

## Novel tobacco and nicotine products and youth in the European Union

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In recent years, there has been a rapid proliferation of novel tobacco and nicotine products in the market, which have gained in popularity among adolescents. The prevalence of ever users of electronic cigarettes (e-cigs) in Europe among those aged 10–24 ranges from 5.5% to 56.6%, with significant variations across countries. Adolescents have reported several reasons for e-cig use initiation, including low harm perception, social acceptability, novelty, and peer influence. Despite being marketed as safe alternatives, e-cigs are not risk-free and have already been associated with respiratory diseases. A major concern is their potential to renormalize smoking among non-smokers and to foster nicotine dependence, leading to the initiation of conventional cigarette smoking, which would reverse actual declining trends in tobacco consumption. Hence, to prevent a setback on the progress made in tobacco control, there is a pressing need for more comprehensive regulation, with a particular focus on adolescents, given that the teenage years are pivotal in determining future smoking behavior.

**Key words:** tobacco, novel products, youth, European Union, tobacco control

### Introduction

Tobacco use remains a major public health problem worldwide. In the European region, the prevalence of tobacco use among adults is the highest globally, and one of the highest among adolescents. Accordingly, the proportion of all-cause mortality attributable to tobacco use is also higher in the region (16% in adults  $\geq 30$  years old) than the global average (12%) [1]. Hence, accelerating the decline of tobacco use in all population groups should continue to be a high priority across the region [2].

Implementation of comprehensive evidence-based tobacco control policies has the potential to reduce tobacco-related

diseases across Europe [2]. These policies have shown to significantly decrease tobacco use prevalence and increase smoking cessation rates in the region [3, 4]; especially, when implemented at the highest level. The European Union (EU) has ratified the WHO Framework Convention on Tobacco Control (FCTC) [5] and, subsequently, over the last decades all EU Member States (MS) have implemented key tobacco control policies; however, considerable differences still exist across the EU [6].

Smoking prevalence in the EU has declined considerably, from 32.0% in 2007 [7] to 23.0% in 2020 [8]. New forms of tobacco and nicotine products – electronic cigarettes (e-cigs), heated-tobacco products (HTPs), and smokeless tobacco –

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have been aggressively introduced in the market to attract new customers, retain users, and re-engage those that have already quit [9]. Although the prevalence of e-cig use and smoking HTPs are currently relatively low in the general population in the EU, these products, especially e-cigs, have rapidly gained in popularity among adolescents and have become the most commonly used tobacco products in some countries [10–12]. Their popularity may respond to aggressive marketing to children and youth, accessibility, appealing flavors, high nicotine delivery, and lower risk perceptions [13]. All in all, despite the progress made since the ratification of WHO FCTC, the emergence of novel tobacco products continues to challenge tobacco control efforts globally.

The aim of this work is to review the use and trends of novel tobacco and nicotine products in the EU, as well as their potential harm for bystanders. Additionally, this manuscript will discuss the challenges the new products pose for tobacco control, and provide recommendations for policymakers and other stakeholders to move forward to a tobacco and nicotine-free generation by 2040, as outlined in the Europe's Beating Cancer Plan [14].

### **Prevalence of ever use of novel tobacco and nicotine products in the EU**

According to Tehrani et al., the worldwide prevalence of ever users of e-cigs was 23.0% with a higher prevalence among men (22%) than women (16%). Current e-cig users were 11.0%, with a higher prevalence in men (12%) than in women (8%). Among adolescents and college students, the prevalence of e-cig ever users was even higher – up to 25% [10]. Even more alarming, an upward trend of lifetime e-cig use in the youngest segments of the population has been reported.

In the EU, in 2020, 14.0% of EU citizens had used an e-cig at least once or twice, meeting the criteria for ever use [8]. The proportion of ever users varied widely between countries, ranging from 6.0% in Poland up to 29.0% in Ireland. Young adults (15–24 years old) and current smokers of conventional tobacco were more likely to have tried e-cigs in their lifetime, compared to older groups (over 55 years old) and never or former smokers [8]. These findings are in line with previous studies in the region showing higher odds of ever use among the younger population [15]. Finally, although only 5% of EU citizens reported being daily users of e-cigs, this proportion has critically increased by 12% between 2017 and 2020 [8], showing an upward trend for both current and lifetime e-cigarette use in Europe [10].

