BMJ Open First experience with nicotine products and transition to regular tobacco use: a secondary data analysis in 28 **European countries**

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ABSTRACT

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Nikita B Rajani; nikita.rajani14@imperial.ac.uk Objective The majority of tobacco users have had their first contact with nicotine at a young age. The aim of this study was to explore the association between the first tobacco or nicotine product tried and the transition to regular product use in 28 European countries. Methods A secondary analysis of participants aged 15-40 years (n=8884) from 28 countries was conducted (Eurobarometer wave 93.2; August-September 2020). Participants who reported having ever tried tobacco or nicotine products were asked which product they tried first. Self-reported history of tobacco use determined whether they were established users (≥ 1 time weekly) of a range of products at any point in their life. Multilevel logistic regression was used to measure the association between first product tried and becoming a regular user of tobacco or nicotine products.

Results There was large variation between countries in the proportion of participants aged \leq 40 years that ever tried tobacco or nicotine; Estonia had the highest proportion of ever users (85.8%) and Poland had the lowest (38.9%). Among those who had ever tried tobacco or nicotine, boxed cigarettes were the most common first product (72.3%) and pipe was the least common (0.4%). Compared with those who first tried e-cigarettes, the odds of ever becoming a regular user of any tobacco or nicotine product were higher among those who first had handrolled cigarettes (adjusted OR, aOR 2.23; 95% Cl 1.43 to 3.48) or boxed cigarettes (aOR 2.08; 95% Cl1.43 to 3.02) and lower among those who first tried waterpipe (aOR 0.22; 95% CI 0.14 to 0.34).

Conclusions Although this study cannot infer causality, the findings show that odds of becoming a regular tobacco user differs widely depending on the first product used. Better understanding of the associations between first product use and regular tobacco use could be informative to tobacco control policy-makers and help tailor prevention programmes.

INTRODUCTION

Tobacco consumption is a preventable cause of death and disability, responsible for approximately 8 million deaths annually.¹ Although global consumption rates of tobacco have declined over the past decade, Europe remains the region with the highest

STRENGTHS AND LIMITATIONS OF THIS STUDY

- \Rightarrow This study is the most up-to-date analysis exploring the proportion of individuals that ever tried a tobacco or nicotine product and the type of product they first tried.
- \Rightarrow The analysis of data from 28 European countries with weighted samples allows for cross-country comparisons and novel insights to aid Europeanwide tobacco control policies.
- \Rightarrow Due to the cross-sectional nature of the study, no causal inferences can be made regarding the transition to regular tobacco use.
- \Rightarrow Since there was limited information about dual or poly use of tobacco products, more complex analyses regarding experimentation and transition from one product to another were not possible.
- \Rightarrow The exclusion of individuals above 40 years of age limits the generalisability of the findings to other age populations.

ŋġ, smoking prevalence among adults with almost 16% share of all-cause mortality reportedly due to smoking among adults aged 30 and uning, over.² Generally, the majority of smokers start smoking during adolescence or young adulthood. Studies show that almost 20% of European smokers start smoking before the age of 15 years and the majority before the age of 18, although the picture varies between countries.^{3 4} Adolescence and young adulthood constitute a significant period where experimentation with different products is frequent and long-lasting habits are developed. Therefore, tobacco or nicotine product experimentation can predict future smoking and long-term usage of tobacco.⁵⁶

In the past, European markets were primarily dominated by cigarettes, making it most likely that the first contact with nicotine would be through cigarettes. However, in more recent years, the tobacco and nicotine market has changed considerably with the increase in popularity of e-cigarettes, heated tobacco,

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flavoured tobacco and the resurgence of waterpipes. The increased palatability of these new products and the widespread perception among adolescents who flavoured tobacco is less harmful has led to increased consumption of many novel products among younger populations.⁷⁻⁹ Studies have shown that consumption of these novel alternatives, particularly experimentation with e-cigarettes, could serve as a vehicle for nicotine addiction and possibly lead to regular use of conventional or novel products later in life.¹⁰¹¹ This phenomenon is widely known as the gateway effect which suggests that adolescent e-cigarette use is associated with subsequent regular tobacco consumption. A systematic review of 16 studies found that e-cigarette use in non-smoking adolescents was associated with almost 5 times greater odds of subsequent smoking, although there is less confidence that the association is causal.¹⁰

