify associations between these sociodemographic factors and use of cessation aids among i) former e-cigarette or HTP users and current users who have tried to quit and ii) former smokers and current smokers who have tried to quit smoking. We applied the official Eurobarometer weights for descriptive analyses to account for the sampling design. Descriptive results are presented as weighted % with 95% Confidence Intervals (95% CI). Regression results are presented as adjusted Odds Ratios (aOR) with 95% CI. All analyses were conducted using StataSE 15.0 (College Station, TX: StataCorp LLC).

Patient and Public Involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS

Among the Eurobarometer sample of 28,300 respondents from 27 EU MS and the UK there were 6,661 current smokers and 9,889 ever smokers who have ever attempted to quit smoking . There were also 1,103 respondents who had ever attempted or succeeded to quit e-cigarettes or HTP. A total of 284 respondents were exclusive e-cigarette or HTP users. Sample characteristics are presented in Supplementary Table 1.

Among current tobacco smokers, 51.1% (n=3,369) reported having made a previous attempt to stop smoking. Those aged 15-24 (aOR 0.44; 95% CI 0.36-0.55) and 25-39 years (aOR 0.78; 95% CI 0.68-0.90) were less likely to have attempted to quit smoking compared to those 55+ years old. Similarly, smokers with higher education were more likely to report an attempt to quit compared to those in the lowest educational category, as were males compared to females (Table 1).

Among current exclusive e-cigarette or HTP users, 27.1 % (n=69) reported having made an attempt to quit these products (Table 1). Compared to users aged 55 years or more, younger users were more likely to have attempted to quit e-cigarette or/and HTP products (aOR for 15-24 year-olds 7.34; 95% CI 2.48-21.71). All other socio-demographic factors assessed were not statistically significantly associated with having attempted to quit among exclusive e-cigarette or/and HTP users.

Methods used to quit or attempt to quit

Three quarters of ever smokers who had attempted to quit, reported having done so without assistance (75.8%), with 28.8% reporting the use of a cessation aid in at least one quit attempt. The most popular cessation aids were nicotine replacement therapy (NRT) or other pharmacotherapy (13.4%) followed by e-cigarettes (11.3%) (Table 2). Only 2% of those who had attempted to quit smoking tobacco reported

using HTP as a cessation aid. Among those who had attempted or ever succeeded to quit e-cigarettes or HTP, 58.8% tried without assistance and 39.5% used at least one cessation aid. Within this group, using e-cigarettes was the most popular option (19.7%) followed by NRT or other pharmacotherapy (10.1%). HTP were used as a cessation aid by 5.3% of the respondents within this group of e-cigarettes/HTP users (Table 2). In both groups, just above 6% of the respondents had sought support from medical or smoking cessation services.

Sociodemographic factors associated with methods to quit

Younger people (compared to those 55+ years old) were generally more likely to have used e-cigarettes, HTP or smokeless tobacco to quit tobacco smoking; however this pattern was not observed in quitting e-cigarettes or HTP. In both groups, those 25-39 years old were the least likely to seek medical support to quit (aOR 0.62 for smoking and aOR 0.42 for e-cigarettes/HTP) (Tables 3 and 4). Males were more likely to have used smokeless tobacco to quit all products, but no other statistically significant differences between males and females were observed. People with difficulties paying bills had higher odds of having used e-cigarettes to quit smoking (aOR 1.41) and having used HTP to quit e-cigarettes (aOR 2.70) compared to those with no financial difficulties. Finally, people at the highest educational level were the least likely to have used e-cigarettes to quit smoking and HTP, while those living in urban areas were more likely -compared to rural areas- to have used NRT or other pharmacotherapy to quit smoking (OR 1.19) or e-cigarettes/HTP (OR 1.78)(Tables 3 and 4).

DISCUSSION

Our analysis of data from 28 European countries showed that around half of current tobacco smokers and a quarter of current e-cigarette/HTP users have attempted to quit. Among them, 3 out of 10 tobacco smokers and 4 out of 10 e-cigarette/HTP users used a cessation aid, with e-cigarettes and pharmacotherapy being the most popular aids in both groups. Younger users were less likely to have attempted to quit smoking, but more likely to have attempted to quit e-cigarettes/HTP compared to older users. We also found sociodemographic differences in the frequency and type of cessation aids used.

Only 27.1% of current e-cigarette/HTP users -who were not concurrently smoking- reported a past attempt to quit compared to 51.1% of current smokers. This group excludes the many users of novel tobacco products who also smoke tobacco (dual users), therefore is not directly comparable to current smokers in our study; however, the proportion of e-cigarette/HTP users who had tried to quit was objectively low. This can be partly explained by the fact that e-cigarette/HTP users are younger on average than smokers, but even in the younger age group (15-24 years old) more smokers than e-cigarette/HTP users had tried to quit (36.1% vs 28.1%). This discrepancy may be in part due to perceptions of harm about different products. The majority of smokers want to quit and many have tried to as the health risks associated with smoking are well known [17]. Novel tobacco products are perceived as less harmful than cigarettes by a substantial proportion of those who use them [2, 18], which may weaken their incentive to quit entirely. Within this context, messaging to quit novel tobacco products should be part of tobacco control policies in Europe.

Although relatively few e-cigarette/HTP users had tried to quit, almost 40% of those who did used a cessation method. This was much higher than among ever smokers (current and former) in our study, as well as in previous studies in the EU and internationally [9, 19]. Many of the e-cigarette/HTP users in this

analysis may have been former smokers who initially resorted to other nicotine products to quit smoking, therefore could be more inclined to use a cessation method again, especially by transitioning to another novel product. There is broad consensus regarding the effectiveness of pharmacotherapy and health professional support for smoking cessation, but -to the authors' knowledge- there are no studies that examine these cessation methods within the context of quitting e-cigarette or HTP use [20-22]]. Our findings show that there is a considerable proportion of e-cigarette/HTP users who are trying to quit and are open to using cessation aids. Thus, smoking cessation services need to prepare for a potentially more diverse group of nicotine users who may require support. Nevertheless, the majority of both smokers and e-cigarette/HTP users reported trying to quit without any aid and only a minority of respondents used medication or medical services, which highlights the pressing need for expansion of cessation support across Europe, along with a wider set of tobacco control policies which are known to encourage people to quit with or without cessation aids [3].

We found that education and financial constraints were associated with attempting to quit and use of cessation methods. People with lower education level or/and those who had difficulties paying bills were less likely to try to quit smoking and use pharmacotherapy to quit e-cigarette/HTP, as well as more likely to use e-cigarettes to quit smoking and HTP to quit e-cigarettes. These inequalities are not surprising; poor access of vulnerable populations to smoking cessation in Europe and elsewhere is a well-established problem [23, 24] and socioeconomic differences in smoking and novel tobacco and nicotine product use have been shown in Europe before [2, 4, 25, 26]. Although HTP use is less prevalent among financially vulnerable groups in Europe and the US [26, 27] individuals facing financial problems may be more likely to switch to HTP to quit e-cigarette use due to poor accessibility to medical services.

