E-CIGARETTE USE, OPINION ABOUT HARMFULNESS AND ADDICTION AMONG UNIVERSITY STUDENTS IN BRATISLAVA, SLOVAKIA

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SUMMARY

Objectives: The study aimed to investigate the use of electronic cigarettes (EC) among medical students, their knowledge and beliefs (opinion about harmfulness and addiction potential) on ECs, perceptions of the risk, as well as to assess the type of education and cessation training they received during their study at Faculty of Medicine, Comenius University in Bratislava, Slovakia.

Methods: This cross-sectional, anonymous online e-mailed survey was conducted among medical students via the Study Department by sending e-mails containing the survey link. Participants completed the online questionnaire adapted from the American Survey on Tobacco and Alternative Tobacco Products. It included questions about the personal use of EC, perceptions about the harms and their role in disease causation, education and cessation training, and practices related to conventional cigarettes (CC), EC, and alternative tobacco products (ATP). The e-mailed questionnaire filled in 577 medical students (71.9% women) from Comenius University in Bratislava, the average age was 23 ± 2 years. The sample comprised 486 (84.2%) Slovak and 91 (15.8%) foreign students. The data were analysed using the Statistical Package for Social Science (SPSS) version 25.

Results: There were 385 (66.7%) non-smokers, 111 (19.3%) ex-smokers and 81 (14%) current smokers in the study sample. EC currently use 13.5% of medical students, with a statistically significant intersexual difference (22.2% males vs. 10.12% females; OR = 2.53, 95% CI: 1.55–4.13), more foreign students than Slovak students (24.2% vs. 11.52%; OR = 2.44, 95% CI: 1.41–4.26), more smokers of conventional cigarettes than non-smokers (46.9% vs. 8.06%; OR = 10.07, 95% CI: 5.85–17.34). EC seems to be less harmful to 59.97% of students, mostly in the age group ≤ 24 (61.76% vs. 51.49%; OR = 1.46, 95% CI: 1.03–2.07), 41.25% of students consider EC to be less addictive, 55.6% think they do not get enough education on EC during their medical study.

Conclusion: The results overall show the high consumption of tobacco products and the lack of knowledge and awareness among medical students, future health care providers. In health promotion and disease prevention, they should serve as a model for their patients and for the general public as well. Our study emphasizes the need for intervention in this field at medical faculties and for support of further monitoring in Slovakia and other countries and draws attention to the ongoing lack of EC regulation.

Key words: university students, electronic cigarettes, questionnaire survey, Slovakia

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INTRODUCTION

There is a general agreement that smoking belongs to one of the worst public health threats, particularly in the WHO European Region, where has been reported one of the highest levels of tobacco-use prevalence (over 29%) (1). Tobacco in any form kills more than 8 million people each year and it is the major risk factor for many chronic non-communicable diseases and the leading preventable cause of death worldwide (2, 3). Smoking remains a regular bad habit among the majority of those who smoke. Fortunately, considerable progress has been made in reducing conventional cigarette smoking among youth in some countries (4, 5). On the other hand, a great number of smokers persists. Overall, more than a quarter of Europeans consume tobacco products (4).

When it comes to alternative tobacco products (ATP), the discussion continues among the common population, scientists, stakeholders, and policymakers; their use has some proponents, but also opponents. Among smoking alternatives, electronic cigarettes (EC) have likely received the greatest advocacy, policy, and media attention. As they are relatively shortly on the market compared to conventional cigarettes (CC), health effects

and health consequences are not clear yet, the trends in vaping should continue to be monitored and investigated carefully (6, 7).

The study aimed to investigate the use of EC among medical students, their knowledge and beliefs (opinion about harmfulness and addiction potential) on EC, perceptions of the risk, as well as to assess the type of education and cessation training they received during their study at Faculty of Medicine, Comenius University in Bratislava, Slovakia. As future health care providers, medical students will play a key role in health promotion and disease prevention, and they should serve as a model for their patients and the general public as well.

