FRYC, Ewelina and CHARZYŃSKA-GULA, Marianna. Health behaviors and perception of risks associated with the use of e-cigarettes and other tobacco substitutes among secondary school students in the Podkarpackie Province. Journal of Education, Health and Sport. 2026;87:67857. eISSN 2391-8306.
https://doi.org/10.12775/JEHS.2026.87.67857
https://apcz.umk.pl/JEHS/article/view/67857

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).
Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).
The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 31.12.2025. Revised: 10.01.2026. Accepted: 10.01.2026. Published: 16.01.2026.

Health behaviors and perception of risks associated with the use of e-cigarettes and other tobacco substitutes among secondary school students in the Podkarpackie Province

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Abstract

Introduction: The popularity of e-cigarettes/tobacco heaters/snus has been steadily growing in recent years. They are increasingly replacing traditional cigarettes. This is most often the result of users' belief that they are healthier and safer than traditional cigarettes, but also a result of fashion. This is a serious problem among today's youth.

Research objective: The aim of the study was to learn about the awareness and behaviors of young people in the Podkarpackie Province related to e-cigarettes and other substitutes for traditional tobacco smoking.

Material and methods: A diagnostic survey method was used with a questionnaire technique and an original electronic questionnaire. The study surveyed 310 secondary school students (women: 52.58%; men: 47.42%) from general secondary schools, technical schools, vocational schools, and vocational schools.

Results: Nearly 40% of the students surveyed do not smoke tobacco, either traditionally or electronically. E-smokers account for 23.87%, traditional cigarettes 11.29%, snus 5.48%, and tobacco heaters 3.23%. The study group also included ex-smokers (5.81% - former traditional smokers, 4.19% -former electronic smokers), as well as passive tobacco smokers (24 students - 7.74%). The general health awareness of the surveyed students is at a fairly low level, with an average level of knowledge about the consequences of smoking and tobacco use.

Conclusions: The scale of use of traditional smoking substitutes is a serious and growing problem. Active education on the harmful effects of various forms of tobacco smoking should be an integral part of young people's lives, both at school and at home.

Keywords: e-smoking, tobacco heaters, snus, student, health awareness

Introduction

The issue of health behaviors has been a topic of interest for many years for both theorists and scientists from various fields. Due to the diverse approaches to this issue, characteristic of individual disciplines, many concepts have emerged regarding the definition and classification of health behaviors.

Health behaviors can be divided into those that promote health, known as pro-health or positive behaviors, and those that are anti-health, referred to as negative or self-destructive behaviors. Health-promoting behaviors aim to strengthen health and prevent disease, while anti-health behaviors contribute to health problems, negatively affecting the physical, emotional, and psychosocial spheres.

Shaping healthy behaviors and attitudes in young people is a process supported and reinforced by many factors. In addition to the influence of the immediate family environment, peer group, friends, role models, and personal experience, media activity is also significant, especially for the youngest population [6].

According to alarming information provided during a meeting of the Parliamentary Public Health Team in 2023, more than half of Polish students have smoked their first cigarette, and 12% smoke tobacco on a daily basis. Particularly worrying is the increasing percentage of young people who smoke cigarettes, including teenagers under the age of 15. Data from the National Institute of Public Health – National Institute of Hygiene in Warsaw show that currently 28% of adult Poles smoke cigarettes regularly – 27% of women and 30% of men. It is worrying that, according to the latest European School Survey Project on Alcohol and Other Drugs (ESPAD) study, as many as 71.2% of students aged 15-16 consider buying cigarettes to be "quite easy" or "very easy" for them, despite the ban on selling them to minors. Similar alarming information is also presented in the 2024 American report Truth Initiative — E-cigarette factsheet [37].

Often, the first step for young people towards traditional cigarettes is e-cigarettes and nicotine heaters [1]. Their users are predominantly school-age teenagers, with as many as 29% using these products regularly [39]. It is important to remember that a teenager who starts smoking often becomes an adult smoker [11,27,4].