Strengths and limitations

Our analysis was conducted in a sample pooled from 28 countries which differ in terms of smoking prevalence, regulations, taxation, tobacco control policies, attitudes towards novel tobacco products and quitting behaviours [1, 2, 28, 29]. As a result, findings from this study may not reflect the situation in each individual country. To our knowledge, this is the first study to analyse quitting behaviours among e-cigarette and HTP users and compare them with smoking cessation in European countries and hence provides original groundwork data across many countries to be further built upon. The number of respondents who were current e-cigarette/HTP users or who have attempted to quit was relatively small, thus analysis by country or within more specific subgroups was not feasible and confidence intervals among current users were wide. However, the samples were representative and the methodology was largely consistent across all countries, although some adjustments were necessary due to COVID-19 restrictions. Our analyses were also limited by the fact that the Eurobarometer questionnaire did not distinguish between e-cigarettes and HTP and did not assess quitting attempts among people concurrently using cigarettes (dual users). Therefore our findings may not be generalizable to all users of e-cigarettes and HTP. Separating HTP and e-cigarettes in survey questions and assessing in detail dual and poly-users is becoming increasingly essential considering their popularity. Finally due to the cross sectional study design, we were are only able to indicate associations but not causality.

Conclusion

In this analysis of data from 28 European countries, we found that a quarter of novel tobacco and nicotine users had tried to quit and a substantial proportion of them used a cessation aid. This is a positive finding, although the proportion of those who had attempted to quit was lower than among current tobacco smokers. Product experimentation is increasing; however, currently there is no evidence-based approach to quitting e-cigarettes and HTPs as cessation services primarily remain targeted to tobacco smoking cessation. Our findings indicate populations that may be more receptive to

cessation and hence motivate the tobacco control community to provide cessation support to users of all novel products and researchers to further explore quitting behaviours among different subgroups of e-cigarette and HTP users.

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FTF had the key role in study conception and design. FTF, MLEA and AAL contributed to the data analysis. FTF, AAL, CIV and MLEA contributed to data interpretation, drafting and reviewing the manuscript.

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Table 1. Sociodemographic factors associated with attempts to quit smoking among exclusive tobacco user and exclusive e-cigarette or heated tobacco products users in 28 European countries, in 2020.

	Attempted to quit smoking		Attempted to quit e-cigarette or HTP	
	N (weighted %)	**aOR (95% CI)**	**N (weighted %)**	**aOR (95% CI)**
	N=6,661	**N=6,604**	**N=284**	**N=283**
Age				
55+ years (ref)	1,234 (55.2)	1.00	7 (10.2)	1.00
40-54 years	1,070 (52.7)	1.00 (0.88 – 1.14)	21 (36.7)	4.25 (1.53 – 11.79)
25-39 years	871 (50.8)	0.78 (0.68 – 0.90)	24 (32.4)	4.09 (1.53 – 10.94)
15-24 years	194 (36.1)	0.44 (0.36 – 0.55)	16 (28.1)	7.34 (2.48 – 21.71)
Sex				
Female (ref)	1,617 (55.9)	1.00	28 (23.4)	1.00
Male	1,752 (47.2)	0.90 (0.81 – 1.00)	41 (29.8)	1.18 (0.64 – 2.18)
Difficulty paying bills				
Never/almost never (ref)	2,041 (52.4)	1.00	39 (26.0)	1.00
From time to time/most of the time	1,307 (48.9)	0.94 (0.84 – 1.05)	30 (30.3)	1.59 (0.85 – 2.98)
Highest level of education completed				
Lower secondary or lower (ref)	762 (50.2)	1.00	11 (26.0)	1.00
Upper secondary	1,644 (46.9)	1.12 (0.98 – 1.29)	25 (31.6)	0.87 (0.35 – 2.15)
Tertiary up to bachelor	632 (57.4)	1.21 (1.01 – 1.45)	24 (23.6)	0.86 (0.33 – 2.26)
Masters or above	331 (63.6)	1.27 (1.02 – 1.58)	9 (22.6)	1.24 (0.38 – 4.03)
Area of residence				
Rural (ref)	1,057 (48.8)	1.00	18 (22.8)	1.00
Urban	2,309 (52.0)	1.04 (0.93 – 1.16)	51 (28.5)	0.95 (0.47 – 1.89)
Total	**3,369 (51.1)**		**69 (27.1)**	

aOR=adjusted Odds Ratios from multilevel logistic regression models, adjusting for all variables included in the table.

Individuals with missing data in any of the included variables were excluded from the regression analyses.

Table 2. Methods used in cessation of tobacco and e-cigarettes/ heated tobacco products in 28 European countries

	Cessation by ever smokers		Cessation by E-cigarettes or HTP users[a]	
	N	Weighted % (95% CI)	N	Weighted % (95% CI)
Nicotine replacement therapy or other pharmacotherapy	1,298/9,889	13.4 (12.2 – 14.6)	123/1,103	10.1 (7.5 – 13.4)
Electronic cigarettes or any similar device	842/9,889	11.3 (10.2 – 12.5)	210/1,059	19.7 (15.9 – 24.2)
Heated tobacco products	220/9,889	2.0 (1.6 – 2.6)	56/1,050	5.2 (3.5 – 7.9)
Smokeless tobacco	192/9,889	1.5 (1.2 – 1.9)	37/1,103	2.1 (1.2 – 3.6)
Medical support or stop smoking services	555/9,889	6.3 (5.5 – 7.2)	68/1,103	6.1 (4.0 – 9.1)
Without assistance	7,681/9,889	75.8 (74.3 – 77.3)	657/1,103	58.8 (53.7 – 63.7)
Any aid	2,636/9,889	28.8 (27.2 – 30.4)	453/1,103	39.5 (34.7 – 44.6)

[a] Percentages shown among current e-cigarette or heated tobacco products users who have tried to quit and former users.

Table 3. Sociodemographic factors associated with methods to quit e-cigarettes or heated tobacco products.