MATERIALS AND METHODS

This cross-sectional, anonymous online e-mailed survey was conducted among medical students via the Study Department by sending e-mails containing the survey link. Participants completed the online questionnaire Study on Tobacco and Alternative Tobacco Products. The questionnaire was adapted from the Tobacco and Alternative Tobacco Products Survey of the School of Medicine, New York University (NYU), based on the methodology and results of three studies (National Youth Tobacco Survey 2011, Global Health Professions Student Survey, and Survey on Medical Students' Habits and Knowledge of Waterpipe in a Canadian Medical School). It included questions about the use of CC, EC, perceptions of the harms and their role in disease causation, education and cessation training and practices related to CC and EC (8).

To acquire comparable results in Slovakia, we used the identical questionnaire that had been translated into the Slovak language. Questionnaires were available online for six weeks beginning in May 2015. The students were emailed three times to encourage them to complete the survey.

In this contribution, we focused mainly on the assessment of EC use in medical students, as well as their opinion about harmfulness and addiction and knowledge on electronic cigarettes.

The online questionnaire was completed by 577 medical students from the study programme General Medicine at Comenius University in Bratislava, the average age was 23 ± 2 years. The sample comprised 486 (84.2%) Slovak and 91 (15.8%) foreign students (residing outside Slovakia and studying in the English language), 415 (71.9%) women (Table 1). The study sample was selected from 2,194 General Medicine students (all six grades) in the study year 2014/2015. The estimated minimum sample size on a 95% confidence level was 222 medical students. The overall response rate was 26.3%.

The study was approved by the Ethics Committee of the Faculty of Medicine, Comenius University and University Hospital, on 25 July 2017 with the number 87/2017-ATP Survey – Tobacco and Alternative Tobacco Products Survey.

The data were analysed using the Statistical Package for Social Science (SPSS) version 25 (International Business Machines Corp., New Orchard Road, Armonk, New York, USA).

Descriptive statistics was used to obtain proportions. Proportions with a 95 percent confidence interval (95% CI) were estimated and reported in the tables. Associations between categorical data in both groups of students were evaluated by the chi-square test and contingency tables. To compare the frequency of EC use, perception of harmfulness and perception of addiction and cessation intervention among different groups of students, the odds ratio (OR) was used as the ratio of a certain factor present in a given population. The statistically significant level was determined at $p < 0.05$.

RESULTS

There were 385 (66.7%) non-smokers, 111 (19.3%) ex-smokers, and 81 (14%) current smokers in the study sample. EC currently uses 13.5% of medical students, with a statistically significant intersexual difference (22.2% males vs. 10.12% females; OR = 2.53, 95% CI: 1.55–4.13). There was also a statistically significant difference in terms of EC smoking among medical students studying in English and the Slovak language – foreign students were more likely to smoke EC (24.2% vs. 11.52%; OR = 2.44; 95% CI: 1.41–4.26). More EC vapers were among smokers of CC than among non-smokers (46.91% vs. 8.06%; OR = 10.07, 95% CI: 5.85–17.34) (Table 2).

EC appears to be less harmful to almost 60% of students, mostly in the age group ≤24 (61.76% vs. 51.49%; OR = 1.46; 95% CI: 1.03–2.07). More than 32% of students consider EC as equally harmful and 8% even more harmful (Table 3).

The opinion of students about the addiction of EC did not differ significantly in any of the monitored categories; 41.2% of students considered EC as less addictive, 49% as equally addictive, and nearly 10% more addictive than CC (Table 4).

About 55.6% of students think they do not get enough education on ATP and EC during their medical study, with a statistically significant intersexual difference (47.53% males vs: 58.80% females; OR = 0.65, 95% CI: 0.49–0.85), 48.5% of foreign and 58.4% of Slovak students do not have an idea about the EC content (Table 5).

