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INSIGHTS INTO YOUTH SMOKING INITIATION IN SERBIA

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ABSTRACT

Background

This study aims to analyze smoking initiation determinants among young people in Serbia, focusing on price and non-price tobacco control measures, social and family influences, and the impact of the educational environment and health behaviour programs. Insights into youth smoking initiation are significant for the implementation of tobacco control policies in Serbia because 15.1 percent of youth aged 13-16 have smoked cigarettes at least once during their lives. Since the average age at which young people in Serbia try cigarettes for the first time is 12, tobacco control policies need to be improved to have a greater impact on young people and additional health and educational programs on the harmful effects of tobacco use need to be implemented.

Methodology

This study uses the data from the Global Youth Tobacco Survey (GYTS), which is a cross-sectional, school-based survey implemented and monitored through collaboration between the World Health Organization (WHO) and the U.S. Centers for Disease Control and Prevention (CDC). The GYTS collects data on various aspects of tobacco use among students in grades 7 and 8 in elementary schools and grades 1 and 2 in high schools. The determinants of smoking initiation among young people (13 to 16 years old) are estimated using a split population model. To estimate the impact of different variables influencing smoking initiation among students, we used cigarette prices, non-price tobacco control policy variables, tobacco control policy index, as well as gender, family smoking status, teachers smoking indoors, education on smoking, and friends' smoking behaviour.

Results

The results show that for each unit increase in price, the risk of smoking initiation declines. Higher prices reduce the likelihood of cigarette initiation among students by 0.2 to 2.2 percent. Moreover,-the initiation elasticity ranges from -0.089 to 0.107. In other words, if cigarette prices increase by 10 percent, the number of youths who initiate smoking will be lower by 0.89 or 1.07 percent. Non-price tobacco control measures are effective in reducing smoking initiation since hazard ratios are below one. Implementing non-price tobacco control measures can discourage smoking initiation among students by 5.1 to 7.8 percent. Parental smoking, both maternal and paternal, increases the risk of youth smoking initiation, with exposure to smoking siblings also contributing to higher risk. Youth exposed to parental smoking at home are more likely to start smoking compared to adolescents not exposed to this factor. Furthermore, adolescents who see their teachers smoking or have friends who offer them cigarettes are more likely to start smoking. Peer influence is the factor that matters the most, notably stronger for girls.

Conclusion

This study provides valuable insights into the determinants influencing smoking initiation among young people in Serbia, underlining the impact of cigarette prices, social influences and education. It highlights the significant influence of family and teachers on young people's smoking behavior, while cigarette prices have a statistically significant influence, their direct impact on smoking initiation is relatively weak. The results suggest that incorporating these findings into policy can help reduce tobacco use among youth by addressing the critical role of family, peers and education.

JEL codes: I12, I18, L66

Keywords: Youth smoking initiation, split population model, elasticity, cigarette prices, tobacco taxation

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1. INTRODUCTION

Youth smoking initiation remains a public health concern worldwide, with significant implications for long-term health outcomes (CDC, 2022). In Serbia, as in many other countries with high smoking prevalence, understanding the factors that contribute to the onset of smoking among youth is crucial for the development of effective prevention and cessation strategies and interventions. According to the latest data published by the Institute of Public Health "Batut", 15.1 percent of students in the fifth and seventh grades of elementary school and the first year of high school have smoked cigarettes at least once in their lives, with the frequency of smoking increasing with age (HBSC, 2024). Boys in the fifth and seventh grades of elementary school are more likely to try smoking than girls. However, the frequency of smoking at least once is higher for girls than for boys in the first grade of high school. Compared to 2018, the percentage of students in the fifth and seventh grades of elementary school who have tried cigarettes has increased, while this percentage has decreased among students in their first year of high school (Table A1). Besides cigarettes, students also use heated tobacco products, electronic cigarettes, or nicotine pouches. The results of the same survey show that one in five first grade students have used electronic cigarettes in the past 30 days (19.9 percent), which are equally popular among boys and girls (Table A2). 12.8 percent of fifth- and seventh-grade elementary school students and first-grade high school students have tried smoking hookah at least once in their lives, 6.4 percent have tried heated tobacco products and 4.9 percent of students have tried snus or nicotine pouches (Table A3). This study aims to provide an analysis of smoking initiation determinants among young people in Serbia, focusing on price and non-price tobacco control measures, social and family influences, and the impact of the educational environment and programs.

This study builds on the existing literature by using a split-population model in the field of health economics in LMICs. By examining the impact of various determinants, this research provides a holistic view of the factors contributing to smoking initiation. However, the study does not address the role of alternative tobacco products, which are increasingly prevalent among youth.

The results presented in the study can contribute to a better understanding of youth smoking behavior in Serbia and provide valuable insights for policymakers and public health professionals in order to create strategies against the tobacco pandemic. The evidence-based policy recommendations will improve new policy documents on the positive effects of price and non-price tobacco control measures.

The *Literature Review* section provides a comprehensive overview of existing research on youth smoking initiation, analyzing both price and non-price measures while identifying gaps in the literature, particularly for low- and middle-income countries (LMICs). The *Methodology* is divided into several subsections: Data (inputs to the study), Split population model, GYTS Survey Description, and Variables. The *Results* section presents descriptive statistics and results from the split-population model. Finally, the *Discussion, Conclusion, and Recommendations* sections summarize the key insights into youth smoking initiation in Serbia and provide concrete policy recommendations.

2. LITERATURE REVIEW

In recent years, extensive research has been conducted to understand why adolescents around the world begin smoking. Most studies focus on when and how young people started smoking and how they decided to quit (DeCicca et al., 2008). Researchers have identified the price of cigarettes as an important factor in whether or not young people start smoking (Lewit et al, 1981; Chaloupka and Grossman, 1996; Chaloupka, 1999; Czart et al, 2001; Tauras et al, 2001; Ding, 2003; Zhang et al, 2006; Nonnemaker and Farrelly, 2011; Kim et al, 2016; Guindon, 2014; Joseph and Chaloupka, 2014). However, several studies have found inconclusive evidence of the influence of price on smoking initiation among adolescents (Douglas and Hariharan, 1994; Douglas, 1998). Some researchers divided teenagers into two categories to clarify the influence of price on smoking initiation. They concluded that the most important determinant of youth smoking is price, but younger teenagers (13 to 16 years old) are less sensitive to price compared to older teens (17 to 18 years old) (Gruber and Zinman, 2001). In the US, for example, some studies have found no relationship between tobacco prices and smoking initiation (DeCicca et al., 2008). There are also differences between boys and girls when it comes to how they respond to price changes (Cawley et al, 2004; Nonnemaker and Farrelly, 2011; Tauras et al, 2013; Nikaj and Chaloupka, 2014).

The practice has shown that adolescents usually get their first cigarette from friends, siblings, and parents. According to Klein et al. (2013), more than 50 percent of students got their first cigarette from a friend, and almost 30 percent took or stole it from someone (parents, relatives, friends). Bradshaw et al. (2021) find that adolescents and early adults may initiate smoking because their friends or, even their parents, provide access to cigarettes and encourage them to smoke.

In addition to price measures, non-price measures have also proven to be determinants of smoking initiation. As Lopez Nicolas (2002) points out, increased health warning campaigns have proven to be effective in preventing smoking initiation. Similarly, laws on the minimum age for purchasing cigarettes have shown a negative impact on smoking initiation, while restrictions on smoking in public places have directly influenced cigarette consumption by creating a less smoking-friendly environment, especially among young people (Tauras et al., 2001; Palali & van Ours, 2019).