		Pharmacotherapy OR (95% CI)	E-cigarettes OR (95% CI)	Heated tobacco products OR (95% CI)	Smokeless tobacco OR (95% CI)	Medical support OR (95% CI)	Without assistance OR (95% CI)	Any aid OR (95% CI)
		N=1,095	N=1,057	N=1,043	N=1,095	N=1,095	N=1,095	N=1,095
Age								
	55+ years (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	40-54 years	0.97 (0.59 - 1.59)	1.64 (1.07 - 2.52)	0.82 (0.35 - 1.91)	0.96 (0.31 - 2.99)	1.04 (0.57 - 1.92)	1.00 (0.71 - 1.41)	1.13 (0.81 - 1.59)
	25-39 years	0.59 (0.35 - 0.99)	1.21 (0.78 - 1.88)	0.86 (0.38 - 1.95)	2.20 (0.80 - 6.08)	0.42 (0.20 - 0.86)	1.15 (0.82 - 1.61)	0.88 (0.62 - 1.23)
	15-24 years	0.61 (0.30 - 1.23)	0.95 (0.53 - 1.71)	1.83 (0.75 - 4.48)	1.55 (0.46 - 5.27)	0.50 (0.19 - 1.31)	1.52 (0.97 - 2.37)	0.70 (0.45 - 1.09)
Sex								
	Female (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Male	0.98 (0.67 - 1.44)	0.84 (0.61 - 1.15)	0.67 (0.38 - 1.18)	3.15 (1.38 - 7.20)	0.98 (0.59 - 1.62)	1.03 (0.80 - 1.32)	1.03 (0.80 - 1.32)
Difficulty paying bills								
	Never/almost never (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	From time to time/most of the time	1.24 (0.82 - 1.85)	1.13 (0.80 - 1.58)	2.70 (1.47 - 4.96)	0.92 (0.43 - 1.98)	1.35 (0.79 - 2.30)	0.96 (0.73 - 1.25)	1.37 (1.05 - 1.79)
Education								
	Lower secondary or lower (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Upper secondary	1.20 (0.67 - 2.16)	0.99 (0.65 - 1.52)	1.18 (0.54 - 2.60)	0.68 (0.26 - 1.77)	1.53 (0.74 - 3.16)	0.98 (0.69 - 1.40)	1.09 (0.77 - 1.54)
	Tertiary up to bachelor	2.34 (1.28 - 4.30)	0.83 (0.51 - 1.35)	1.15 (0.44 – 3.00)	0.52 (0.17 - 1.54)	1.11 (0.48 - 2.58)	0.89 (0.60 - 1.32)	1.22 (0.83 - 1.80)
	Masters or above	1.10 (0.49 - 2.48)	0.48 (0.24 - 0.97)	1.07 (0.31 - 3.75)	0.18 (0.02 - 1.61)	1.49 (0.56 - 3.96)	1.15 (0.70 - 1.90)	0.65 (0.39 - 1.09)
Area of residence								
	Rural (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Urban	1.78 (1.09 - 2.90)	1.04 (0.73 - 1.48)	0.97 (0.49 - 1.90)	2.95 (0.99 - 8.83)	0.84 (0.48 - 1.46)	0.97 (0.73 - 1.29)	1.20 (0.90 - 1.60)

OR= adjusted Odds Ratios from multilevel logistic regression models.

Regression models fitted among those who have attempted or succeeded to quit e-cigarettes or HTP.

Table 4. Sociodemographic factors associated with methods to quit smoking among ever smokers (n=9,828), in 27 EU MS and the UK, 2020.

		Medication OR (95% CI)	E-cigarettes OR (95% CI)	Heated tobacco products OR (95% CI)	Smokeless tobacco OR (95% CI)	Medical support OR (95% CI)	Without assistance OR (95% CI)	Any aid OR (95% CI)
Age								
	55+ years (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	40-54 years	1.49 (1.29 – 1.71)	2.30 (1.91 – 2.78)	2.92 (1.96 – 4.36)	2.45 (1.62 – 3.69)	1.00 (0.81 – 1.23)	0.66 (0.58 – 0.74)	1.62 (1.45 – 1.81)
	25-39 years	1.03 (0.87 – 1.23)	3.11 (2.56 – 3.79)	4.96 (3.34 – 7.37)	3.83 (2.52 – 5.82)	0.62 (0.47 – 0.81)	0.69 (0.60 – 0.79)	1.58 (1.39 – 1.80)
	15-24 years	0.51 (0.34 – 0.76)	2.61 (1.88 – 3.64)	7.23 (4.27 – 12.26)	7.24 (3.99 – 13.11)	0.59 (0.34 – 1.01)	0.74 (0.58 – 0.94)	1.43 (1.14 – 1.81)
Sex								
	Female (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Male	0.88 (0.78 – 0.99)	0.95 (0.82 – 1.10)	1.14 (0.87 – 1.51)	2.85 (2.02 – 4.02)	0.74 (0.62 – 0.88)	1.06 (0.96 – 1.17)	0.98 (0.89 – 1.07)
Difficulty paying bills								
	Never/almost never (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	From time to time/most of the time	1.24 (1.08 – 1.43)	1.41 (1.20 – 1.66)	1.22 (0.90 – 1.64)	1.25 (0.84 – 1.85)	1.16 (0.94 – 1.43)	0.81 (0.72 – 0.90)	1.26 (1.13 – 1.40)
Education								
	Lower secondary or lower (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Upper secondary	1.06 (0.88 – 1.26)	1.15 (0.93 – 1.42)	1.09 (0.71 – 1.67)	1.12 (0.69 – 1.82)	0.92 (0.72 – 1.17)	0.95 (0.82 – 1.09)	1.14 (1.00 – 1.31)
	Tertiary up to bachelor	1.08 (0.89 – 1.31)	1.06 (0.83 – 1.34)	1.43 (0.88 – 2.31)	0.86 (0.50 – 1.49)	1.04 (0.79 – 1.36)	0.95 (0.82 – 1.12)	1.14 (0.98 – 1.32)
	Masters or above	0.85 (0.68 – 1.07)	0.67 (0.50 – 0.90)	1.28 (0.74 – 2.21)	0.44 (0.22 – 0.91)	0.89 (0.65 – 1.23)	1.36 (1.13 – 1.64)	0.75 (0.63 – 0.90)
Area of residence								
	Rural (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Urban	1.19 (1.04 – 1.36)	1.05 (0.89 – 1.24)	1.16 (0.84 – 1.59)	1.00 (0.70 – 1.43)	1.07 (0.88 – 1.30)	0.94 (0.85 – 1.05)	1.09 (0.99 – 1.21)

OR= adjusted Odds Ratios from multilevel logistic regression models.

Regression models fitted among those who have attempted or succeeded to quit smoking.

Supplementary Table 1. Sample characteristics.

	Smoking		E-cigarettes or HTP	
	Have attempted or succeeded to quit N (weighted %)	**Current smokers N (weighted %)**	**Have attempted or succeeded to quit N (weighted %)**	**Current users N (weighted %)**
Age				
55+ years	5,020 (46.3)	2,236 (30.7)	289 (20.3)	78 (25.0)
40-54 years	2,595 (27.2)	2,046 (29.3)	316 (29.3)	76 (24.8)
25-39 years	1,862 (21.2)	1,819 (2.3)	357 (36.5)	89 (30.3)
15-24 years	410 (5.4)	560 (10.7)	141 (13.9)	40 (19.8)
Sex				
Female	4,462 (44.7)	3,067 (45.1)	502 (43.5)	123 (41.8)
Male	5,427 (55.3)	3,594 (54.9)	601 (56.5)	161 (58.2)
Difficulty paying bills				
Never/almost never	6,954 (69.6)	3,759 (57.5)	673 (57.1)	188 (70.8)
From time to time/most of the time	2,883 (30.4)	2,852 (42.5)	422 (42.9)	94 (29.2)
Education				
Lower secondary or lower	2,069 (28.3)	1,567 (29.5)	213 (28.5)	47 (25.7)
Upper secondary	4,116 (36.4)	3,436 (44.8)	500 (38.5)	108 (38.0)
Tertiary up to bachelor	2,292 (21.2)	1,088 (16.5)	274 (22.4)	95 (23.8)
Masters or above	1,409 (14.1)	566 (9.3)	116 (10.6)	34 (12.4)
Area of residence				
Rural	3,151 (28.8)	2,097 (27.4)	292 (23.7)	73 (24.4)
Urban	6,734 (71.2)	4,560 (72.6)	811 (76.3)	211 (75.6)
Smoking				
Never smoker	-	-	61 (6.3)	42 (21.5)
Current smoker	3,368 (35.0)	6,661 (100.0)	601 (56.8)	-
Former smoker	6,521 (65.0)	-	440 (36.9)	242 (78.5)
Total	**9,889 (100)**	**6,661 (100)**	**1,103 (100)**	**284 (100)**