Table 1. *Demographic characteristics of the sample (N = 577)*

Characteristics	n	%	95% CI
Gender			
Women	415	71.92	68.03–75.52
Men	162	28.08	24.48–31.97
Residence			
Slovak	486	84.23	80.94–87.05
Abroad	91	15.77	12.95–19.06
Age			
≤24	476	82.50	79.09–85.46
>24	101	17.50	14.54–20.91
Smoking status – conventional cigarettes			
Non-smoker	385	66.72	62.69–70.53
Former smoker	111	19.24	16.15–22.74
Current smoker	81	14.04	11.36–17.20
Smoking status – electronic cigarettes			
No	499	86.48	83.36–89.11
Yes	78	13.52	10.89–16.64

CI – confidence interval

Table 2. *Sample characteristics and the use of electronic cigarettes (N = 577)*

Characteristics	n	Use of electronic cigarettes % (95% CI)		Bivariate analysis	
		No	Yes	OR (95% CI)	p-value
Gender					
Women	415	89.88 (86.46–92.53)	10.12 (7.47–13.53)	2.53 (1.55–4.13)	< 0.001
Men	162	77.78 (70.59–83.92)	22.22 (16.08–29.41)		
Residence					
Slovak	486	88.48 (85.22–91.11)	11.52 (8.89–14.78)	2.44 (1.41–4.26)	< 0.001
Abroad	91	75.82 (65.72–84.19)	24.18 (15.81–34.28)		
Age					
≤ 24	476	86.97 (83.54–89.80)	13.03 (10.20–16.46)	1.25 (0.69–2.28)	0.45
> 24	101	84.16 (75.55–90.67)	15.84 (9.33–24.45)		
Smoking status – conventional cigarettes					
Non-smoker	496	91.94 (89.09–94.11)	8.06 (5.89–10.91)	10.07 (5.85–17.34)	< 0.001
Smoker	81	53.09 (41.67–64.27)	46.91 (35.73–58.33)		
Total	577	86.48 (83.36–89.11)	13.52 (10.89–16.64)		

OR – odds ratio; CI – confidence interval

Table 3. *Perception of harmfulness of electronic cigarettes compared to conventional cigarettes (N = 577)*

Characteristics	n	Opinion about harmfulness % (95% CI)			Bivariate analysis	
		Less harmful	Equally harmful	More harmful	OR (95% CI)	p-value
Gender						
Women	415	60.24 (55.34–64.95)	33.01 (28.55–37.80)	6.75 (4.61–9.72)	1.19 (0.88–1.62)	0.12
Men	162	59.26 (51.27–66.90)	29.63 (22.72–37.30)	11.11 (6.72–16.99)		
Residence						
Slovak	486	61.11 (56.60–65.44)	31.48 (27.41–35.85)	7.41 (5.31–10.20)	1.36 (0.94–1.96)	0.83
Abroad	91	53.85 (43.08–64.36)	35.16 (25.44–45.88)	10.49 (5.40–19.18)		
Age						
≤ 24	476	61.76 (57.21–66.12)	30.88 (26.80–35.28)	7.35 (5.25–10.17)	1.46 (1.03–2.07)	0.03
> 24	101	51.49 (41.33–61.55)	37.62 (28.18–47.82)	10.89 (5.56–18.65)		
Smoking status – conventional cigarettes						
Non-smoker	496	60.08 (55.61–64.40)	31.85 (27.81–36.18)	8.06 (5.84–10.91)	0.99 (0.66–1.49)	0.93
Smoker	81	59.26 (23.24–44.68)	33.33 (23.24–44.68)	7.41 (2.77–15.43)		
Total	577	59.97 (55.83–63.97)	32.06 (28.30–36.07)	7.97 (5.95–10.57)		

OR – odds ratio; CI – confidence interval

DISCUSSION

The results of our study indicate a high prevalence of current (14%) and former smokers among medical students (19.3%), every fifth student is an ex-smoker and every seventh is a current smoker. Similar findings were obtained about experiences with EC, which currently uses 13.5% of medical students, with a statistically significant intersexual difference. According to Kapan et al., there is a higher prevalence of EC use among males, adolescents and young adults, as well as within populations of Eastern European countries (9).