Having a friend or family member who smokes is also important. Hanging out with friends who smoke or having family members who smoke at home, increases the probability that someone will start smoking (Kobus, 2003; Suranovic et al., 1999; Powell and Chaloupka, 2005). On the other hand, the results of different studies have shown that children whose parents do not smoke can help prevent the onset of smoking (Hill et al., 2005; O'Loughlin et al., 2009).

To the best of our knowledge, there is no similar research in Serbia providing evidence on the topic of youth smoking initiation. Investigating the effects of price and non-price tobacco control measures on smoking initiation among young people in Serbia is crucial due to the high prevalence of smoking initiation at a young age and the associated long-term health consequences.

This study will help improve public health outcomes and understand the factors that may help prevent youth smoking initiation in Serbia.

3. METHODOLOGY

Data

The Global Youth Tobacco Survey (GYTS) datasets for Serbia are used in this research. The GYTS is a national representative school-based survey conducted worldwide to monitor tobacco use among youth and to evaluate the impact of tobacco control policies. It is a component of the Global Tobacco Surveillance System (GTSS). It is implemented and monitored through collaboration between the World Health Organization (WHO), the U.S. Centers for Disease Control and Prevention (CDC), and other international partners. The GYTS collects data on various aspects of tobacco use among students in grades 7 and 8 in elementary school and grades 1 and 2 in high school (13 to 16 years old). GYTS topics include the prevalence of smoking, initiation and cessation of smoking, exposure to secondhand smoke, attitudes toward tobacco use, and knowledge about the health effects of smoking. Data is also gathered on factors affecting tobacco use, such as media and advertising, access to tobacco products, and tobacco control policies.

The survey uses a standardized methodology and questionnaire, allowing for the comparability of data across different countries and regions. Countries can slightly adapt the questionnaires according to the specific questions related to tobacco control issues. By tracking trends in youth tobacco use over time and evaluating the effectiveness of tobacco control measures, GYTS helps policymakers and public health officials develop evidence-based strategies to reduce youth tobacco use and prevent the incidence of tobacco-related diseases.

There are four waves of GYTS (repeated cross-section surveys) for Serbia, covering the years 2003, 2008, 2013 and 2017. In this study, we use the 2008, 2013 and 2017 GYTS due to data availability.

According to the WHO, the GYTS questionnaire is designed to cover the following topics: a) Knowledge and attitudes of young people towards cigarette smoking, b) Prevalence of cigarette smoking and other tobacco use among youth, c) The role of the media and advertising in young people's use of cigarettes, d) Access to cigarettes, e) Tobacco-related school curriculum, f) Environmental tobacco smoke (ETS), g) Cessation of cigarette smoking. Over the years, however, the questionnaire has not covered all topics. In addition, the questionnaire has also been modified to adapt to new tobacco products and trends in their use.

In Serbia, all of these topics were addressed. However, the structure of the questionnaire varies across the individual years, so the questions are not fully compatible when all three waves are considered together. In all waves, the survey includes students in 7th and 8th grade of elementary schools and 1st and 2nd grade of high schools in Serbia. As the questionnaires used in the surveys were slightly adapted over the years, this affected the design of the variables used in the study. "*Do your parents smoke?"* was only asked in 2008, while in 2013 and 2017 it was designed *as "How often do you see your father (stepfather or mother's partner) smoking in your home?"* and *"How often do you see your mother (stepmother or father's partner) smoking in your home?"*. In

2008, several questions considered the friend's smoking status and its impact on initiation *"Do any of your closest friends smoke cigarettes?*", *"If one of your best friends offered you a cigarette, would you smoke it?"*, and *"Do you think boys who smoke cigarettes have more or less friends?/Do you think girls who smoke cigarettes have more or less friends?"*. In 2013 and 2017 all these questions were changed to only one "Does your friend offer you tobacco?". These examples indicate that there were differently designed questions on the same topics over the years. But, besides that issue, we found out that in the databases the same question has different response options in different waves (e.g. last 30 days/last month). To solve this problem, as elaborated in a later section, we had to recode the answers to get comparable answers in order to merge all available waves into one database.

Split population model

To model the determinants of smoking initiation, we used duration analysis, assuming that all individuals eventually experience the event of interest. Duration analysis examines the time it takes for events to occur, providing insights into the factors influencing their timing and occurrence. The duration analysis in this study follows the literature (Jovanovic et al, 2023; Mugoša et al, 2023) on smoking among youth and focuses on understanding the timing and determinants of smoking initiation. By examining the duration between the age of risk and the age of smoking initiation, we identified the key factors that influence the timing of smoking initiation in young people. This analytical approach allows us to examine how variables such as price, peer influence, and family background affect the timing of smoking onset among adolescents.

Although this approach makes the best use of the information in the sample, it is not realistic to assume that all respondents will initiate smoking, as there are a number of students who never try it. Therefore, we used the split-population model as it provides a more comprehensive understanding of smoking behavior among youth as it also takes into account individuals who may never start smoking. This model is also used by Kostova et al. (2011), Merkaj et al. (2022), and Jovanovic et al. (2023). The split-population model accounts for the possibility that some respondents will never experience the event and weights each observation by the estimated probability of eventual smoking initiation. This model is useful when it is unlikely that a significant proportion of the sample will ever experience the event, such as never starting smoking despite being at risk. A detailed explanation of the split-population duration model can be found in Guindon (2014). To implement the split-population model, the data must be structured in a pseudo-longitudinal format, including the transformation of cross-sectional surveys into pseudo-panel data. Transforming cross-sectional surveys to pseudo-panel data involves organizing the data in a format similar to panel data, even if the surveys are conducted with different individuals at different points in time. In a traditional panel dataset, the same individuals are surveyed repeatedly over time. Pseudo-panel data, on the other hand, constructs panels by grouping individuals based on common characteristics, such as age or cohort, rather than tracking the same individuals over time. This allows analyzing changes over time within these groups. In our study, respondents are grouped by age cohorts (e.g., 12-year-olds, 13-year-olds, etc.), while the changes

within each cohort are analyzed over the years. By treating these age groups as "pseudo-panels," we can estimate the effects of various factors on smoking initiation or cessation over time.

This format enables analysis of time-to-event data, where the first step is to identify the year of smoking initiation based on respondents' reported age when they first tried a cigarette. Furthermore, in line with previous research, we assume an initial age of risk for smoking initiation, setting it at age 9 to capture the onset of experimentation with cigarettes (Jovanovic et al., 2023).

Survey Description

GYTS employs a globally standardized methodology, which involves a two-stage sampling design. In the first stage, schools are selected using a probability proportional to the number of students. Within these selected schools, classes are then chosen randomly, and all students in the selected classes are eligible to take part in the survey. As the GYTS refers to the population of young, in the following table you may find the details on Serbia's total youth population (SORS, 2022).

Table 1. Youth in Serbia, by age and gender

Age	Gender	Republic of Serbia
10–14	Total	323,322
	Boys	166,740
	Girls	156,582
15–19	Total	337,351
	Boys	172,986
	Girls	164,365
20–24	Total	337,105
	Boys	172,013
	Girls	165,092
25–29	Total	373,087
	Boys	190,414
	Girls	182,673

Source: SORS database, available at: https://data.stat.gov.rs/?caller=SDDB

In 2008, a total of 4,727 students participated in the Serbia GYTS, 3,350 of whom were aged between 13 and 15. The school response rate was 100.0%, the student response rate was 89.8%, the class response rate was 99.6% and the overall response rate was 89.4%.

In 2013, a total of 3,994 eligible students in grades 7 and 8 of primary school and grade 1 of high school completed the survey, out of whom 3,076 were aged between 13 and 15 years. The overall response rate was 83.2%.

In 2017, a total of 3,861 eligible students in grades 7 and 8 of primary schools and grade 1 of high schools completed the survey, out of whom 3,362 were aged 13-15.