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1	
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3	
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4	
Objectives	3	State specific objectives, including any prespecified hypotheses	5	
Methods				
Study design	4	Present key elements of study design early in the paper	6	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6	
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6	
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case		
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6,	
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6,*	
Bias	9	Describe any efforts to address potential sources of bias	8	
Study size	10	Explain how the study size was arrived at	6,	

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7, 8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	8
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	9
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	9
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	n/a
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time *Case-control study*—Report numbers in each exposure category, or summary measures of exposure *Cross-sectional study*—Report numbers of outcome events or summary measures	*9, 10*
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9, 10
		(*b*) Report category boundaries when continuous variables were categorized	n/a
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a

Continued on next page

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13
Generalisability	21	Discuss the generalisability (external validity) of the study results	12, 13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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How do Europeans quit using tobacco, e-cigarettes and heated tobacco products? A cross-sectional analysis in 28 European countries

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How do Europeans quit using tobacco, e-cigarettes, and heated tobacco products? A cross-sectional analysis in 28 European countries

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ABSTRACT

Objectives: While smoking tobacco remains a substantial cause of harm in Europe, novel products such as e-cigarettes (EC) and Heated Tobacco Products (HTP) have entered the market recently. While debate still persists over the role of these novel products, they are now in widespread use. This study aimed to explore prevalence and methods of attempts to quit EC and HTP.

Setting: We analysed the 2020 Eurobarometer survey, which collected data in 28 European countries.

Participants: A representative sample of individuals residing in these countries aged ≥15 years.

Primary and secondary outcome measures: Multi-level regression analyses were performed to assess differences in quit attempts and cessation methods among tobacco smokers and exclusive EC/HTP users separately.

Results: 51.1% of current tobacco smokers and 27.1% of exclusive EC or HTP users reported having ever made a quit attempt. The majority of former and current smokers (75.8%) who made a quit attempt did so unassisted, with 28.8% reporting at least one attempt using a cessation aid. The most popular cessation aids were NRT or other medication (13.4%) and e-cigarettes (11.3%). 58.8% of exclusive EC or HTP users who had made a quit attempt did so unassisted, with 39.5% reporting the use of a cessation aid.

Conclusions: Most EC and HTP users in Europe try to quit unassisted, although more of them report use of a cessation aid compared to tobacco smokers. Cessation support services should take into consideration the increasing numbers of users of EC and HTP who may be trying to quit.

Data Availability Statement

All data used in this analysis is publicly available at https://www.gesis.org/en/eurobarometer-data-service/home.

Strengths and limitations of the study

- This is the first study to analyse quitting behaviours among e-cigarette and heated tobacco products users and compare them with smoking cessation in multiple European countries.
- Samples were nationally representative and the questionnaire consistent across countries.
- Sample sizes in individual countries were relatively small, so we pooled data from 28 countries. Hence, findings may not reflect the situation in each individual country.
- Dual users (who also smoked cigarettes) were not assessed in this analysis.

MAIN TEXT

INTRODUCTION

Tobacco continues to kill millions of people in Europe and globally [1]. While the prevalence of tobacco smoking has been declining in the European Union (EU) [2, 3], the popularity of Heated Tobacco Products (HTPs) and other nicotine products, such as electronic cigarettes (e-cigarettes, EC), is increasing [2, 4]. Overall, the prevalence of tobacco smoking, as well as e-cigarette and HTP use in Europe, are among the highest in the world.

Despite their differences in technical design, e-cigarettes and HTP share many common characteristics such as their appealing packaging, variety of flavours, and novelty that make them popular among adolescents and young adults [5, 6]. Furthermore within the framework of the European Union (EU) Tobacco Products Directive (TPD) they are not subject to the same regulations as cigarettes and other tobacco products with regard to packaging, flavourings, labeling and taxation [7]. A key component of their promotion is the tobacco industry's claim that they are both products of 'reduced harm' compared to cigarettes although the evidence on their health effects is far from conclusive [8]. In this context, e-cigarettes have become very popular among European smokers who are trying to quit smoking and recent data suggest that HTP are following a similar trajectory [2, 9, 10].

The public health community is divided over the role of novel tobacco and nicotine products. Public Health England, for example, has largely embraced a harm reduction approach in which e-cigarettes play a key role [11].In contrast, the European Respiratory Society has not endorsed harm reduction in tobacco control [12]. This discrepancy reflects of the conflicting evidence base, especially for e-cigarettes. For instance, there is mounting evidence that e-cigarettes may help some smokers to quit in clinical settings [13, 14], but not at the population level [14]. Daily use seems to increase the chances to

quit smoking, but non-daily use actually hinders cessation [14, 15]. The picture is further complicated by the fact that many of those who attempt to quit with e-cigarettes become dual or long-term users [16]. Regardless of perceptions on harm reduction and concerns around e-cigarette and HTP use among youth, it is widely accepted that none of these products is harmless. Therefore, from a public health perspective, the optimal outcome for all never and former smokers who use e-cigarettes or HTP would be to stop using them and become nicotine-free eventually.

However, little is known about e-cigarette and HTP use cessation, especially among people who do not concurrently use cigarettes. These products remain quite popular in Europe, although many users are trying to quit within an environment of strong tobacco control policies. Hence, Europe is a unique setting to explore quitting behaviours of e-cigarette or/and HTP users. The aim of our secondary dataset analysis was to assess factors associated with attempts to quit and the use of cessation aids among HTP and e-cigarette users, as well as tobacco smokers in 28 European countries.

METHODS

Data source

All data come from the Eurobarometer survey, wave 93.2, which were collected in August-September 2020 [17]. Eurobarometer surveys collect data from the 27 EU member states and the United Kingdom which is a former member of the EU through a multi-stage sampling design in which primary sampling units (PSU) are selected from each region within each country, proportional to population size. Within each PSU, starting addresses are selected randomly and a standard random route is followed to systematically select participating households. Data are then collected through a face-to-face interview with a randomly selected person aged ≥15 years in each household. This approach was modified in some of the countries due to COVID-19 restrictions. Thus, all interviews were conducted online in Estonia, Finland, Ireland, Luxembourg, Sweden and the United Kingdom, while data were collected through a mix of online and face-to-face interviews in Belgium, Denmark, Spain, Netherlands. In all cases, the online samples were selected through a probabilistic design [2]. Response rates, overall or by country, are not reported in the Eurobarometer; however, post-stratification and population size weighting is applied to ensure that samples are nationally representative in terms of age, sex, and area of residence. The total sample was 28,300 participants across the 28 countries.