Easier availability of the EC and its widespread distribution is accompanied by many controversial views. Since electronic nicotine delivery systems (ENDS) are on the market for a relatively short time compared to CC, long-term health effects are still not known (7). According to the YUPESS study, examining the prevalence and habits of CC and EC use among university students from Central and Eastern Europe, CC is still more popular than EC; 12.3% of respondents admitted to smoking CC, while 1.1% admitted to vaping EC; 1.8% of respondents said they used EC and CC at the same time (dual use). The percentage of students who had smoked cigarettes or e-cigarettes varied greatly by country, ranging from 33.4% in Russia and 34.4% in Slovakia to 55.6% in Lithuania. Females were less likely than males to try CC or EC, as well as being CC, EC, or dual users. EC attitudes differed dramatically between smokers and non-smokers. Only 6% of participants

Table 4. *Perception of electronic cigarette addiction comparing to conventional cigarettes (N = 577)*

Characteristics	n	Opinion about addiction % (95% CI)			Bivariate analysis	
		Less addictive	Equally addictive	More addictive	OR (95% CI)	p-value
Gender						
Women	415	40.72 (35.98–45.64)	50.36 (45.45–55.27)	8.42 (6.43–12.18)	1.07 (0.80–1.43)	0.20
Men	162	42.59 (34.8–50.59)	45.06 (37.25–55.06)	12.35 (7.71–18.42)		
Residence						
Slovak	486	40.74 (36.36–45.27)	50.00 (45.77–54.53)	9.26 (6.90–12.28)	1.05 (0.73–1.49)	0.20
Abroad	91	43.96 (33.56–54.75)	42.86 (32.53–53.66)	13.19 (7.00–21.90)		
Age						
≤ 24	476	40.97 (36.54–45.55)	49.37 (44.80–53.95)	9.66 (7.23–12.77)	0.99 (0.70–1.41)	1.00
> 24	101	42.57 (32.79–52.81)	46.53 (36.55–56.73)	10.86 (5.56–18.65)		
Smoking status – conventional cigarettes						
Non-smoker	496	40.52 (36.19–45.00)	50.60 (46.12–55.08)	8.87 (6.59–11.81)	1.11 (0.77–1.59)	0.55
Smoker	81	45.68 (34.56–57.13)	38.27 (27.69–49.74)	16.05 (8.83–25.88)		
Total	577	41.25 (37.22–45.40)	48.87 (44.73–53.03)	9.88 (7.63–12.68)		

OR – odds ratio; CI – confidence interval

Table 5. *Sample characteristics and cessation intervention (N = 577)*

Characteristics	n	Receiving enough training % (95% CI)			Bivariate analysis	
		Agree	Neutral	Disagree	OR (95% CI)	p-value
Gender						
Women	415	17.35 (13.90–21.42)	23.86 (19.86–28.31)	58.80 (53.88–63.55)	0.65 (0.49–0.85)	0.002
Men	162	26.54 (19.92–34.04)	25.93 (19.37–33.39)	47.53 (39.04–55.51)		
Residence						
Slovak	486	19.75 (16.36–23.63)	23.87 (20.20–27.96)	56.38 (51.83–60.82)	0.98 (0.63–1.24)	0.76
Abroad	91	20.88 (13.06–30.67)	27.47 (18.63–37.83)	51.65 (40.93–62.26)		
Age						
≤ 24	476	19.12 (15.74–23.00)	25.21 (21.42–29.41)	55.67 (51.08–60.18)	1.12 (0.81–1.55)	0.34
> 24	101	23.76 (15.86–33.26)	20.79 (13.36–30.01)	55.45 (45.22–65.34)		
Smoking status – conventional cigarettes						
Non-smoker	496	19.35 (16.03–23.17)	25.81 (22.06–29.94)	54.84 (50.34–59.26)	1.00 (0.70–1.45)	0.84
Smoker	81	23.46 (14.75–34.18)	16.05 (8.83–25.88)	60.49 (49.01–71.19)		
Total	577	19.93 (16.79–23.48)	24.44 (21.03–28.19)	55.63 (51.47–59.72)		

OR – odds ratio; CI – confidence interval

thought EC was safe for their health, with 34.6% of EC smokers, 34% of dual users, and only 4.7% of non-smokers agreeing (10).