Interest in examining if and how individuals progress from experimenting and trying tobacco products to becoming regular users of the same or other tobacco products is not novel, particularly with regard to e-cigarettes. Shahab et al found that e-cigarette initiators were less likely to become regular smokers compared with adolescents who first tried other combustible or noncombustible tobacco products.12 Other research has found that in the UK approximately one in seven e-cigarette users transitioned into a regular cigarette smoker.¹³ Aside from e-cigarettes, studies have also explored the transition from other types of tobacco products to regular consumption. For example, a systematic review found that waterpipe tobacco smoking doubled the odds of later initiation and regular consumption of conventional cigarettes.¹⁴ On the other hand, some studies have found that not many cigarette smokers transition to exclusive regular use of smokeless tobacco.¹⁵

While some studies have explored first contact with tobacco or nicotine and regular use, a large proportion of research has focused on conventional cigarettes and e-cigarettes. Moreover, there is limited research exploring and comparing the phenomenon of transitioning from experimentation or first contact to regular use of different tobacco or nicotine products. Similarly, few studies explore and compare this phenomenon between various countries and regions although it is likely that circumstances between regions will vary, and countryspecific findings may not be generalisable. Due to the high number of smokers in the European region, a crosscountry and cross-product comparison could be valuable and informative for tobacco policy-makers. Therefore, our study aimed to compare the first experience users had with various tobacco or nicotine products in different European countries and explore the association between the first tobacco or nicotine product used and the transition to regular product use.

METHODS

Sample and data

To study the association between the first tobacco or nicotine product used and the transition to regular product

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products' included ever regular users of at least one of the following: e-cigarettes, smokeless tobacco and heated tobacco products.

The sociodemographic data collected included the participants' country of residence, sex (male; female), age in years (15-24, 25-34 and 35-40), type of community (rural or village, small/middle town and large town), financial status (any difficulty paying bills and almost never/never) and employment status (not working, unemployed and working).

Statistical analysis

The statistical software STATA V.16 (StataCorp) was used to perform the analyses presented. Descriptive statistics are presented as weighted proportions with 95% CIs. One multilevel logistic regression model (allowing for clustering of observations within countries) was run to explore the associations between sociodemographic variables (age, sex, area of residence, financial status and occupation) and the odds of ever having tried any tobacco or nicotine product among respondents aged ≤40 years. Multilevel logistic regression models adjusted for age, sex, area of residence and financial difficulties were run to explore the association between the first nicotine or tobacco product tried and regular use of any tobacco or nicotine product, regular use of combustible tobacco products and regular use of non-combustible products. The selection of the independent variables for the regression model was made through an iterative process considering the Akaike information criterion and the Bayesian information criterion. Regression model results are presented as adjusted OR (aORs) with 95% CIs. Any missing observations and responses of 'don't know' were excluded from the regression analysis but were included in descriptive analyses where possible. As a result, a total of 46 and 109 observations were excluded from the regression analyses among those who had tried a nicotine or tobacco product and among the entire sample, respectively.

Patient and public involvement

The study had no patient or public involvement.

RESULTS

Among the 8884 respondents aged ≤ 40 years, 5564 participants had ever tried a tobacco or nicotine product (figure 1). The sociodemographic characteristics of those who had ever tried tobacco or nicotine and of the overall sample ≤40 years of age are presented in online supplemental table 1. Figure 1 shows there is a variation among countries regarding the proportion of individuals that ever tried a tobacco or nicotine product. The country with the highest proportion of people reporting having tried a tobacco or nicotine product was Estonia (85.8%) and the country with the lowest proportion was Poland (38.9%). Across the EU, boxed cigarettes were the most common product first tried (72.3%), followed by waterpipe tobacco

(8.6%), hand-rolled cigarettes (8.3%), cigars/cigarillos (3.1%), e-cigarettes (2.6%), smokeless tobacco (2.3%), other products (1.9%), heated tobacco products (0.4%)and pipe (0.4%). The proportion of the different types of tobacco or nicotine products that participants first tried in each country is displayed in online supplemental figure 1.

Table 1 presents the association between sociodemographic factors and having tried a tobacco or nicotine product. The analysis found that males were more likely to have tried a tobacco or nicotine product than women. Similarly, older participants (35-40 years) were more likely (aOR 1.59; 95% CI 1.38 to 1.84) to have used tobacco or nicotine products than younger participants (15-24 years). The odds of having tried a tobacco or nicotine product in those living in a large town were higher than those living in rural areas (aOR 1.28; 95% CI 1.14 to 1.44). Participants who almost never or never had difficulty paying their bills were less likely to have tried a tobacco or nicotine product than those with any difficulty. Additionally, participants in the 'not working' group were less likely to have tried a tobacco or nicotine product compared with those unemployed and those working.