Measures

Tobacco Smoking, HTP and e-cigarette use

Interviewees were asked “Regarding smoking cigarettes, cigars or a pipe, which of the following applies to you?”. Responses included “You currently smoke” (current smokers); “You used to smoke but you have stopped” (former smokers); and “You have never smoked” (never smokers).

All participants were asked “Thinking about the following products [heated tobacco products; e-cigarettes], which of the following applies to you?”. Responses were given separately for HTP and e-cigarettes and included “You currently use it” (current users); “You used to use it but you have stopped” (former users); “You have tried only once or twice”; “You have never used it”; “Don’t Know”.

Quitting

Former and never smokers who reported current use of HTP or e-cigarettes (‘exclusive HTP or e-cigarette users’) were asked if they had ever tried to stop using e-cigarettes or HTPs. Those who responded “Yes, in the last 12 months” or “Yes, more than a year ago” were considered to have made a quit attempt, although it was not specified if this referred to e-cigarettes or HTP. Similarly, current tobacco smokers were asked if they had ever tried to quit smoking with the same response options.

E-cigarette or HTP users who did make a quit attempt, as well as all former users of e-cigarettes and HTP, were further asked what they used to stop or to try to stop using e-cigarettes or HTP. For each of the following categories they could answer “Yes” or “No”: “Nicotine replacement medication (like nicotine gum, patch or inhaler) or other medication”; “Oral tobacco (snus), chewing tobacco or nasal tobacco (snuff)”; “Medical support or stop smoking services (such as a quitline)”; “You stopped or you tried to stop without assistance”; “Electronic cigarettes or any similar device”; and “Heated tobacco products”. The e-cigarette option was not presented to current e-cigarette users and the HTP option was not presented to current HTP users. All former smokers and current smokers who reported a past quit attempt were asked what they used to stop or to try to stop smoking and were given the same options.

Socio-demographic data

The survey collected data on age (15-24; 25-39; 40-54; and ≥55 years), sex (male; female), education: (up to lower secondary; upper secondary; tertiary up to bachelor; masters degree or above), difficulties to pay bills during the last twelve months (almost never/never; and from time to time/most of the time) and area of residence (rural; and urban).

Statistical analysis

We fitted two-level multivariable logistic regression models with random intercepts, which accounted for clustering of observations within countries with different levels of cigarette, e-cigarette, and HTP use to explore factors associated with i) having tried to quit e-cigarettes or HTP among current exclusive e-cigarette or HTP users and ii) having tried to quit smoking among current smokers. The independent variables included in the models were sex, age, difficulty paying bills, area of residence, and education.

We used similar, two-level models to identify associations between these sociodemographic factors and use of cessation aids among i) former e-cigarette or HTP users and current users who have tried to quit and ii) former smokers and current smokers who have tried to quit smoking. We applied the official Eurobarometer weights ("weight EU28") for descriptive analyses to account for the sampling design and produce estimates that are representative for each country and the 28 countries as a whole [18]. Regression analyses were unweighted as it has been suggested that unweighted regression models may provide more robust results [19, 20]. Descriptive results are presented as weighted % with 95% Confidence Intervals (95% CI). Regression results are presented as adjusted Odds Ratios (aOR) with 95% CI. All analyses were conducted using StataSE 15.0 (College Station, TX: StataCorp LLC).

Patient and Public Involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

Ethics approval

No ethics approval was required as all data used were anonymised and publicly available.

RESULTS

Among the Eurobarometer sample of 28,300 respondents from 28 countries there were 6,661 current smokers, 6,529 former smokers, and 895 current users of e-cigarettes or/and HTPs (609 of whom reported also smoking cigarettes). In total, 9,889 ever smokers had ever attempted or succeeded to quit smoking. There were also 1,103 respondents who had ever attempted or succeeded to quit e-cigarettes or HTP. A total of 284 respondents were exclusive e-cigarette or HTP users. Sample characteristics are presented in Supplementary Table 1. Missing data were <0.1% in all variables with the exception of current e-cigarette and HTP use, where missing data were <1%.

Among current tobacco smokers, 51.1% (n=3,369) reported having made a previous attempt to stop smoking. Those aged 25 years or older were more likely to have attempted to quit smoking compared to those 15-24 years old. Similarly, smokers with higher education were more likely to report an attempt to quit compared to those in the lowest educational category, as were males compared to females (Table 1).

Among current exclusive e-cigarette or HTP users, 27.1 % (n=69) reported having made an attempt to quit these products (Table 1). Compared to users aged 15-24 years, those aged 55 and above were less likely to have attempted to quit e-cigarette or/and HTP products (aOR 0.14; 95% CI 0.05-0.40). All other socio-demographic factors assessed were not statistically significantly associated with having attempted to quit among exclusive e-cigarette or/and HTP users. Additional details regarding the regression models are shown in Supplementary Table 2.

Methods used to quit or attempt to quit

Three quarters of ever smokers who had attempted to quit, reported having done so without assistance (75.8%), with 28.8% reporting the use of a cessation aid in at least one quit attempt. The most popular cessation aids were nicotine replacement therapy (NRT) or other pharmacotherapy (13.4%) followed by e-cigarettes (11.3%) (Table 2). Only 2% of those who had attempted to quit smoking tobacco reported using HTP as a cessation aid. Among those who had attempted or ever succeeded to quit e-cigarettes or HTP, 58.8% tried without assistance and 39.5% used at least one cessation aid. Within this group, using e-cigarettes was the most popular option (19.7% excluding current HTP users) followed by NRT or other pharmacotherapy (10.1%). HTP were used as a cessation aid by 5.3% of the respondents within this group (excluding current e-cigarette users) (Table 2). In both groups, just above 6% of the respondents had sought support from medical or smoking cessation services.

Sociodemographic factors associated with methods to quit

Older people (compared to those 15-24 years old) were generally less likely to have used e-cigarettes, HTP or smokeless tobacco to quit tobacco smoking; however this pattern was not observed in quitting e-cigarettes or HTP. (Tables 3 and 4). Males were more likely to have used smokeless tobacco to quit all products, but no other statistically significant differences between males and females were observed. People with difficulties paying bills had higher odds of having used e-cigarettes to quit smoking (aOR 1.41) and having used HTP to quit e-cigarettes (aOR 2.70) compared to those with no financial difficulties. Finally, people at the highest educational level were the least likely to have used e-cigarettes to quit smoking and HTP, while those living in urban areas were more likely -compared to rural areas- to have used NRT or other pharmacotherapy to quit smoking (OR 1.19) or e-cigarettes/HTP (OR 1.78)(Tables 3 and 4).