According to the last available results from Eurobarometer in 2021, there are 25% of current smokers in the Slovak Republic. When comparing these results to those collected in 2014, the overall proportion of daily smokers has remained the same in the Member States, proportions have increased in Slovakia (+4 percentage points) comparing to 2017. The average number of cigarettes smoked per day by daily smokers varies across countries, the average number of cigarettes smoked exceeds 10, on average more than 14 cigarettes a day. In most countries, change has been minimal since the last survey. Slovakia stands out for a significant increase in the average number of cigarettes smoked daily, up by 2.8 since December 2014 (from 15.9 in 2014 to 18.7 in 2017). Since the March 2017 survey, a significant decrease can be found in Slovakia (−1.7) (4).

According to the WHO Report on the Global Tobacco Epidemic, the age-standardized prevalence estimates in Slovakia for tobacco smoking among adults in 2021 was 24% (11).

The traditional male dominance, typical of the adult population in most countries of the world, is slowly disappearing in the younger age groups in Europe and the US. The number of smokers, especially young women, is increasing dangerously, which may have health implications for the entire population (12).

Based on epidemiological data on smoking in children and adolescents, the prevalence of smoking in the adult population

in the future, its characteristics, as well as the extent of health impacts can be estimated.

EC consumption has increased considerably especially among youth, growing an astounding 900% among high school students in the US from 2011 to 2015 (13).

Data from several representative surveys in Great Britain suggest that vaping prevalence among all adults in Great Britain has remained stable since 2015. From 2017 to 2018, estimates for prevalence were 5.4% to 6.2% for all adults, higher for smokers, with increasing experimentation and use of EC over time among youth (14).

An estimated 10.8 million people in the US used EC in 2016. The prevalence of e-cigarette use varied widely among states. The estimates were ranging from 3.1% to 7.0% (15).

According to Eastwood et al. (16) from the United Kingdom, EC vaping in young people is increasing but is largely limited to those who smoke CC. Among young people (11 to 18 years of age) involved in the YouGov online survey, EC usage increased significantly from 4.6% (2013) to 8.2% (2014). Among regular EC users vaping increased from 0.9% to 1.7%.

Comparable data to our study were in the American study (National Youth Tobacco Survey, 2013). From 24,658 young people, only half of the youngsters have heard about EC. Of these, around 13% have already actively tested them and more than 4% still smoke (17).

In a study conducted at New York University out of a total of 431 students who completed the questionnaire, 64 students (14.7%) reported being current users of tobacco or tobacco products including cigarettes (n = 17, 3.9%) and alternative tobacco products (n = 21, 4.8%) (8).

In Austria, EC use is 1.5 times higher among university students compared to the general population (18).

In our Youth and Parents Behavioural Survey (YABS) performed on the sample of 15–19 years old youngsters in Bratislava we found out that the occurrence of CC smoking in the secondary school students' sample was almost 20%; older students and students from vocational schools smoked significantly more. The experience with ATP (except EC) had 63.1% of students. There were no differences in experience with EC vaping among age groups – a very high percentage (> 40%) in both groups (younger and older) (19).

In a comparative study from Jessenius Faculty of Medicine, Comenius University in Martin, the prevalence of daily smoking in medical students increased in 1995, 1999 and 2004 in males and females. The proportion of women initiating smoking during their university study increased and in both genders the proportion of never smokers dramatically dropped (20). The study's findings indicate a rising trend in tobacco usage, particularly among women, which is cause for concern. Prevention principles should be emphasized more in medical schools, and students should be motivated to live a healthy lifestyle and fulfil their future role in public health.

Significant increases in EC use and increasing popularity among young people lead to concerns mainly for possible consequences. Therefore, it is important to explore trends in the perception and use of not only CC but also EC in this age group. The reasons for using EC in young adults are differing and are not limited to stopping smoking. Quitting smoking is not the only reason to use EC by young adults (21).