Table 2 shows that among participants aged ≤ 40 years, those who had tried boxed-cigarettes as the first tobacco product were most likely to become ever regular users of any tobacco or nicotine product (71.5%, 95% CI 69.1% to 73.7%) while those who first tried waterpipe (19.0%, 95% CI 13.7% to 25.8%) were least likely to become ever regular users of any tobacco or nicotine product. Similarly, among those who had tried boxed or handrolled cigarettes as the first product, the probability of becoming ever regular user of combustible products was the highest. On the other hand, the highest percentage of \exists ever regular users of non-combustible tobacco was among those who first tried e-cigarettes (37.7%, 95% CI 24.9% to 52.4%). Participants who tried waterpipe as their first tobacco product also were least likely to become ever regular users of non-combustible products (3.4%, 95% CI 1.7% to 6.8%).

The adjusted association between first tobacco or nicotine product tried and becoming an ever regular user of tobacco is presented in figure 2 and supported by online supplemental table 2. Compared with those who first tried e-cigarettes, the odds of becoming a regular user of any tobacco or nicotine products were higher among those who first had a hand-rolled cigarette (aOR 2.23; 95% CI 1.43 to 3.48) or boxed cigarettes (aOR 2.08, 95% CI 1.43 & to 3.02). We observed a substantial increase in the odds \boldsymbol{g} of becoming a regular user of any individual or combination of combustible tobacco products among those who had first tried a hand-rolled cigarette (aOR 3.50, 95% CI 2.22 to 5.50) and a threefold increase among those who had first tried a boxed cigarette (aOR 2.96, 95% CI 2.02 to 4.35), compared with those who first tried e-cigarettes. aORs of becoming an ever regular user of combustible tobacco products did not differ significantly among those who first tried smokeless tobacco, heated tobacco

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Figure 1 Proportion (%) of participants aged ≤40 years who have tried tobacco or nicotine product in each country.

products, pipe or cigars/cigarillos compared with the first trial with e-cigarettes.

Discussion

We conducted a cross-country analysis among 28 European countries examining the type of tobacco or nicotine product first tried and the likelihood of becoming a regular user of any tobacco or nicotine product. Our analysis showed variation between countries with regard to the overall proportion of people who had tried tobacco or nicotine products and the type of product they tried. Overall, boxed cigarettes were the most common first tobacco or nicotine product tried followed by waterpipe while e-cigarettes and heated tobacco were relatively low. Generally, boxed and hand-rolled cigarettes as the first used tobacco or nicotine product were associated with the highest likelihood of becoming a regular user of any product while water-pipe was associated with the lowest likelihood. Our analysis found that some sociodemographic characteristics such as being male or unemployed were associated with a greater likelihood of having tried a tobacco or nicotine product compared with being female or not working. These findings are in line with previous research which shows that the prevalence of tobacco use is higher among men than women in European countries¹⁹; it seems that these disparities start from the stage of experimentation with tobacco. Similarly, the association between financial stress and tobacco use is also well established in the literature.^{20 21}

As expected, we found that boxed cigarettes were the most common first product across the 28 European countries analysed; the dominance of boxed cigarettes as the primary product in European region has been well documented.⁸ Other tobacco or nicotine products such as waterpipe and hand-rolled cigarettes were also reported to have been tried as a first product by a relatively large proportion of participants. Waterpipe has become a more

Table 1Multilevel logistic regression model exploringthe association between sociodemographic factors andlikelihood of having tried tobacco or nicotine (n=5564)

Sociodemographic factors	Have tried a tobacco or nicotine product aOR (95% CI)
Sex	
Male (reference)	1.00
Female	0.67 (0.61 to 0.73)
Age (in years)	
15–24 (reference)	1.00
25–34	1.51 (1.33 to 1.72)
35–40	1.59 (1.38 to 1.84)
Type of community	
Rural area or village (reference)	1.00
Small/middle town	1.08 (0.96 to 1.21)
Large town	1.28 (1.14 to 1.44)
Difficulty in paying bill	
Any difficulty (reference)	1.00
Almost never/never	0.69 (0.62 to 0.76)
Occupation	
Not working (reference)	1.00
Unemployed	1.73 (1.41 to 2.12)
Working	1.49 (1.31 to 1.70)
aOR, adjusted Odds Ratio.	

popular product in recent decades, particularly among youth.²² Consistent with our findings, Jawad *et al* found a high prevalence of waterpipe use in a study examining 25 eastern Mediterranean and European countries, with particularly high consumption in Latvia and Czech