DISCUSSION

Our analysis of data from 28 European countries showed that around half of current tobacco smokers and a quarter of current e-cigarette/HTP users have attempted to quit. Among them, 3 out of 10 tobacco smokers and 4 out of 10 e-cigarette/HTP users used a cessation aid, with e-cigarettes and pharmacotherapy being the most popular aids in both groups. Younger users were less likely to have attempted to quit smoking, but more likely to have attempted to quit e-cigarettes/HTP compared to older users. We also found sociodemographic differences in the frequency and type of cessation aids used.

Only 27.1% of current e-cigarette/HTP users -who were not concurrently smoking- reported a past attempt to quit compared to 51.1% of current smokers. This group excludes the many users of novel tobacco products who also smoke tobacco (dual users); therefore is not directly comparable to current smokers in our study. Similarly, the questions assessing use may not adequately differentiate between established and experimental users; experimentation with novel products could be more frequent than with smoking. However, even with these limitations, the proportion of e-cigarette/HTP users who had tried to quit was objectively low. This can be partly explained by the fact that e-cigarette/HTP users are younger on average than smokers, but even in the younger age group (15-24 years old) more smokers than e-cigarette/HTP users had tried to quit (36.1% vs 28.1%). This discrepancy may be in part due to perceptions of harm about different products. The majority of smokers want to quit and many have tried to as the health risks associated with smoking are well-known [21]. Novel tobacco products are perceived as less harmful than cigarettes by a substantial proportion of those who use them [2, 22], which may weaken their incentive to quit entirely. Within this context, messaging to quit novel tobacco products should be part of tobacco control policies in Europe.

Although relatively few e-cigarette/HTP users had tried to quit, almost 40% of those who did used a cessation method. This was much higher than among ever smokers (current and former) in our study, as well as in previous studies in the EU and internationally [9, 23]. Many of the e-cigarette/HTP users in this analysis may have been former smokers who initially resorted to other nicotine products to quit smoking, therefore could be more inclined to use a cessation method again, especially by transitioning to another novel product. There is broad consensus regarding the effectiveness of pharmacotherapy and health professional support for smoking cessation, but -to the authors' knowledge- there are no studies that examine these cessation methods within the context of quitting e-cigarette or HTP use [24-26]]. Our findings show that a considerable proportion of e-cigarette/HTP users are trying to quit and are open to using cessation aids. Thus, smoking cessation services need to prepare for a potentially more diverse group of nicotine users who may require support. Nevertheless, the majority of both smokers and e-cigarette/HTP users reported trying to quit without any aid and only a minority of respondents used medication or medical services, which highlights the pressing need for expansion of cessation support across Europe, along with a wider set of tobacco control policies which are known to encourage people to quit with or without cessation aids [3].

We found that education and financial constraints were associated with attempting to quit and use of cessation methods. People with lower education level or/and those who had difficulties paying bills were less likely to try to quit smoking and use pharmacotherapy to quit e-cigarette/HTP, as well as more likely to use e-cigarettes to quit smoking and HTP to quit e-cigarettes. These inequalities are not surprising; poor access of vulnerable populations to smoking cessation in Europe and elsewhere is a well-established problem [27, 28] and socioeconomic differences in smoking and novel tobacco and nicotine product use have been shown in Europe before [2, 4, 29, 30]. Although HTP use is less prevalent

among financially vulnerable groups in Europe and the US [30, 31] individuals facing financial problems may be more likely to switch to HTP to quit e-cigarette use due to poor access to medical services.

Strengths and limitations

Our analysis was conducted in a sample pooled from 28 countries which differ in smoking prevalence, regulations, taxation, tobacco control policies, attitudes towards novel tobacco products and quitting behaviours [1, 2, 32, 33]. As a result, findings from this study may not reflect the situation in each individual country. To our knowledge, this is the first study to analyse quitting behaviours among e-cigarette and HTP users and compare them with smoking cessation in European countries and hence provides original groundwork data across many countries to be further built upon. The number of respondents who were current e-cigarette/HTP users or who have attempted to quit was relatively small, thus analysis by country or within more specific subgroups was not feasible and confidence intervals among current users were wide. However, the samples were representative and the methodology was largely consistent across all countries, although some adjustments were necessary due to COVID-19 restrictions. These adjustments, but also the COVID-19 pandemic itself may have had an impact on the findings; for instance, non-pharmaceutical interventions widely applied during the pandemic, such as lockdowns, may have limited the opportunities to use some of these products in social settings whereas the focus of healthcare on COVID-19 increased barriers to accessing cessation services. Our analyses were also limited by the fact that the Eurobarometer questionnaire did not distinguish between e-cigarettes and HTP and did not assess quitting attempts among people concurrently using cigarettes (dual users). Considering that many of the users of novel products also smoke cigarettes [30] our findings may not be generalizable to all users of e-cigarettes and HTP. Separating HTP and e-cigarettes in survey questions and assessing in detail dual and poly-users is becoming increasingly essential considering their popularity.

Finally due to the cross-sectional study design, we were are only able to indicate associations but not causality.

Conclusion

In this analysis of data from 28 European countries, we found that a quarter of novel tobacco and nicotine users had tried to quit and a substantial proportion of them used a cessation aid. This is a positive finding, although the proportion of those who had attempted to quit was lower than among current tobacco smokers. Product experimentation is increasing; however, currently there is no evidence-based approach to quitting e-cigarettes and HTPs as cessation services primarily remain targeted to tobacco smoking cessation. Our findings indicate populations that may be more receptive to cessation and hence motivate the tobacco control community to provide cessation support to users of all novel products and researchers to further explore quitting behaviours among different subgroups of e-cigarette and HTP users.

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The authors declare no competing interests.

Contributorship statement:

FTF had the key role in study conception and design. FTF, MLEA and AAL contributed to the data analysis. FTF, AAL, CIV and MLEA contributed to data interpretation, drafting and reviewing the manuscript.

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Table 1. Sociodemographic factors associated with attempts to quit smoking among current smokers and current exclusive e-cigarette or heated tobacco products users in 28 European countries, in 2020.