In the final database used for this study, only students aged 13-16 were included, while others were excluded due to inconsistencies in the data. The total number of students in the final

database is 11,105. The largest share of the sample has students aged 14 and 15. The details are given in the following table.

Table 2. The structure of the respondents by age

Age	Number of students	%
13	1,994	17.96
14	3,325	29.94
15	3,973	35.78
16	1,813	16.32

Source: Authors' own calculations based on GYTS data

Variables

The period covered by the analysis in this study extends from 2007 to 2018 and is determined by the years in which the GYTS were conducted and the availability of compatible cigarette price data. The dependent variable is smoking initiation. It is based on the question *"Have you ever tried or experimented with cigarette smoking, even one or two puffs?"* and is equal to 1 if respondents have ever tried cigarettes (respond as yes) or 0 if the respondents have never tried cigarettes (respond as no). This variable is in line with the literature in the field such as Merkaj et al. (2022), Mugoša et al. (2023), and Jovanovic et al. (2023).

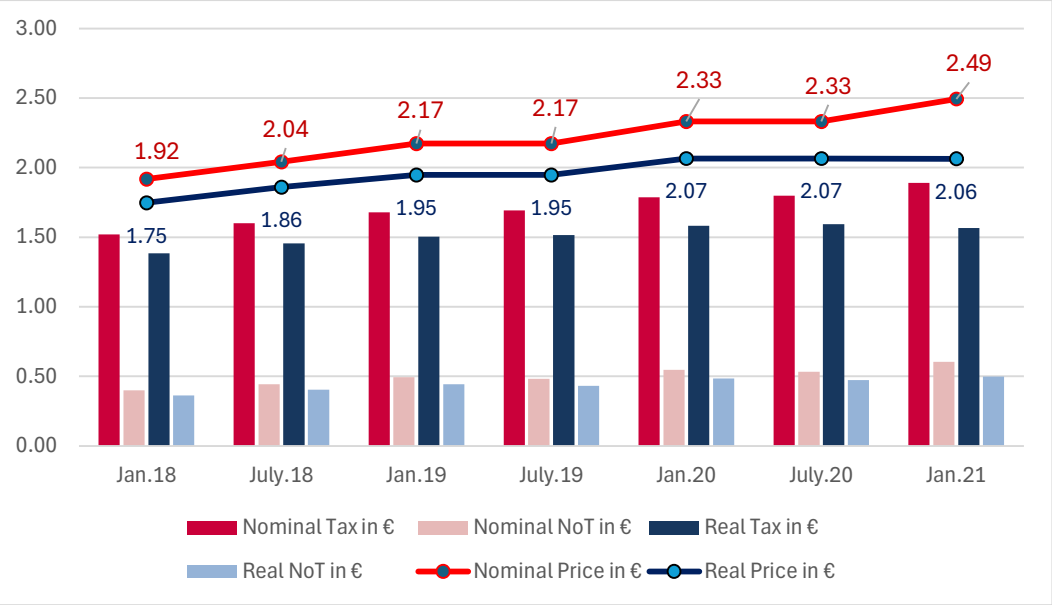
To determine the variables that influence smoking initiation among students, we decided to use cigarette prices, non-price tobacco control policy variables[1], tobacco control policy index[2], as well as gender, family smoking status, the question on whether teachers smoke indoors, education on smoking, and friends' smoking behavior. These variables were chosen based on the available literature, the requirements of the study, and the specifics of tobacco control in Serbia. The dependent variable is expressed by modelling as a function of the selected variables of interest. The most frequently used variable for cigarette prices is the weighted average price (WAP). The WAP of cigarettes is a statistical indicator that considers the different prices of cigarettes in sales, as well as the quantity of those cigarettes sold at a certain price. The weighted price is calculated by multiplying each cigarette price by the share of sales of that price in total cigarette sales, then adding up those values and dividing by the total cigarette sales. This indicator provides an average price that reflects both the diversity of prices and the volume of cigarette sales. The data on cigarette prices is obtained by the Tobacco Administration for the period 2007 to 2018.

The latest available data on the weighted average price of cigarettes per pack in Serbia was published for the year 2021. Figure 1 shows its trend in the period from 2018 to 2021, in nominal and real terms. The cigarette price is constructed of several components, such as the specific excise, the ad valorem excise, the value-added tax (VAT), and the net-of-tax (NoT). The sum of the excise duty and tax components makes the total tax burden on the cigarette price per pack.

[1] The non-price tobacco control policy variable refers to only one specific policy measure implemented in one year (Advertising Law and the Law on Preventing Population from Exposure to Tobacco Smoke).
[2] The tobacco control policy index refers to the sum of all tobacco control policy measures implemented in one year, as designed by Ross and Al-Sadat (2007).

According to the Excise Law, the specific excise is defined by the excise calendar for all imported or domestically produced cigarettes. This calendar includes adjustments to the specific excise every 6 months. The current excise calendar is published for the period until December 31, 2025. In addition to the specific excise, the law also implies the calculation of a 33 percent ad valorem excise based on the retail cigarette prices. It is important to note that the total excise of cigarettes per pack needs to be adjusted to the Consumer Price Index (CPI) in Serbia. These adjustments are mandatory if the annual CPI exceeds 2 percent. The last adjustment in Serbia was made in mid-2024.

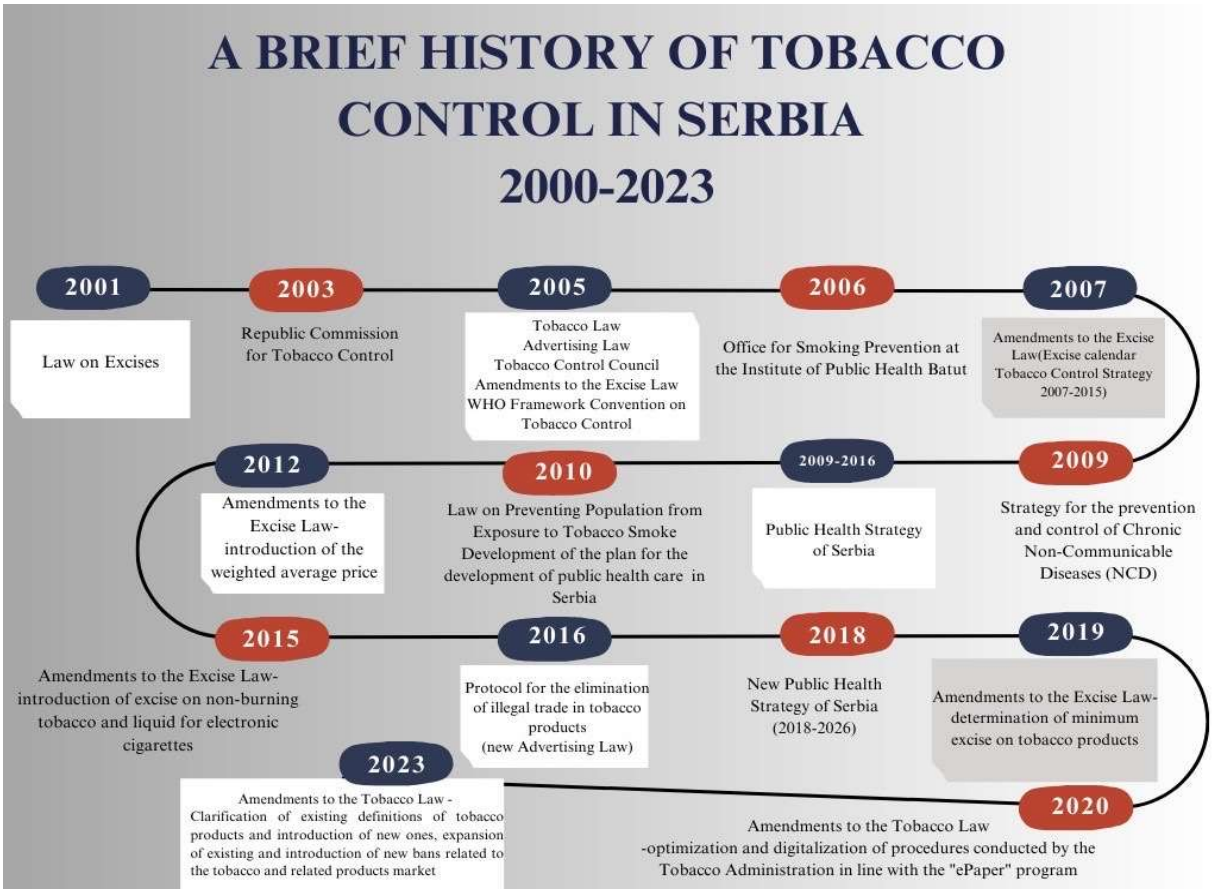
Figure 1. Nominal and real values of weighted average price (WAP), total tax, and net-of-tax per cigarette pack in Serbia, in EUR