Republic.²³ The consumption of waterpipe as a first product tried and its increase in popularity among youth since then can be attributed to multiple factors such as the rise in café culture of serving flavoured waterpipes in many EU regions. The perception among young populations that waterpipe is less harmful and less addictive than conventional tobacco products is another possible contributing factor for why young populations may be more inclined to try or experiment with it as their first tobacco product.²⁴

Aside from factors such as increasing popularity and perception that flavoured tobacco is less harmful, the perception of novelty has also contributed to the increased consumption and experimentation of other products such as e-cigarettes in younger populations. Tolke found that 8 among young adolescents, the perception of novelty and harmlessness were primary drivers of experimentation.²⁵ Although research has found high prevalence of experimenting or having first contact with e-cigarettes, our analysis showed that the proportion of people who reported to have first tried e-cigarettes or other novel products such as heated tobacco was still relatively low compared with cigarettes. This could be explained by the relatively recent uses rela emergence of these products as many individuals in our study had their first experience with tobacco or nicotine in a period when e-cigarettes and heated tobacco products were not yet readily available. Our sample did not include a sufficient number of adolescents and young adults to đ allow in-depth analysis in these groups, and hence was not e appropriate to investigate current trends in age groups where experimentation and trying tobacco or nicotine for the first time is most likely to happen. However, with ta a sample that would have been able to capture current trends, it is likely that first contact with nicotine through e-cigarettes and other novel products would have been more prevalent in adolescents and young adults.

Table 2Weighted proportion (%) of respondents aged \leq 40 years who tried a tobacco or nicotine product and became everregular users of one of the products in product groups (n=5564)

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	Weighted proportion in percentage (95% CI) of respondents that tried a nicotine/ tobacco product and became ever regular users*		
First tobacco or nicotine product	Ever regular user of combustible tobacco†	Ever regular use of non- combustible nicotine‡	Ever regular use of any product§
E-cigarettes	29.4 (18.8 to 42.9)	37.7 (24.9 to 52.4)	49.1 (35.0 to 63.3)
Boxed cigarettes	68.3 (65.9 to 70.6)	9.8 (8.4 to 11.5)	71.5 (69.1 to 73.7)
Hand-rolled cigarettes	68.7 (60.6 to 75.8)	12.1 (7.5 to 19.0)	69.8 (61.7 to 76.8)
Cigars/cigarillos	37.2 (25.7 to 50.3)	8.4 (3.1 to 20.9)	37.8 (26.3 to 50.9)
Pipe	48.1 (21.1 to 76.3)	18.8 (3.6 to 59.1)	48.1 (21.1 to 76.3)
Waterpipe	18.5 (13.2 to 25.2)	3.4 (1.7 to 6.8)	19.0 (13.7 to 25.8)
Smokeless tobacco	37.1 (24.0 to 52.4)	34.0 (20.9 to 50.1)	51.1 (37.1 to 64.9)
Heated tobacco	35.2 (14.0 to 64.3)	22.3 (9.1 to 45.3)	49.1 (22.2 to 76.5)

*Regular use is defined as self-reported daily or weekly use of the respective product.

+Combustible tobacco: boxed cigarette, hand-rolled cigarettes, cigars/cigarillos, waterpipe and pipe.

‡Non-combustible nicotine products: e-cigarettes, smokeless tobacco, heated tobacco.

§Any product refers to all combustible and non-combustible products.

Regular User of Combustible Tobacco Products



Regular User of Non-Combustible Tobacco Products



Regular User of Any Tobacco Product



Figure 2 Association between first tobacco or nicotine product used and becoming a regular user of combustible, non-combustible or any tobacco or nicotine product.

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When comparing different countries, we found that there was large variation in terms of the overall proportion of people who tried tobacco or nicotine and the type of product that was first tried. There are several possible reasons that can explain these variations such as tobacco control policies, market prices, availability of products, and differing social and cultural norms. For instance, in some countries such as Finland, Estonia and Latvia, the prevalence of ever use was found to be very high, perhaps because of the widespread experimentation with waterpipe or/and smokeless tobacco. On the other hand, our analysis showed that in other countries, such as Poland, Italy, Malta and Portugal, a much lower proportion of participants aged ≤ 40 had tried a tobacco or nicotine product. Although the prevalence of smoking is not low in those countries,¹⁹ their common characteristic was that boxed cigarettes dominated the responses in the question about the first product ever used.