A growing proportion of young people in the UK believe that vaping EC is as harmful as smoking tobacco. Eastwood et al. comparing 2013 and 2014 found that the number of young people who perceived EC as less harmful compared to CC decreased from 73.4% to 66.9%, while the proportion of young people who considered EC as equally harmful increased from 11.8% to 18.2% (16).

In a study by NYU researchers, American students shared the view that ATP, including EC, contributes less to the emergence and development of various diseases than CC. Users of other tobacco products, Caucasians, and those students whose family members smoked were more likely to perceive EC as relatively safer (8).

EC seem to be equally harmful to almost one-third of our medical students, two-thirds of students consider them to be less harmful, some students think they are even more harmful. Older students more often perceived EC as more harmful compared to younger students. Perception of EC as less harmful than CC was associated with increased EC use, including cigarette-naive EC users (22).

In the YUPESS study only 6.0% of subjects believed that EC use is safe for health and that opinion was shared by 34.6% of e-smokers, 34% of dual users, and only 4.7% of non-smokers; two-thirds of the respondents believe e-smoking results in addiction (10).

According to Paudyal and Movia in their research among Austrian students, 78.1% believed that EC are harmful to the health of those who use them (18).

In our study, we also focused on observing students' opinions in terms of their perception of the degree of the addictiveness of EC compared to CC. The opinions of students did not differ significantly in any of the monitored categories; the majority of students thought they are equally addictive; slightly over 40% of students considered EC less addictive and one out of ten students more addictive than CC. About 55.6% of students think they do not get enough education on ATP and EC during their medical study, with a statistically significant intersexual difference (47.53% males vs. 58.80% females; OR = 0.65, 95% CI: 0.49–0.85), 48.5% of foreign and 58.4% of Slovak students do not have an idea about the EC content.

The EC remains a controversial topic, having both its opponents and supporters.

EC advocates argue that EC could help reduce the global risk of death attributed to conventional cigarette smoking, as well as reduce exposure to environmental tobacco smoke (16, 23, 24).

They further proclaim that EC are used almost exclusively as safer alternatives to conventional tobacco products in CC smokers who seek to reduce or quit smoking completely and do not constitute a "gateway" to smoking initiation (25).

For now, EC can hardly be considered safe for everybody, even if they have less harmful consequences than CC. It cannot be disputed against the assumptions of the harm reduction strategy for smokers and its supportive way of reducing the negative consequences of smoking (7). Dual use is common, and many adolescents use new products only. Moreover, EC might attract a broader range of groups to smoking (26). Currently, it seems that the biggest users of EC are young people and current tobacco smokers (27).

Although many claims exist about EC efficacy, studies have yielded conflicting results, but they emphasize the role EC may have in reducing smoking levels and helping promote smoking ces-

sation. Future research is needed to evaluate the long-term health outcomes and efficiency of EC with a greater discussion between patients and clinicians regarding this smoking cessation tool (27).

Future studies must therefore work to find potential interference between human health and the effect of EC usage, quit attempts, or second- and third-hand exposure (27).

On the other hand, some risks from their use are evident. Non-combustible tobacco is not a harmless alternative, as it is also a risk factor for some health-related problems. Nicotine is a potent psychoactive drug that, when bound to specific acetylcholine receptors, causes the leaching of neurotransmitters, especially dopamine and hormones, followed by a reward for the smoker in terms of wellbeing and increased short-term performance. Any use of nicotine, and therefore smoking of EC, can be expected to cause dependence, both physical and mental, in most users (28, 29).

Given the rapid distribution of nicotine at inhalation exposure, nicotine can be expected to exert its vasomotor efficacy in smoking of EC through activation of the sympathetic nervous system and adrenal glands, which poses an increased risk especially in patients with cardiovascular disease (30).

An additional risk is associated with the possibility of an overdose. While a smoker gets an average of 1 mg of nicotine from a CC, EC cartridges contain about 18 mg, but also higher amounts of nicotine. A fatal dose for an adult is considered 30–60 mg, for a child 10 mg of nicotine (31).