Source: Author's calculation based on data obtained from Tobacco Administration

To include the impact of tobacco control policies we constructed a tobacco policy index followed by Ross and Al-Sadat (2007). The policy index is calculated as the sum of all policies implemented at the time of analysis. Policies that were adopted before 2007 but were implemented during the observed period are also included. The policies from the 2010 Law on Preventing Population from Exposure to Tobacco Smoke and 2016 Advertising Law were used for the robustness check (Table A14). A history of Tobacco Control Policies is presented in Figure 2.

Figure 2. History of Tobacco Control Policies in Serbia 2000 – 2023



Source: Author's research

The two most important policies that may have an impact on the initiation among youth are the Advertising Law and the Law on Preventing Population from Exposure to Tobacco Smoke. The implementation of the Advertising Law aims to restrict and regulate the advertising of tobacco products to protect public health. The Law sets strict guidelines for the promotion of tobacco products to reduce exposure to their advertisements and influence smoking cessation, especially among young people. These guidelines include a ban on advertising tobacco products on television, radio, in the print media, and in public places. In addition, the sponsorship of sports and cultural events by tobacco manufacturers is prohibited. The implementation of these measures is closely monitored, and violations are subject to punishment by the law. Furthermore, Serbia has ratified the World Health Organization Framework Convention on Tobacco Control (WHO FCTC) in 2005, which further encourages the implementation of tobacco control measures. These initiatives aim to reduce the attractiveness of smoking among citizens and contribute to reducing the number of smokers, as well as improving the overall health of the population. The Law on Preventing Population from Exposure to Tobacco Smoke regulates where smoking is permitted and where it is not permitted. Smoking is strictly prohibited in healthcare facilities,

schools, and state institutions, while it is partially allowed in restaurants and bars. The Law requires the placement of signs that mark areas where smoking is prohibited. Penalties are prescribed for those who do not follow these bans, which may include fees or closure of the facility. Special attention is paid to protecting non-smokers from passive smoking, to ensure their right to clean air.

Of the socio-demographic characteristics of the respondents, gender was included in the study, despite the lack of significant difference in smoking prevalence between men and women in Serbia, where rates are high in both genders (Zubović et al., 2020). However, hazardous influences can have different effects on the onset of smoking among adolescents, with gender playing an important role. Social pressure, peer influence, and the media can contribute to the initiation of smoking among boys and girls in different ways (Primack, 2009; Simons-Morton et al., 2004). To address these issues, interventions must be tailored to the specific vulnerabilities of each gender (World Health Organization, 2018). By identifying and mitigating these risks, we can reduce smoking initiation rates among boys and girls, promoting healthier choices and behaviors (Schneider et al., 2016; Villanti et al., 2017). Therefore, it is of great importance to include gender in the analysis to test if there are statistically significant differences in smoking initiation between girls and boys. The influence of the family on the onset of smoking among youth is a topic that has been researched in many scientific studies (Gilman et al, 2009; Kong et al, 2012). Some of the key findings indicate that the family environment and parental behavior can significantly impact smoking among children and adolescents. Studies have shown that children whose parents or older family members smoke are more likely to start smoking at a younger age and have a higher risk of becoming regular smokers. This could be because children model their parent's behavior and they perceive smoking in their family as acceptable or normal. As the questions about parental smoking were different across the different waves, we have used and modified questions "*How often do you see your father (stepfather or mother's partner) smoking in your home?", "How often do you see your mother (stepmother or father's partner) smoking in your home?",* and *"How often do you see your brother/sister smoking in your home?".* To be comparable among databases, the question was recoded so that the answers "about every day, sometimes" were combined into one answer marked as "yes" (in other words, the student has a parent who smokes at home). A similar procedure was used for the variable brother/and sister smoking variable (sibling smoking). Another important explanatory variable often discussed in the literature is the friends' smoking status. The original variable used in the literature to estimate the impact of susceptibility to best friends' pressure was based on the question "*Do any of your closest friends smoke cigarettes?"* Since this question was only asked in the GYTS 2008, we used a more consistent question for our analysis *"If one of your best friends offered you a cigarette, would you smoke it?".* This approach allows us to maintain comparability across all three waves and to better estimate the influence of peers on youth smoking initiation.

Teachers have an important role in preventing children from smoking in several ways. They can educate about the harmful effects of smoking, inform students about the negative health consequences, and support students in developing social skills and resilience to peer pressure. Prevention programs in schools and collaboration with parents are essential to prevent children

from starting to smoke. Research has shown that children who see their teachers smoking are more likely to have a positive attitude towards smoking and may even start smoking (Poulsen et al., 2002). When children see their teachers smoking, it can diminish their perception of teachers' authority and reduce their influence in promoting healthy behavior among students. A variable used in the analysis is derived from the question *"During school hours, how often do you see teachers smoking indoors on school premises?"*. The answers "about every day, sometimes" were combined into one answer as "yes" (in other words, the student has seen a teacher who smoked at school indoors). As previously mentioned regarding the importance of educating young people about the dangerous effects of smoking, one section of the GYTS focuses specifically on assessing knowledge of these effects and when students have acquired this knowledge. We decided to include the question *"During this school year, were you taught in any of your classes about the dangers of smoking?".*

4. RESULTS

Descriptive statistics

The average age of the respondents in the sample is 14.5 years. In Serbia, young people start smoking at the age of 12, with a slight difference between genders. Boys usually initiate smoking at the age of 11.7, while girls usually initiate at the age of 12.2. More than 40 percent of students have tried or experimented with cigarette smoking. A detailed analysis can be found in Table 3.

Table 3. Descriptive statistics

Number	Indicator	Description	Value
1	**Age**	**The average age of the respondents at the time of the interview**	**14.5**
		2008	14.4
		2013	14.7
		2017	14.4
	Male		14.5
	Female		14.5
2	**Age of initiation**	**Average age of the respondents when they first tried cigarettes**	**12.0**
		2008	11.0
		2013	12.3
		2017	12.6
	Male		11.7
	Female		12.2
3	**Smokers (%)**	**A dummy variable that indicates the respondents that have ever tried of experimented with cigarette smoking, even one or two puffs**	**40.8**
	Male		41.0
	Female		40.5

4	**Age**	**Average age of the respondents from the sample who tried cigarettes**	**14.50**
	Male		14.52
	Female		14.49

Source: Authors' own calculations based on GYTS data

The frequency of smoking is an important parameter of the smoking status among youth since most of them are in experimental phases and do not consider themselves smokers. *"Did you smoke in the past 30 days?"* is a variable that is used to assess recent smoking behavior among the respondents. It can be used as a variable for changes in smoking behavior over time. In Serbia, most students have not smoked at all during the past 30 days. On the other hand, 3.8 percent of students have smoked cigarettes every day during the past month. An additional 3.6 percent of students have smoked cigarettes for only one or two days.