While boxed cigarettes were reported to be the most common first product tried in all 28 countries, there was substantial variation in other products tried, which can similarly be explained by regulatory and cultural factors. For example, the proportion of people who had an e-cigarette as their first tobacco or nicotine product varied considerably among countries with the highest proportion reported in the UK and Ireland. This finding is expected given the more permissive and relaxed regulations towards e-cigarettes in these countries compared with others.²⁶ Similarly, Sweden was found to have a much higher percentage of users that tried smokeless tobacco as their first product compared with other countries where the use of smokeless tobacco was relatively low. A form of smokeless tobacco known as Swedish snus/moist snuff is commercially available in Sweden but banned in the rest of the EU.²⁷

Our analysis also explored the association between the type of first product tried and becoming a regular user of any tobacco or nicotine product. We found that compared with e-cigarettes, boxed and hand-rolled cigarettes were associated with a higher probability of becoming a regular user of any tobacco or nicotine product and trying waterpipe was associated with a lower probability of becoming a regular user of any product. This seemed to be an element of a broader pattern, in which those who started with combustible products are more likely to become regular users of combustible products whereas those who started with non-combustible products were more likely to become regular users of non-combustible products. While trying non-combustible products first was associated with a lower 'conversion rate' to becoming a regular user compared with conventional cigarettes, a sizeable proportion of those who first tried e-cigarettes and other non-combustible products still ended up becoming regular users of combustible tobacco. This raises concerns about the gateway theory which has often been explored regarding e-cigarettes.¹⁶ ¹¹ Although no causal inferences can be concluded, this could be useful information for tobacco control policy-makers given the

high level of interest and debate regarding e-cigarette use, particularly among youth.

Some associations can be explained by the circumstances under which first contact with tobacco or nicotine occurs. For example, waterpipe is often consumed during a social event which could lead to many people trying it without having any intention of becoming a tobacco or nicotine user.²⁸ Exposure to it is often brief, therefore, addiction to nicotine, which leads to sustained use, may be less likely compared with cigarettes, for example. Similarly, e-cigarettes and heated tobacco products are novel and appealing to youth who often perceive them as more galatable and less harmful²⁵; there may be a proportion ŝ of people who try such products out of curiosity but have no intention of turning into regular users. Despite that, a 8 considerable proportion of those who started with e-ciga-rettes and heated tobacco products ended up becoming regular users of nicotine-containing products, although regular users of nicotine-containing products, although we do not know the trajectory that led them to regular use.

Aside from yielding novel insights regarding first experience with nicotine products and transition to regular use, there are several strengths of our analysis. This is the most use up-to-date study assessing first tobacco or nicotine product use and transition to regular use of tobacco or nicotine products in Europe. The analysis of data from 28 European countries with weighted samples allows for cross-country comparisons and more in-depth insights on European 8 tobacco control policy development. Although none response rates of the Eurobarometer were not published, the use of weighted estimates in this study, was able to account for this non-response to a certain extent. At the same time, some limitations must also be acknowledged. The study design with no follow-up information means Ξ that no causal inferences can be made about first nicotine or tobacco product tried and becoming a regular user. ≥ Since all questionnaires were self-reported, it is important to address that responses could be subject to recall bias or misreporting, although there is no reason to believe this varied between countries or population subgroups. Although we adjusted for factors such as age, sex and financial difficulties, there may be residual confounding S since the survey did not capture data on factors such as race/ethnicity and mental health. Moreover, information about dual or poly use of tobacco or nicotine products in the past/present was limited; therefore, our analysis could not capture the complexities of experimentation and transitions from one tobacco or nicotine product to another. Lastly, the exclusion of individuals above 40 years of age reduced the country-specific sample size, thus resulting in a broader CI for specific estimates. However, we felt that it was necessary to limit the age range in order to reflect relatively recent changes in the European tobacco market and provide a more relevant picture.

CONCLUSION

Our study found that wide variation exists in Europe both in terms of overall experimentation with tobacco

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and nicotine products and regarding the most popular products for early experimentation. Although this analysis provides a big picture overview for countries across Europe, it could not explore the local tobacco markets and how national policies and cultural factors can influence experimentation and transition to regular use of the same or a different product. These issues are important because the tobacco industry targets youth. Preventing any experimentation with nicotine is a key aim of tobacco control, as well as limiting transition to regular use following experimentation. Thus, our findings can support targeted interventions which should be tailored to the local context.

Contributors JG collected the data and conducted the analysis presented. FTF conceptualised the study and contributed to data analysis. JG and NBR drafted the manuscript. All authors contributed to the interpretation of the results and manuscript revision. FTF is the guarantor of the study; he accepts full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish. All authors read and approved the final manuscript.

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