There are scant global data regarding the use of HTPs. Data from the United States (US), Japan and Korea report prevalence of ever use of 2.2% [16], 15.0% [17] and 10.7% [18], respectively, among adults from 2017 to 2020. Ever use of HTPs in EU Member States (MS) in 2020 was lower than for e-cigs (6.5%) in citizens 15 years or older [8]; however, this prevalence has considerably increased since 2017 according

to previous data in the region reaching 1.8% [19]. Overall, 1.3% were current users and 0.7% reported a daily use. As with e-cigs, in most EU MS, the use of HTPs is mostly occasional. Czech Republic was the MS with the highest prevalence of ever users of HTPs (14.6%), followed by Latvia (13.8%) and Ireland (12.3%). Conversely, France had the lowest prevalence (2.8%), followed by Poland (3.8%) and Malta (3.9%). Similarly to e-cigs, an inverse association between age and HTPs use was observed as people aged 15–24 years old were significantly more likely to report ever, current, and daily use compared to older age groups [19, 20].

Data on the prevalence of e-cigs and HTP ever use in children and adolescents is limited and difficult to compare since authors define youth with different age ranges. A recent narrative review by Kapan et al. [21] reported that the highest prevalence of having tried e-cigs was found among those aged 10–24, ranging from 5.5% to 56.6%. A study among school students in England reported that 19.2% of the respondents (aged 14–17 years old) had tried e-cigs; among them 35.8% were regular users and 15.8% had never used them [22]. Another study in Denmark found that 26.5% of respondents aged 15–17 years had at least tried e-cigs and 1.1% HTPs. Finally, a recent survey from Poland [23] reported that 57.8% of respondents (aged 15–19 years old) have used e-cigs and about 44% HTPs, from which 37.9% and 12.6%, respectively, were never smokers of conventional cigs.

Differences in the prevalence of ever e-cigs and HTP use across EU MS, both in adults and adolescents, may be partially explained by variations in their prevalence of combustible cigarette smoking (e.g., manufactures, cigarettes, cigars, roll-your-own tobacco, pipe), as current smokers are more likely to have tried these products [15]. Other explanations could be, first, differences in the local tobacco market and the market penetration of these products [20], since the date of their first commercialization varies widely across countries [19]. Second, availability and access to smoking cessation programs may play a role, as e-cigs are often sold as quitting tools (such as in the UK where guidelines recommend them for smoking cessation) [24]. And, finally, other legal or regulatory factors such as affordability, advertising, promotion and sponsorship, restricting flavors, and enforcement of smoke-free laws in public settings, may also contribute to differences in use [15, 25].

### **Characteristics of e-cigarette and novel tobacco products' users**

The vulnerability of adolescents to using e-cigs and other novel tobacco products may be influenced by various characteristics. Adolescents who have a low risk perception may be particularly susceptible to using these products. According to Perikleous et al. [12], determinants of e-cig use among students include male gender, low school performance, high school grade, daily smoking, having household members and peers who smoke, and ever-use of other tobacco products (such

as waterpipe smoking). Moreover, other studies have found strong associations between ever e-cig use and alcohol use, both with a moderate and binge drinking pattern [22] as well as cannabis use [26]. These associations suggest that adolescents who access e-cigarettes are also more likely to experiment or use other psychoactive substances and engage in risk-taking behavior.

### **Health hazards associated with the use of novel tobacco and nicotine products**

Novel tobacco and nicotine products have been commonly marketed as “safer” alternatives to traditional combustible cigs and smoking cessation tools. Although these products often produce lower levels of some carcinogens and toxic chemicals compared to conventional cigarettes, they are not risk free [19]. A recent review on the health consequences of e-cig use found a moderate association with increased risk of myocardial infarction and stroke in daily users, and with asthma exacerbation, chronic bronchitis, and e-cig use-association lung injury (EVALI) in adolescents and younger users [27]. Moreover, e-cigs are especially toxic to children and adolescents due to the impact of nicotine on the development of their brains [28]. Regarding HTPs, little data on the short- and middle-term health consequences of using HTPs is available; however, they also raise concerns about their safety since, similarly to e-cigs, they produce new substances (such as emission of metals, and volatile organic compounds) not generated by conventional cigarettes, whose impact on health has not yet been evaluated [19]. The long-term effects for both of these products are still unknown since they were first introduced in the market only a few years ago.