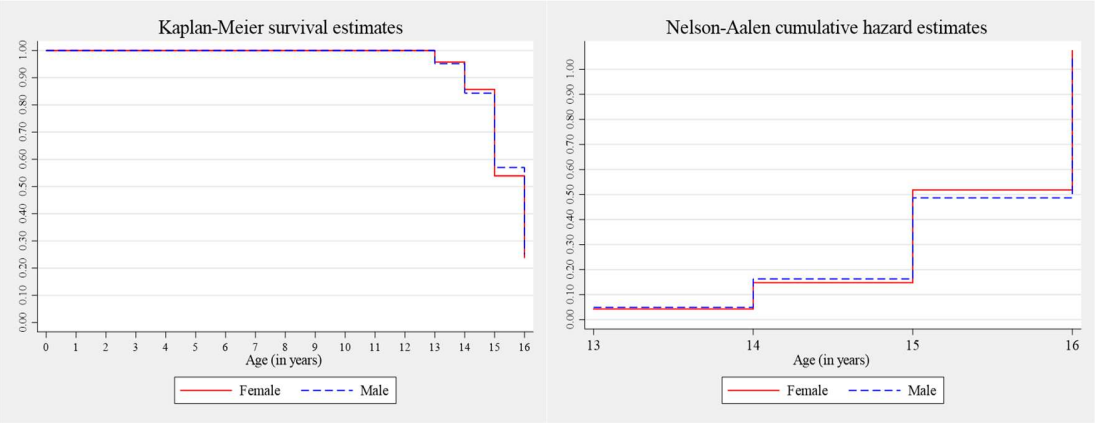
However, despite the results on the frequency and intensity of smoking in Serbia, it is encouraging that 43.7 percent of the students who have tried smoking (even one or two puffs) have tried to quit. The details are provided in Table A6 and Table A7 in the Appendix. More than 15 percent of students who tried smoking (even just one or two puffs) received advice to quit from a friend, and 13 percent from family. It is worrying that more than 10 percent of students who tried smoking (even one or two puffs) did not receive any advice from friends, family, or professionals (Table A9). On the other hand, almost 60 percent of students were educated about the harmful effects of smoking (Table A10). Considering that the use of tobacco products is not prohibited in TV series and movies, young people are very exposed to such influence, especially by people who are their idols. Consequently, more than 80 percent of respondents see people using tobacco on TV (Table A11).

Since gender can play a significant role in the design and implementation of tobacco control policies among youth, we employed a t-test for statistically significant differences between genders in the initiation of smoking among young people. A higher absolute value of the t-test statistic indicates a greater difference between the groups. In the case of Serbia, the t-test statistic is 5.4232. This shows that there is a substantial difference in the initiation of smoking between genders. The difference in smoking initiation between girls and boys may influence the characteristics of non-price tobacco control measures, as some of them may be considered more effective for girls compared to boys, and vice versa.

Figure 3 shows the results for the risk of smoking initiation for boys and girls (Kaplan-Meier survival function) as well as the cumulative hazard risk of smoking initiation (Nelson-Aalen hazard estimates). The probability that someone will become a smoker decreases over time. For example, the graph shows that the probability of respondents starting to smoke after 15 years is 55 percent for both girls and boys. The second graph illustrates the Nelson-Aalen cumulative hazard, offering valuable insights into the cumulative risk associated with smoking initiation. For example, the cumulative risk of starting to smoke at the age of 15 is slightly above 50 percent for girls and slightly below 50 percent for boys. This is quite a surprising result, considering that it is

widely accepted in the literature that the risk of becoming a smoker increases up to a certain age and decreases thereafter, but is lower in girls than in boys.

Figure 3. Hazard to initiate smoking by gender in the period 2007 - 2018



Source: Authors' own calculations based on GYTS data

This result motivated us to conduct an analysis using logistic regression, where we aimed to examine the influence of family members on initiation among girls. The results showed that among girls, the likelihood of starting smoking is 1.74 times higher if the mother is a smoker and when tobacco products are consumed at home. In contrast, the probability of initiation when the father is a smoker and when tobacco products are consumed at home is 1.22, i.e. lower than the impact of the mother. In addition, the influence of siblings on smoking initiation is most pronounced for girls, reaching 3.57 times the probability. For boys, the likelihood of starting smoking if the mother is a smoker is 1.41, while the likelihood of starting smoking if the father is a smoker is 1.30. If a brother or sister are smokers and uses tobacco at home, the probability that the boy will start smoking is 2.66.

Results of the split population model

The results of the split-population model are shown in Table 4. Model 1 is basic and includes only the price variable, gender, and the policy index. Model 2 is an extension of Model 1 as we include the variables that capture the effects of family smoking at home, the effects of peers as well as variables that provide insights into the effects of teacher smoking in school buildings. Model 4a and Model 4b are similar to Model 2 but are estimated separately for males and females. Model 3 includes an additional variable on education in schools about the dangers of using tobacco. The individual effects of the policy variables (the Law on Preventing Population from Exposure to Tobacco Smoke and the Advertising Law) are given separately, in the Appendix. To capture the possible reinforcing effects between sibling smoking and parental smoking, we added upgraded model 1 and provided the results in the Appendix (table A16). The models are estimated only with the variable "father smoking at home" (Model 1a), only with the variable "mother smoking at home" (Model 1b), and only with the variable "siblings smoking at home" (Model 1c). The idea behind this is that each possible pair between these three variables might have mutually

reinforcing effects. In other words, siblings smoking might matter even more if parents also smoking – or maybe less with the family effects already captured by the parents.

Table 4. Split-population survival model (hazard ratios)

	Model 1	Model 2	Model 3	Model 4a (gender = male)	Model 4b (gender = female)
Price	0.998*** (0.0004)	0.978*** (0.0006)	0.999*** (0.0002)	0.999** (0.0004)	0.998*** (0.001)
Gender(female)	0.810*** (0.024)	1.066** (0.002)	0.907*** (0.001)		
Policy index	0.945** (0.024)	0.949*** (0.002)	0.931*** (0.029)	0.922** (0.039)	0.949** (0.039)
Father is smoking at home		1.043*** (0.003)	1.091*** (0.029)	1.130** (0.069)	1.019*** (0.040)
Mother is smoking at home		1.081*** (0.009)	1.184*** (0.032)	1.246*** (0.052)	1.168** (0.045)
Brother/sister is smoking at home		1.255*** (0.010)	1.428*** (0.044)	1.508*** (0.072)	1.410*** (0.063)
Teacher is smoking in school building		1.051** (0.033)	1.108*** (0.029)	1.039** (0.045)	1.035** (0.034)
Best friend offered tobacco		1.131*** (0.009)	2.872*** (0.080)	2.480*** (0.122)	3.022*** (0.120)
Thought dangers of tobacco			0.933*** (0.025)		
Cure probability (never fail probability)****	0.080*** (0.004)	0.117*** (0.008)	0.052*** (0.003)	0.107*** (0.013)	0.118*** (0.004)
log-likelihood	-18509.894	-21316.184	-12926.992	-9483.268	-9148.402
Price elasticity	-0.089	-0.107	-0.087	-0.084	-0.065

Note. Standard errors are shown in parentheses. We control for duration dependency in all specifications.