	Attempted to quit smoking		Attempted to quit e-cigarette or HTP	
	N (weighted %)	**aOR (95% CI)**	**N (weighted %)**	**aOR (95% CI)**
	N=6,661	**N=6,604**	**N=284**	**N=283**
Age				
15-24 years (ref)	194 (36.1)	1.00	16 (28.1)	1.00
25-39 years	871 (50.8)	1.77 (1.43 – 2.19)	24 (32.4)	0.56 (0.23 – 1.34)
40-54 years	1,070 (52.7)	2.26 (1.83 – 2.79)	21 (36.7)	0.58 (0.23 – 1.45)
55+ years	1,234 (55.2)	2.26 (1.83 – 2.78)	7 (10.2)	0.14 (0.05 – 0.40)
Sex				
Female (ref)	1,617 (55.9)	1.00	28 (23.4)	1.00
Male	1,752 (47.2)	0.90 (0.81 – 1.00)	41 (29.8)	1.18 (0.64 – 2.18)
Difficulty paying bills				
Never/almost never (ref)	2,041 (52.4)	1.00	39 (26.0)	1.00
From time to time/most of the time	1,307 (48.9)	0.94 (0.84 – 1.05)	30 (30.3)	1.59 (0.85 – 2.98)
Highest level of education completed				
Lower secondary or lower (ref)	762 (50.2)	1.00	11 (26.0)	1.00
Upper secondary	1,644 (46.9)	1.12 (0.98 – 1.29)	25 (31.6)	0.87 (0.35 – 2.15)
Tertiary up to bachelor	632 (57.4)	1.21 (1.01 – 1.45)	24 (23.6)	0.86 (0.33 – 2.26)
Masters or above	331 (63.6)	1.27 (1.02 – 1.58)	9 (22.6)	1.24 (0.38 – 4.03)
Area of residence				
Rural (ref)	1,057 (48.8)	1.00	18 (22.8)	1.00
Urban	2,309 (52.0)	1.04 (0.93 – 1.16)	51 (28.5)	0.95 (0.47 – 1.89)
Total	**3,369 (51.1)**		**69 (27.1)**	

aOR=adjusted Odds Ratios from multilevel logistic regression models, adjusting for all variables included in the table.

Individuals with missing data in any of the included variables were excluded from the regression analyses.

Table 2. Methods used in quit attempts of tobacco and e-cigarettes/ heated tobacco products in 28 European countries.

	Quit attempts by ever smokers		Quit attempts by E-cigarettes or HTP users[a]	
	N	Weighted % (95% CI)	N	Weighted % (95% CI)
Nicotine replacement therapy or other pharmacotherapy	1,298/9,889	13.4 (12.2 – 14.6)	123/1,103	10.1 (7.5 – 13.4)
Electronic cigarettes or any similar device	842/9,889	11.3 (10.2 – 12.5)	210/1,059	19.7 (15.9 – 24.2)
Heated tobacco products	220/9,889	2.0 (1.6 – 2.6)	56/1,050	5.3 (3.5 – 7.9)
Smokeless tobacco	192/9,889	1.5 (1.2 – 1.9)	37/1,103	2.1 (1.2 – 3.6)
Medical support or stop smoking services	555/9,889	6.3 (5.5 – 7.2)	68/1,103	6.1 (4.0 – 9.1)
Without assistance	7,681/9,889	75.8 (74.3 – 77.3)	657/1,103	58.8 (53.7 – 63.7)
Any aid	2,636/9,889	28.8 (27.2 – 30.4)	453/1,103	39.5 (34.7 – 44.6)

[a] Percentages shown among current e-cigarette or heated tobacco products users who have tried to quit and former users.

Table 3. Sociodemographic factors associated with methods to quit e-cigarettes or heated tobacco products in 28 European countries, 2020.

		Pharmacotherapy OR (95% CI)	E-cigarettes OR (95% CI)	Heated tobacco products OR (95% CI)	Smokeless tobacco OR (95% CI)	Medical support OR (95% CI)	Without assistance OR (95% CI)	Any aid OR (95% CI)
		N=1,095	N=1,057	N=1,043	N=1,095	N=1,095	N=1,095	N=1,095
Age								
	15-24 years (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	25-39 years	0.97 (0.47 – 1.97)	1.27 (0.73 – 2.22)	0.47 (0.21 – 1.08)	1.42 (0.50 – 4.07)	0.83 (0.30 – 2.26)	0.76 (0.49 – 1.16)	1.25 (0.82 – 1.91)
	40-54 years	1.60 (0.80 – 3.20)	1.73 (0.99 – 3.00)	0.45 (0.19 – 1.07)	0.62 (0.19 – 1.98)	2.07)0.81 – 5.28)	0.66 (0.43 – 1.02)	1.62 (1.05 – 2.48)
	55+ years	1.65 (0.81 – 3.36)	1.05 (0.58 – 1.89)	0.55 (0.22 – 1.33)	0.64 (0.19 – 2.19)	1.99 (0.76 – 5.16)	0.66 (0.42 – 1.03)	1.43 (0.92 – 2.22)
Sex								
	Female (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Male	0.98 (0.67 - 1.44)	0.84 (0.61 - 1.15)	0.67 (0.38 - 1.18)	3.15 (1.38 - 7.20)	0.98 (0.59 - 1.62)	1.03 (0.80 - 1.32)	1.03 (0.80 - 1.32)
Difficulty paying bills								
	Never/almost never (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	From time to time/most of the time	1.24 (0.82 - 1.85)	1.13 (0.80 - 1.58)	2.70 (1.47 - 4.96)	0.92 (0.43 - 1.98)	1.35 (0.79 - 2.30)	0.96 (0.73 - 1.25)	1.37 (1.05 - 1.79)
Education								
	Lower secondary or lower (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Upper secondary	1.20 (0.67 - 2.16)	0.99 (0.65 - 1.52)	1.18 (0.54 - 2.60)	0.68 (0.26 - 1.77)	1.53 (0.74 - 3.16)	0.98 (0.69 - 1.40)	1.09 (0.77 - 1.54)
	Tertiary up to bachelor	2.34 (1.28 - 4.30)	0.83 (0.51 - 1.35)	1.15 (0.44 – 3.00)	0.52 (0.17 - 1.54)	1.11 (0.48 - 2.58)	0.89 (0.60 - 1.32)	1.22 (0.83 - 1.80)
	Masters or above	1.10 (0.49 - 2.48)	0.48 (0.24 - 0.97)	1.07 (0.31 - 3.75)	0.18 (0.02 - 1.61)	1.49 (0.56 - 3.96)	1.15 (0.70 - 1.90)	0.65 (0.39 - 1.09)
Area of residence								
	Rural (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Urban	1.78 (1.09 - 2.90)	1.04 (0.73 - 1.48)	0.97 (0.49 - 1.90)	2.95 (0.99 - 8.83)	0.84 (0.48 - 1.46)	0.97 (0.73 - 1.29)	1.20 (0.90 - 1.60)

OR= adjusted Odds Ratios from multilevel logistic regression models.

Regression models fitted among those who have attempted or succeeded to quit e-cigarettes or HTP.

Table 4. Sociodemographic factors associated with methods to quit smoking among ever smokers (n=9,828), in 28 European countries, 2020.