### **Exposure to secondhand aerosols from tobacco and nicotine products**

The potential passive exposure to the aerosol exhaled by e-cig and HTP users, as their use has increased in indoor places including those with tobacco smoke-free bans, is also under investigation. A systematic review indicated that second-hand aerosols (SHA) exhaled by e-cig users contain potential toxic compounds such as nicotine, carbonyls, metals, and organic volatile compounds, besides particulate matter [29]. E-cig exposure to SHA among non-users at home have been less frequently reported (i.e., 5.8% among 12 European countries) than in other public places (16.0%) [30]. Yet, exposure to SHA in homes is linked with significantly higher levels of cotinine, 3'-OH-cotinine and 1,2-propanediol in saliva, and cobalt in urine among exposed bystanders residing with e-cigarette users [31, 32].

### **Reasons to start using novel tobacco and nicotine products**

Subjective perceptions and beliefs about these products direct consumer behavior, particularly among young populations

[33]; therefore, understanding the reasons why adolescents start using these novel products is key to counteract tobacco industry marketing strategies and implement and enforce a robust regulatory framework for these products [20].

Common reasons to start using e-cigs in all population groups include perceived safety [23, 34], novelty and curiosity [12], peer influences, avoidance of smoking regulations [34], and social acceptability [9, 35]. However, some generational differences exist. While adults are commonly also attracted by the potential of these products to help them quit smoking or reduce their daily conventional cigarette consumption; teenagers and young adults are charmed by their appealing flavors (mostly candy) [9, 21, 36], low price, and perceived “coolness” [34]. Similarly, HTPs are also perceived to be less harmful or risk-free [20] and more socially acceptable. Although available data on adolescents' perceptions in the EU is scarce, most of the beliefs and perceptions for e-cigarettes may be also true for HTPs [9].

### **Main challenges for global tobacco control globally**

#### **Gateway for tobacco smoking initiation among adolescents**

The teenage years are a critical period in establishing future smoking behaviors. A key public health concern with novel tobacco and nicotine products is their potential to recruit never smokers, especially adolescents, to nicotine dependence [37]. The tobacco industry is promoting the substitution of conventional cigarettes by e-cigarettes, as a key-element of what the industry (and some tobacco control advocates) calls the “tobacco harm reduction” strategy [38]. However, e-cig use is increasing especially among nonsmokers and experimental smokers [39]. Indeed, among teenagers, unlike adult populations in which e-cig users are current or former smokers [22], the proportion that had tried e-cigs who had never smoked conventional cigarettes is noteworthy. For example, data from Poland and Wales (UK) show a high proportion of adolescents reporting ever use of e-cigarettes among those who were never smokers (37.9% and 43.2%, respectively) [21, 40].

E-cig use is associated with the initiation of conventional cigarette smoking among adolescents, thereby increasing their probability of becoming tobacco addicts and suffering from tobacco-related harms in the medium and long run. In this regard, two recent systematic reviews and meta-analysis by O'Brien [37] and Adermark et al. [39] found that adolescents reporting ever e-cigarette use were four times more likely to start smoking tobacco cigarettes compared to those who had never used them at baseline. Findings, thereby, support an association between e-cig ever use and future conventional cigarette smoking in never smokers and recurrence in experimental smokers even after adjusting for potential confounders, which indicates the robustness of the associations observed. These results pose an important public health threat as it

undermines hard-won progress in tobacco control that has succeeded in preventing smoking initiation among the youth over the past decades.

### **Renormalization of the act of tobacco smoking**

Another public health problem associated with novel tobacco products is their potential to renormalize smoking. This can occur when adolescents view smoking as a socially accepted behavior due to the growing prevalence and visibility of these products. The renormalization hypothesis [41] suggests that the increasing extent to which smoking is perceived as a “normal” behavior and accepted by a non-smoking majority, including the youth, is challenging the success of tobacco control efforts in recent decades [26]. Particularly concerning are the high rates of ever use observed among never smokers in the EU, especially among adolescents [22, 23]. Factors such as social acceptability [9] and perceiving these products as “cool” were two of the main reasons reported for US teenagers to start using these products [34].

Harm perceptions of e-cigs and other novel tobacco products among adolescents may also contribute to the renormalization of smoking. These products are often perceived as a healthier alternative since they are thought to be less harmful than conventional cigarettes by both young [42] and adult populations [15, 20, 43]. Previous studies suggest that perceptions play a significant role in predicting their use among young people. A recent meta-analysis showed that adolescents, who believed e-cigs were less harmful and less addictive than conventional cigarettes, were twice as likely more likely to have tried these products [13]. Even more concerning is the finding that low harm perception predicts the initiation of e-cigarette use among youth non-smokers [44].