** p < 0.10, ** p < 0.05, *** p < 0.01*

***** Cure probability (never fail probability) refers to the probability that an individual (girl or boy) will never experience the event of interest (in this case smoking). For example, cure probability of 0.080 indicate that about 8% of participants will never try smoking.*

According to the results, the price of cigarettes has a statistically significant and negative impact on smoking initiation in all models tested. Since the hazard ratio in Model 1 is 0.998, an increase in the weighted average cigarette prices reduces the risk of smoking initiation by 0.2 percent. The highest impact of prices on smoking initiation likelihood is in Model 2, where the corresponding hazard ratio is 0.978, suggesting that an increase in prices decreases the risk of smoking initiation by 2.2 percent. More precisely, the initiation elasticity for Model 1 is -0.089. In other words, if cigarette prices increase by 10 percent, the number of youths who initiate smoking will be lower

by 0.89 percent. The price elasticity for Model 2 is the highest compared to the other models and suggests a lower smoking initiation among youth by 1.07 percent.

Gender is statistically significant in all presented models.

The policy index stands out as an important factor in our analyses. In our study, the hazard ratio for the policy index is less than one, indicating that non-price tobacco control policies have a positive impact on reducing the risk of smoking initiation among young people.

To observe how parents' smoking status affects adolescents' initiation, we decided to use two variables (according to the questionnaire). Through our analysis, we found that the presence of parents smoking at home was associated with a higher risk of youth smoking initiation. Parental smoking was found to be a statistically significant factor in several models, highlighting its influence on youth smoking behavior. For example, in Model 4a where maternal smoking at home is included as a variable, a hazard ratio of 1.246 was found, suggesting that mothers' smoking at home is associated with an increased risk of smoking initiation. Adolescents whose mothers are smokers and use tobacco at home have a 24.6 percent higher risk of initiating smoking compared with those who do not. In Model 4b, the risk is slightly lower for girls. Similar results are provided for fathers' smoking at home. If we compare Model 4a with Model 4b, we can conclude that the hazard ratio is slightly higher for boys than for girls. Overall, all models presented in Table 4 indicate that parental smoking has a strong influence on increasing the risk of starting smoking among adolescents. These findings underline the importance of the family's role in young people's smoking behavior and provide further evidence of the need for interventions aimed at reducing adolescents' exposure to smoking in the family environment. Siblings living at home with young people also have a significant impact on smoking initiation. The hazard ratio value in Model 2 is 1.255. This hazard ratio indicates that young individuals living with a brother or sister who smoke at home are more likely to initiate smoking compared to those who do not. In other words, adolescents who have a brother or sister who uses tobacco at home have a 25.5 percent higher risk of initiating smoking compared with those who do not. This highlights the significant role of the presence of smoking siblings in the family environment in influencing youth smoking initiation.

Another variable that we tested through the models was to show the role of the education system in the uptake of smoking among adolescents, specifically through the figure of the teacher as a person who is with adolescents almost every day and plays an important role in their education. The analysis showed that the variable has a statistically significant influence. As it was based on the question *"Did you see your teacher smoking indoor/outdoor?"*, the hazard ratio is above 1, meaning that respondents are more likely to start smoking if they see their teachers smoke on school premises. Education about the dangerous effects of cigarette smoking is also an important factor in reducing the risk of starting to smoke. Since the value is statistically significant and less than 1, this means that the risk of starting to smoke is lower when young people are educated about the dangerous effects of smoking in classes during the school year.

The variable with the highest values of hazard ratios estimates the impact of friends on smoking initiation among young people. The values range from 1.131 in Model 2 to 3.022 in Model 4b.

The risk of initiation is higher for girls than for boys when it comes to susceptibility to pressure from their best friends. In other words, girls may be more sensitive to the influence of friends in the context of smoking initiation as younger teenagers. We estimate a probit model with endogenous covariates to test whether the variable "Best friends offered tobacco" is endogenous. We used smoking initiation age and family smoking as instruments because individuals who start smoking at a younger age are more likely to have friends who smoke and offer them tobacco. According to literature review by Hoffman et al. (2006) on the peer influences on adolescents' cigarette smoking, the number of friends who smoke and the frequency of cigarette offers change with an adolescent's age. Moreover, they revealed that as adolescents grow older, they tend to have more friends who smoke and receive more offers to try cigarettes, which increases their likelihood of starting to smoke. Having family members who smoke also increases the likelihood that a person will be exposed to smoking, increasing the likelihood that their friends will also smoke and offer them tobacco. The results are shown in the Appendix. The results show that the coefficient for best friend offered tobacco is positive and lower in the probit model, although the split-population and probit models are not directly comparable. The Wald test of exogeneity results shows that we fail to reject the null hypothesis at a 10% significance level and conclude that the variable is not endogenous. However, these results should be interpreted with caution; while the test does not indicate endogeneity, the evidence is not very strong, and the conclusion might change with a larger dataset.

5. DISCUSSION

The most important research finding is that the price has an impact on smoking initiation among youth in Serbia in addition to non-price control policies.

To make a healthier society in the future for the younger generation, we can employ stronger price measures. Higher excises on tobacco products will lead to higher prices and, consequently, to lower tobacco consumption and an increase in public revenues (Zubović et al, 2023). **Our analysis indicates that price has a significant impact on smoking initiation among young people in Serbia.** The negative hazard ratio for price across all models suggests that higher cigarette prices are associated with a lower probability of smoking initiation. Despite the positive direct effects, the indirect price effects should be considered even more. That is because family and peer smoking behavior could reduce the individual's sensitivity to price increases. After all, the environment (family and friends) supports smoking even when prices rise. Therefore, the price effect may operate indirectly through the social and family environment, especially in families where smoking is present.

This study supports the effectiveness of price increases as a tobacco control measure. By making cigarettes more expensive, the barrier for young smokers to smoke more frequently and intensively is increased, making them less likely to start smoking. This is important in the Serbian context, where economic factors play a crucial role in influencing youth behavior. Therefore, introducing and maintaining higher tobacco taxes could be a key strategy to reduce youth smoking initiation.

In addition to prices and taxation, this study highlights the strong influence of non-price tobacco control policies on youth smoking initiation. Measures such as banning advertising, protecting the population from secondhand smoke, and banning sales to minors significantly reduce the likelihood of young people starting to smoke. Strengthening the implementation of non-price policies, such as smoke-free environments in public places like restaurants and bars, as well as raising the minimum age for tobacco sales, can further reduce smoking initiation among youth in Serbia. While price increases may deter some young people from purchasing tobacco products, their effectiveness is often enhanced when combined with robust non-price measures. Higher tobacco prices can limit affordability, but without comprehensive policies to restrict advertising and access to tobacco, the impact may be less effective. Therefore, a holistic approach that includes both taxation and strong regulatory measures is essential for effectively reducing smoking initiation among youth.

Factors such as cigarette consumption by family members at home and/or the influence of friends and teachers on smoking initiation among young people in Serbia are important for both genders. However, the intensity of these effects varies. For example, results show that the impact of closest friends on the risk of smoking initiation is higher for girls than for boys.

The values of hazard ratios within the split-population model show that the influence of the social environment, especially close friends, is the most important factor for smoking initiation in Serbia. This is not surprising, as young people spend a lot of time with peers who can significantly influence their behavior patterns. It is important to note that due to the lack of specific questions, we were unable to directly estimate the impact of friends' smoking status; instead, we relied on whether respondents would accept cigarettes offered to them by their best friends. The trust that exists between friends and freedom in behavior associated with the presence of closest friends may lead young people to accept cigarettes offered by them. Acceptance of cigarettes may be driven primarily by curiosity or the need for social affiliation.