The use of EC is common in university students and appears to be associated with a variety of mental health and drug abuse problems. Clinicians should be aware that certain mental health conditions are more common in EC users (32).

Furthermore, while the long-term consequences of using EC not only for individuals but for society as a whole are unknown from a public health standpoint, the Surgeon General's Report 2014 suggested that nicotine may have negative effects on brain development not only for children but also for young adults, and that nicotine use in any form is not safe for them and is not recommended (5, 29, 33).

Although several studies are currently underway, due to many methodological problems as well as other negative factors affecting the objectivity of the results – serious conflicts of interest of study implementers, lack of long-term follow-ups, a small number of participants, inconsistencies and discrepancies in methodology, no clear conclusions can be drawn about EC safety (7).

According to the Royal Colleague of Physicians' recommendations, it is important to encourage the use of non-tobacco nicotine products as much as possible to replace conventional smoking to protect the health of the population (25). Several experts acknowledge that ENDS should be regulated as a source of nicotine, not as a tobacco product, but should be demonstrated to be safe and effective before being marketed. They should not be allowed where smoking is not allowed until the exact composition of their emissions and the consequent potential health consequences are not known (7, 22, 31). According to the last available systematic review, there is moderate-certainty evidence that EC with nicotine increase stop smoking rates compared to nicotine replacement therapy and compared to EC without nicotine, and nicotine EC probably helps to quit people for at least six months. It seems EC possibly works better than nicotine replacement therapy and nicotine-free EC and they may work better than no support, or behavioural support alone, and their use is probably not associated with serious unwanted effects. However, we need more evidence to be confident about the effects of EC, particularly the effects of newer types of EC (34).

However, our study has several strengths and limitations. The limitations of the study are cross-sectional design, on an online e-mailed questionnaire basis with all its biases and misclassifications, the relatively small sample size, and the low response rate, but comparable with other similar studies – 38.7% (193/498), 38.7% (9,449/3,659) 38% (3,535/9,398), respectively (35–37). According to Sheehan, response rates to e-mail surveys have decreased since the late 1980s (37).

E-mail response rates may only approximate 25% to 30% without follow-up e-mail and multimode approaches and reinforcements (38). One of the reasons for the low response rate was no possibility to be eligible for the prize drawings as it is in other similar studies with higher response rates.

This is one of the few studies in Slovakia to examine the prevalence of EC use and their knowledge among medical students. Another strength of our study is the homogeneity of the group concerning age, study interests, level of knowledge, and health awareness. This can help to reduce confounding, but it might limit the generalizability of the results to the Slovak or European population. The questionnaire itself had an educational potential and helped us to elucidate educational gaps and to develop missing learning objectives in the curricula. The fact that such data on the use of EC and ATP among Slovak students are rarely present (10) in any accessible international database and peer-reviewed international journals makes the study valuable.

CONCLUSIONS

The results of the present study revealed the high consumption of tobacco products and the lack of knowledge and awareness of the harmful effects of EC among medical students in Bratislava. According to the study, EC use is rather frequent among university students. EC currently uses 13.5% of medical students, with a statistically significant difference between Slovak and foreign medical students who are more likely to smoke EC. In the present study, gender differences in prevalence rates were observed. CC smokers used to vape more than non-smokers.

Medical students are supposed to have enough proper knowledge to prepare for their role, but a concerning percentage of surveyed medical students still use different tobacco products, including EC. It seems they do not have enough knowledge, education, and cessation counselling skills to provide proper information about this topic to patients. Physicians should play an important role in preventing and counselling about risk factors of different non-communicable diseases. They can assist, particularly the younger generation, in applying principles of a healthy lifestyle in disease prevention, such as not starting to smoke, but they can also assist patients who already are addicted to smoking. Future physicians' curriculum, as well as prevention programmes and public health policies, should also include information on new tobacco products and effective smoking cessation.

Our study emphasizes the need for intervention in this field at medical faculties and supports further monitoring and comparing results in larger surveys in Slovakia and other countries. Our findings merit further consideration from research and policy perspectives as to the ongoing lack of EC regulations.

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