		Medication OR (95% CI)	E-cigarettes OR (95% CI)	Heated tobacco products OR (95% CI)	Smokeless tobacco OR (95% CI)	Medical support OR (95% CI)	Without assistance OR (95% CI)	Any aid OR (95% CI)
Age								
	15-24 years (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	25-39 years	2.03 (1.33 – 3.10)	1.19 (0.86 – 1.65)	0.69 (0.43 – 1.11)	0.53 (0.30 – 0.95)	1.05 (0.59 – 1.87)	0.93 (0.72 – 1.20)	1.10 (0.86 – 1.41)
	40-54 years	2.92 (1.94 – 4.41)	0.88 (0.64 – 1.22)	0.40 (0.25 – 0.66)	0.34 (0.19 – 0.61)	1.70 (0.98 – 2.94)	0.89 (0.69 – 1.14)	1.13 (0.89 – 1.43)
	55+ years	1.97 (1.31 – 2.96)	0.38 (0.27 – 0.53)	0.14 (0.08 – 0.23)	0.14 (0.08 – 0.25)	1.70 (0.99 – 2.92)	1.36 (1.06 – 1.74)	0.70 (0.55 – 0.88)
Sex								
	Female (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Male	0.88 (0.78 – 0.99)	0.95 (0.82 – 1.10)	1.14 (0.87 – 1.51)	2.85 (2.02 – 4.02)	0.74 (0.62 – 0.88)	1.06 (0.96 – 1.17)	0.98 (0.89 – 1.07)
Difficulty paying bills								
	Never/almost never (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	From time to time/most of the time	1.24 (1.08 – 1.43)	1.41 (1.20 – 1.66)	1.22 (0.90 – 1.64)	1.25 (0.84 – 1.85)	1.16 (0.94 – 1.43)	0.81 (0.72 – 0.90)	1.26 (1.13 – 1.40)
Education								
	Lower secondary or lower (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Upper secondary	1.06 (0.88 – 1.26)	1.15 (0.93 – 1.42)	1.09 (0.71 – 1.67)	1.12 (0.69 – 1.82)	0.92 (0.72 – 1.17)	0.95 (0.82 – 1.09)	1.14 (1.00 – 1.31)
	Tertiary up to bachelor	1.08 (0.89 – 1.31)	1.06 (0.83 – 1.34)	1.43 (0.88 – 2.31)	0.86 (0.50 – 1.49)	1.04 (0.79 – 1.36)	0.95 (0.82 – 1.12)	1.14 (0.98 – 1.32)
	Masters or above	0.85 (0.68 – 1.07)	0.67 (0.50 – 0.90)	1.28 (0.74 – 2.21)	0.44 (0.22 – 0.91)	0.89 (0.65 – 1.23)	1.36 (1.13 – 1.64)	0.75 (0.63 – 0.90)
Area of residence								
	Rural (ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Urban	1.19 (1.04 – 1.36)	1.05 (0.89 – 1.24)	1.16 (0.84 – 1.59)	1.00 (0.70 – 1.43)	1.07 (0.88 – 1.30)	0.94 (0.85 – 1.05)	1.09 (0.99 – 1.21)

OR= adjusted Odds Ratios from multilevel logistic regression models.

Regression models fitted among those who have attempted or succeeded to quit smoking.

Supplementary Table 1. Sample characteristics.

	Smoking		E-cigarettes or HTP	
	Have attempted or succeeded to quit N (weighted %)	**Current smokers N (weighted %)**	**Have attempted or succeeded to quit N (weighted %)**	**Current users N (weighted %)**
Age				
15-24 years	410 (5.4)	560 (10.7)	141 (13.9)	40 (19.8)
25-39 years	1,862 (21.2)	1,819 (2.3)	357 (36.5)	89 (30.3)
40-54 years	2,595 (27.2)	2,046 (29.3)	316 (29.3)	76 (24.8)
55+ years	5,020 (46.3)	2,236 (30.7)	289 (20.3)	78 (25.0)
Sex				
Female	4,462 (44.7)	3,067 (45.1)	502 (43.5)	123 (41.8)
Male	5,427 (55.3)	3,594 (54.9)	601 (56.5)	161 (58.2)
Difficulty paying bills				
Never/almost never	6,954 (69.6)	3,759 (57.5)	673 (57.1)	188 (70.8)
From time to time/most of the time	2,883 (30.4)	2,852 (42.5)	422 (42.9)	94 (29.2)
Education				
Lower secondary or lower	2,069 (28.3)	1,567 (29.5)	213 (28.5)	47 (25.7)
Upper secondary	4,116 (36.4)	3,436 (44.8)	500 (38.5)	108 (38.0)
Tertiary up to bachelor	2,292 (21.2)	1,088 (16.5)	274 (22.4)	95 (23.8)
Masters or above	1,409 (14.1)	566 (9.3)	116 (10.6)	34 (12.4)
Area of residence				
Rural	3,151 (28.8)	2,097 (27.4)	292 (23.7)	73 (24.4)
Urban	6,734 (71.2)	4,560 (72.6)	811 (76.3)	211 (75.6)
Smoking				
Never smoker	-	-	61 (6.3)	42 (21.5)
Current smoker	3,368 (35.0)	6,661 (100.0)	601 (56.8)	-
Former smoker	6,521 (65.0)	-	440 (36.9)	242 (78.5)
Total	**9,889 (100)**	**6,661 (100)**	**1,103 (100)**	**284 (100)**

Supplementary table 2. Regression models characteristics

Outcome	Number of observations	Number of groups	Average number of observations per group	Akaike's Information Criterion (AIC)	Bayesian Information Criterion (BIC)
Attempted to quit smoking	6604	28	235.9	8395.09	8469.84
Attempted to quit e-cigarette or HTP	283	28	10.4	350.23	350.25
Used pharmacotherapy to quit e-cigarettes or HTP	1095	28	39.1	769.36	824.34
Used e-cigarettes to quit HTP	1057	28	37.5	1046.71	1101.24
Used HTP to quit e-cigarettes	1043	28	37.3	422.58	477.03
Used smokeless tobacco to quit e-cigarettes or HTP	1095	28	39.1	301.23	356.21
Used medical support to quit e-cigarettes or HTP	1095	28	39.1	515.70	570.68
Used no aid to quit e-cigarettes or HTP	1095	28	39.1	1471.98	1526.97
Used any aid to quit e-cigarettes or HTP	1095	28	39.1	1473.39	1528.37
Used pharmacotherapy to quit smoking	9828	28	351.0	7298.57	7377.69
Used e-cigarettes to quit smoking	9828	28	351.0	5278.85	5357.97
Used HTP to quit smoking	9828	28	351.0	1923.69	2002.81
Used smokeless tobacco to quit smoking	9828	28	351.0	1440.92	1520.05
Used medical support to quit smoking	9828	28	351.0	4107.60	4186.72
Used no aid to quit smoking	9828	28	351.0	10086.68	10165.80
Used any aid to quit smoking	9828	28	351.0	10895.56	10974.69

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1	
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3	
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4	
Objectives	3	State specific objectives, including any prespecified hypotheses	5	
Methods				
Study design	4	Present key elements of study design early in the paper	6	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6	
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6	
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case		
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6,	
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6,*	
Bias	9	Describe any efforts to address potential sources of bias	8	
Study size	10	Explain how the study size was arrived at	6,	

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7, 8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	8
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	9
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	9
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	n/a
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time *Case-control study*—Report numbers in each exposure category, or summary measures of exposure *Cross-sectional study*—Report numbers of outcome events or summary measures	*9, 10*
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9, 10
		(*b*) Report category boundaries when continuous variables were categorized	n/a
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a

Continued on next page

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13
Generalisability	21	Discuss the generalisability (external validity) of the study results	12, 13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.