Gender inequalities in smoking prevalence in Serbia exist. Filipović et al. (2010) showed that among students of dentistry, pharmacy, and nursing schools, females were more prevalent smokers than males. At the same time, the National Survey on Pre-and Post-Natal Smoking in the Republic of Serbia revealed that 35.7 percent of women who gave birth in 2008 smoked immediately before conception. Smoking at the beginning of pregnancy and during pregnancy was associated with smoking by other people in the household, as well as lower education and lower socio-economic status of the family. This suggests that young girls are not aware of the harmful effects of tobacco products on personal health and the health of their children. Older women, university students and white-collar workers were more likely to successfully quit smoking. Target groups for intervention are women with lower education and socio-economic status, as well as health professionals and family members who smoke (Krstev et al., 2011).

All these findings underscore the urgent need for additional and continuous education of young people about the harmful effects of all forms of tobacco products. This includes not only traditional cigarettes but also alternative tobacco products such as heated tobacco products, electronic cigarettes, nicotine pouches, and other popular products. Given the current situation

in Serbia and the high smoking prevalence rates among young people, there is an urgent need to better educate children about these new tobacco products. In addition to educating children, it is also essential to raise awareness among parents about the harmful effects of tobacco product use in the presence of children and secondhand smoke exposure. This applies to all types of tobacco products, regardless of whether they are traditional or alternative tobacco products. Only through a comprehensive approach that includes both education and prevention measures, we can address the challenges associated with tobacco use among youth and create a healthier (and wealthier) environment.

6. CONCLUSIONS AND SUMMARY RECOMMENDATIONS

This study provides valuable insights into the complex interplay of factors influencing smoking initiation among adolescents in Serbia. By highlighting the role of cigarette prices, non-price measures, social influences and, the study provides a comprehensive understanding of youth smoking behavior. To the best of our knowledge, the results presented in this study represent the first estimates of the impact of price and non-price measures on smoking initiation among youth in Serbia. At the same time, the implementation of the split-population model in the field of tobacco economics in Serbia represents a significant methodological innovation and makes an important contribution to the existing results published by the research team in previous years. The analysis has produced meaningful results that can serve as important input for policy makers in preparing measures to reduce tobacco consumption among youth. As in other studies available in the literature for LMICs, price has a statistically significant impact on initiation of tobacco use among young people. However, this influence is relatively weak, suggesting that it does not have a direct and strong impact on youth smoking initiation. The positive relationship between the smoking behavior of fathers, mothers, siblings, and best friends suggests that the price effect is higher in models with all variables included. This suggests that family and peer smoking could reduce the sensitivity to price increases. Practice has shown that adolescents usually get the first cigarette from friends, siblings, and parents. And certainly, price is not the deciding factor. The affordability of cigarettes could be an indicator that better reflects the ability of adolescents to buy cigarettes, but on the other hand, the youth participating in this study are not employed, so it is not relevant to speak about the affordability of cigarettes in terms of price at their age. Perhaps an even more important finding for Serbia is the family's strong influence on youth initiation. Regardless of whether a child sees their father, mother or siblings smoking, any consumption of tobacco products at home leads to an increase in initiation among young people. The influence of siblings is significant and clearly shows how important the family is in educating children about the harmful effects of smoking and how behavioral patterns are adopted by the closest family members. In addition, teachers play an important role in youth initiation, so respondents who are involved with teachers who use tobacco products on school grounds are more likely to become smokers. The study was conducted on people aged 13 to 16 who may not yet be fully aware of the harmful effects of smoking on health. Because of their youth, adolescents may be curious to experiment with cigarettes, even if they are aware of the harmful health effects. This curiosity may increase the likelihood of cigarette initiation. However, schools and education

are crucial in this regard, as evidence shows that educating students about the dangerous effects of smoking during school lessons can significantly reduce the risk of smoking initiation.

One limitation of this study is the broad definition of smokers, which includes students who smoked only one or two puffs. This broad definition could bias the results in either direction, making it challenging to draw clear conclusions about smoking behavior and its effects on youth. In addition to this, broader definition was used for role model smokers which might lead to an underestimation of the effects of such role models (i.e. the effects could be stronger if only frequent adult smokers were included).

By integrating insights discussed in this study into policy documents and public health activities, Serbia can strengthen its efforts to reduce tobacco use among youth and foster healthier future generations.

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APPENDIX

Table A1. The percentage of students who have tried cigarettes by grade and year of HBSC* research, Serbia

	5th grade primary school	7th grade primary school	1st grade high school	Total
2018	2.6	7.1	28.3	14.5
2022	4.9	12.6	24.6	15.1

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Note: The data was provided by the Institute of Public Health "Batut"

Table A2. The percentage of students who used electronic cigarettes in the past 30 days, by grade and gender, HBSC 2022, Serbia

	5th grade primary school	7th grade primary school	1st grade high school	Total
2022	4.4	12.5	19.9	13.0

Note: The data was provided by the Institute of Public Health "Batut"

Table A3. The percentage of students who used hookah, heated tobacco products, and snus/nicotine pouches at least once in their lifetime, by grade, HBSC 2022, Serbia

	5th grade primary school	7th grade primary school	1st grade high school	Total
Hookah	5.5	8.9	21.2	12.8
Heated tobacco products	2.8	5.3	9.7	6.3
Snus/Nicotine Pouches	2.9	3.9	7.1	4.9

Note: The data was provided by the Institute of Public Health "Batut"

Table A4. The percentage distribution of youth by number of smoking days in the past 30 days (frequency of smoking), by gender

	0 days	1 or 2 days	3 to 5 days	6 to 9 days	10 to 19 days	20 to 29 days	All 30 days
Total	86.6	3.6	1.8	1.1	1.7	1.5	3.8
Gender							
Boys	86.4	3.3	1.8	1.0	2.0	1.3	4.2
Girls	86.9	3.8	1.8	1.2	1.3	1.7	3.3

Note: sample size 10,819

Table A5. The percentage distribution of youth by number of cigarettes smoked per day in the past 30 days (intensity of smoking), by gender

	Less than 1 cig	1 cig per day	2 to 5 cig	6 to 10 cig	11 to 20 cig	More than 20 cig	I did not smoke
Total	2.4	2.1	3.8	2.3	1.9	1.1	86.5
Gender							
Boys	2.2	1.9	3.6	2.5	2.1	1.4	86.4
Girls	2.5	2.3	4.0	2.2	1.6	0.7	86.7

Note: sample size 10,813

Table A6. The percentage distribution of youth by their attitude to stop smoking now (at the time of the interview), by age and gender

	Yes	No	I do not smoke now	I have never smoked
Total	**4.0**	**5.1**	**15.8**	**75.1**
Gender				
Boys	4.6	5.1	15.5	74.9
Girls	3.4	5.2	16.1	75.3
Age				
13	1.0	1.7	11.4	86.0
14	2.6	2.9	14.6	79.9
15	5.1	6.3	18.2	70.5
16	7.7	11.0	17.9	63.4

Note: sample size 11,105

Table A7. The percentage distribution of youth who tried to smoke (even one or two puffs) by their attitude to stop smoking now (at the time of interview)

	Yes	No	I do not smoke now	I have never smoked
Total	9.3	12.0	35.8	42.9*

Note: sample size 4,527

**42.9 percent of students who answered that they tried to smoke (even one or two puffs) answered that they have never smoked to this question. The reason for it is that they only try to smoke and they have not used cigarettes or other tobacco products in the last 30 days, so they do not consider themselves smokers.*

Table A8. The percentage distribution of youth by the status of receiving the advice to quit smoking, by gender

	Yes, from a family	Yes, from a friend	Yes, from a programme or professionals	Yes, from both programme or professionals and friend or family	No	I have never smoked
Total	5.15	6.15	1.69	0.98	4.07	81.96
Gender						
Boys	5.03	5.57	1.96	0.88	4.42	82.13
Girls	5.26	6.71	1.43	1.08	3.73	81.79