There is limited evidence available regarding the changes in attitudes towards smoking as a normative behavior among the youth. One of the first studies to address this question found limited evidence for the renormalization of youth smoking and suggested a “normalization” of e-cig use in the context of the denormalization of conventional cigarettes [26]. This is in line with previously described data. Meanwhile, whilst the renormalization hypothesis remains unclear, it has been suggested that the “normalization” of e-cigs leads to an increase in smoking prevalence since e-cig use has been associated with tobacco smoking initiation. Further research is needed to better understand the impact of e-cigarettes on youth smoking attitudes and behavior.

### **Further regulating e-cigarettes and novel tobacco products**

A precautionary approach is warranted given the many unknowns regarding these products. Indeed, the WHO recommends regulating e-cigarettes to prevent initiation by non-smokers and children, minimize potential health risks, and protect non-users from secondhand exposure to their emissions

(SHA) [45]. Yet the legal and regulatory status of these products differs widely by country [9, 46]. In 2014, the European Commission enacted the Tobacco Products Directive (TPD) [47], to provide a framework of actions and goals for EU MS to meet the obligations under the WHO FCTC [48].

The TPD lays down rules for e-cigarettes as consumer products, including but not limited to, setting a maximum nicotine concentration and volume for cartridges, tanks, and nicotine liquid containers; mandating child-resistant containers; requiring text-only health warning messages advising consumers that they contain nicotine and should not be used by non-smokers; and providing instructions for use and information on adverse effects, risk groups, addictiveness, and toxicity (article 20) [47]. That said, under the TPD, HTPs are covered under the more general term “novel tobacco products”, which allows manufacturers to self-categorize them either under the definition of tobacco products or smokeless tobacco, the latter being less restrictive (article 19.4) [47, 48]. Tobacco control policy progress in EU MS is lagging behind tobacco industry innovations [2]. Thereby, a more comprehensive regulation of novel nicotine and other tobacco products is needed in the EU. For example, it is necessary that EU MS adopt monitoring strategies over the usage and distribution of these products, and ban their use in public places to protect bystanders. In this regard, the 2<sup>nd</sup> Joint Action on Tobacco Control ([www.jaotc.eu](http://www.jaotc.eu)) [49], launched in October 2021, is aimed at strengthening the cooperation between the EU MS and the European Commission concerning the enforcement and improvement of the Tobacco Products Directive (TPD) and the Tobacco Advertising Directive (TAD), to develop a common ground for strategies on smoke-free environments and tobacco endgame strategies.

Novel tobacco and nicotine products have rapidly penetrated the adolescent market [22]. The lack of regulation governing these products in many European countries has led to unrestricted access to addictive products by children and adolescents. Governments should offer children and adolescents the same protection from these products as for conventional cigarettes through a well-enforced regulatory regime of measures including but not limited to the age restriction on purchase and promotion [22], restraint of availability through licensing outlets, limits to product visibility and attractiveness through savage marketing campaigns, and appropriate pricing through taxation [37]. Besides, it is urgent to incorporate novel tobacco and nicotine products in tobacco smoking prevention programs by targeting vulnerable groups through early intervention efforts [12].

Moreover, given their overwhelming acceptance and popularity among the youth, EU MS should design and implement prevention campaigns via social media [12] and educational interventions [23] in schools to raise the awareness of children and adolescents about these products. These strategies may also have the potential to revert potential misconceptions young people may have regarding their associated health hazards, addictiveness, and harm level [37].

## Conclusions

Novel tobacco and nicotine products have rapidly gained in popularity among children and adolescents across the EU, challenging tobacco control globally. Despite being marketed by the tobacco industry as “safe” alternatives to conventional cigarettes, these products are not risk-free [50]. The usage of these products, especially e-cigarettes, has been associated with an increase in the uptake of conventional cigarette smoking among adolescents, but also with the renormalization of smoking, making it more socially acceptable behavior, even by non-smokers. Therefore, to prevent setbacks in tobacco control efforts, EU MS should implement more stringent restrictions on these products to ensure they at least match the ones in place for conventional cigarettes and roll-your own tobacco.

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