Note: sample size 10,715

Table A9. The percentage distribution of youth who tried to smoke (even one or two puffs) by the status of receiving the advice to quit smoking

	Yes, from a family	Yes, from a friend	Yes, from a programme or professionals	Yes, from both programme or professionals and friend or family	No	I have never smoked
Total	12.95	15.44	3.64	2.45	10.36	55.17

Note: sample size 4,171

Table A10. The percentage distribution of youth who taught in any classes about the dangers of smoking, during the current school year

	Yes	No	Not sure	Do not know
Total	57.28	24.69	6.19	11.84

Note: sample size 11,026

Table A11. The percentage distribution of youth who see people using tobacco on TV, in videos, or movies in the past 30 days

	Yes	No	I never watch TV	I did not watch TV in the past 30 days
Total	82.26	7.4	0.91	9.43

Note: sample size 11,042

Table A12 The percentage distribution of youth by the place where they usually smoke

	At home	At friend's houses	At school	At social events	I do not smoke	I have never smoked	In public places (parks, street corners)	Other places
Total	3.77	1.34	1.98	5.75	27.69	53.83	2.71	2.94

Note: sample size 11,065

Table A13. Robustness Check – different price indicators

	Model 3	Model 3a	Model 3b
Price	0.999*** (0.0002)		
Price (real)		0.999** (0.001)	
Excise			0.998*** (0.006)
Gender(female)	0.907*** (0.001)	1.113*** (0.032)	1.077** (0.032)
Policy index	0.931*** (0.029)	0.944** (0.025)	0.954*** (0.032)
Father is smoking at home	1.091*** (0.029)	1.1139*** (0.035)	1.081** (0.034)
Mother is smoking at home	1.184*** (0.032)	1.206*** (0.037)	1.148*** (0.036)
Brother/sister is smoking at home	1.428*** (0.044)	1.416*** (0.047)	1.365*** (0.049)
Teacher is smoking in school building	1.108*** (0.029)	1.245*** (0.033)	1.062** (0.032)
Best friend offered tobacco	2.872*** (0.080)	2.583*** (0.084)	2.525*** (0.085)
Thought dangers of tobacco	0.933*** (0.025)	0.987** (0.028)	0.911*** (0.027)
Cure probability (never fail probability)	0.052*** (0.003)	0.091*** (0.011)	0.079*** (0.004)
log-likelihood	-12926.992	-12607.476	-9148.402

Note. Standard errors are shown in parentheses. We control for duration dependency in all specifications.

** p < 0.10, ** p < 0.05, *** p < 0.01*

Table A14. Robustness Check – different policy variables

	Model 3	Model 3a	Model 3b
Price	0.999*** (0.0002)	0.999** (0.0003)	0.997*** (0.004)
Gender(female)	0.907*** (0.001)	1.206*** (0.038)	0.936*** (0.022)
Policy index	0.931*** (0.029)		
Policy 2010		0.937*** (0.037)	

Policy 2016			0.999** (0.012)
Father is smoking at home	1.091*** (0.029)	1.182*** (0.039)	1.051*** (0.037)
Mother is smoking at home	1.184*** (0.032)	1.261*** (0.042)	1.109*** (0.043)
Brother/sister is smoking at home	1.428*** (0.044)	1.277*** (0.049)	1.432*** (0.062)
Teacher is smoking in school building	1.108*** (0.029)	1.249** (0.039)	1.052*** (0.039)
Best friend offered tobacco	2.872*** (0.080)	2.578*** (0.091)	3.392*** (0.152)
Thought dangers of tobacco	0.933*** (0.025)	0.965*** (0.030)	0.987** (0.032)
Cure probability (never fail probability)	0.052*** (0.003)	0.099*** (0.010)	0.063*** (0.002)
log-likelihood	-12926.992	-12828.49	-17656.720

** p < 0.10, ** p < 0.05, *** p < 0.01*

Note. Standard errors are shown in parentheses. We control for duration dependency in all specifications

Table A15. Controlling for endogeneity – probit model (odds ratios)

	Model 3	**Probit model**
Price	0.999*** (0.0002)	-0.017*** (0.0001)
Gender(female)	0.907*** (0.001)	-0.077*** (0.007)
Policy index	0.931*** (0.029)	-0.012** (0.008)
Father is smoking at home	1.091*** (0.029)	0.015** (0.008)
Mother is smoking at home	1.184*** (0.032)	0.015*** (0.009)
Brother/sister is smoking at home	1.428*** (0.044)	0.108*** (0.022)
Teacher is smoking in school building	1.108*** (0.029)	0.359*** (0.010)
Best friend offered tobacco	2.872*** (0.080)	2.344*** (0.012)
Thought dangers of tobacco	0.933*** (0.025)	-0.065** (0.008)

Cure probability (never fail probability)	0.052*** (0.003)	
log-likelihood	-12926.992	
Wald test of exogeneity (H0: No endogeneity)		36.679*

*Standard errors are in (). * p < 0.10, ** p < 0.05, *** p < 0.01 * Probit model includes year dummies.*

Table A16. Parental smoking and siblings smoking at home – detailed analysis of mutual reinforcing effects

	Model 1	Model 1a	Model 1b	Model 1c
Price	0.998*** (0.0004)	0.999* (0.0005)	0.999*** (0.001)	0.999** (0.0003)
Gender(female)	0.810*** (0.024)	0.990* (0.009)	0.826*** (0.025)	0.899*** (0.009)
Policy index	0.945** (0.024)	0.864*** (0.026)	0.724*** (0.017)	0.763** (0.059)
Father is smoking at home		1.164*** (0.035)		
Mother is smoking at home			1.237*** (0.037)	
Brother/sister is smoking at home				2.266*** (0.049)
Cure probability (never fail probability)	0.080*** (0.004)	0.077*** (0.008)	0.079*** (0.005)	0.069*** (0.003)
log-likelihood	-18509.894	-13781.08	-13534.603	-16331.26

*Standard errors are in (). * p < 0.10, ** p < 0.05, *** p < 0.01*

Explanation: In Model 2 and Model 3 where all three variables are included in model, coefficients for:

- Father smoking at home are 1.043 and 1.091, statistically significant at 1%.
- Mother smoking at home are 1.081 and 1.184, statistically significant at 1%.
- Brother/sister smoking at home are 1.255 and 1.428, statistically significant at 1%.

When we upgrade Model 1, with variable Father is smoking at home, coefficient is 1.164, statistically a
When we upgrade Model 1, with variable Mother smoking at home, coefficient is 1.237, statistically significant at 1%.
When we upgrade Model 1, with variable Brother/sister smoking at home, coefficient is 2.266, statistically significant at 1%.

The combined effect of having multiple family members (mother, father, brother or sister) who smoke appears to be mutually reinforcing, though the degree of reinforcement varies depending on which family members are smoking. In Model 1a, where only the father is smoking at home is included, the coefficient

is 1.164, while in Model 2 and 3 (mother, father, brother or sister is smoking) coefficients decrease slightly to 1.043 and 1.091. The results show that the effect of the father smoking at home is somewhat reduced when other family members (mother or brother/sister) are also smoking. Therefore, the influence of the father is smoking at home might be partially "captured" by the combined family effect. A similar pattern is observed for variable mother is smoking at home (Model 1b). The mother's influence might also be “captured” by the presence of other smokers (father or brother/sister) in the household. In Model 1c, the coefficient is 2.266, showing a strong effect when the brother/sister is only included in the model. In Models 2 and 3, when parents' smoking behavior is also included, the effect of brother/sister is smoking remains large but lower, with coefficients of 1.255 and 1.428. The results show that the influence of brother/sister is smoking at home remains high, even when accounting for the smoking behavior of parents.