According to the WHO, cigarette smoking remains the largest risk factor for cancer. It accounts for approximately 22% of cancer deaths, killing approximately 6 million people each year [25]. According to the WHO FCTC, all tobacco products made from tobacco leaves and consumed in various ways (smoking, sucking, chewing, sniffing) are a source of various carcinogens and other toxic substances [24]. Approximately 400 deaths per year from lung cancer are the result of passive smoking (Becher and Wahrendorf studies) [19]. The relative risk of lung cancer due to passive smoking is 7.66% for men and 4.7% for women [18].

Smoking is the most common lifestyle-related cause of death. In Poland, at least 70,000 people die each year due to smoking. Lung cancer alone kills 23,000 of our compatriots every year, and this disease is 90% related to smoking (it increases the risk of this cancer by as much as 25 times). Over 2 million Poles suffer from chronic obstructive pulmonary disease (COPD), which is also 90% related to smoking [12]. Smoking contributes to COPD in 90% of cases. Over 2 million Poles suffer from chronic obstructive pulmonary disease (COPD), which is also 90% related to smoking [12]. Smoking contributes to increased alcohol consumption, which has very negative health effects [10].

The health, social, and economic costs associated with smoking are extremely high, which means that any measures aimed at reducing this phenomenon are profitable in the long

term. According to data from the World Health Organization (WHO), healthcare expenditures related to smoking-related diseases account for 6 to 15% of total healthcare costs in the most developed countries. The World Health Organization (WHO) has called on governments to treat e-cigarettes and vaporizers in the same way as traditional tobacco products.

Aim of the study

The aim of the study was to assess the awareness and health behaviors of young people in the Podkarpackie Province in relation to e-cigarettes and other substitutes for traditional tobacco smoking.

Material and methods

The following methods were planned:

- a review method (to analyze the main issues in the light of selected literature on the subject of the study),

- a diagnostic survey method using a questionnaire and a proprietary electronic survey tool. The questionnaire contained 35 closed single- and multiple-choice questions concerning opinions and behaviors related to substitutes for traditional smoking.

The research was conducted online, anonymously, among secondary school students, such as general secondary schools, technical schools, and vocational schools located in Tarnobrzeg, Nowa Dęba, Kolbuszowa, and Rzeszów. The schools were deliberately selected to obtain a variety of responses depending on the type of secondary school, as well as the place of residence – rural areas, small, medium, and large cities (up to 15,000, 50,000, and 150,000 inhabitants).

Consent to participate in the study was included in the introductory text to the questionnaire. The study was preceded by the consent of the management and administrators of the electronic register in each of the schools. The study was evaluated by the Committee for Scientific Research Ethics of the Stanisław Tarnowski University of Agriculture in Tarnobrzeg (consent no. 12/2024/2025 of February 28, 2025).

The statistical analysis of the data collected during the study was performer using IBM SPSS Statistics software. Relationships, correlations, and comparisons of variables are presented in tables. Appropriate tests and/or statistical coefficients were used to analyze the relationships.

Pearson's Chi-2 independence test was performed to check whether there was a statistically significant relationship between nominal variables or between nominal and ordinal

variables. The following abbreviations were used in the tables with this test: N – number, % – percentage, Chi-2 – test statistic, p – test significance. Three levels of statistical significance were adopted (from highest to lowest: $p<0.001$ – marked ***, $p<0.01$ – marked **, and $p<0.05$ – marked *). In this case, the relationship between the variables is statistically significant.

Cramér's V correlation coefficient was calculated to check the strength of the correlation between nominal variables or between nominal and ordinal variables. This coefficient is used when Pearson's Chi-2 independence test showed a statistically significant relationship. Its theoretical range is from 0 to 1. The further from 0 and closer to 1, the stronger the correlation between the variables. The coefficient proves the existence of a correlation but does not provide information about cause and effect.

The Kolmogorov-Smirnov test was performed to check whether the distributions of the quotient variables are consistent with the normal distribution. This was necessary in order to select the appropriate statistical tests in the main part of the analysis. The tables with this test use the following abbreviations: K-S - test statistic, N - number of observations, “p” - test significance. Three levels of statistical significance were adopted (from highest to lowest: $p<0.001$ - marked ***, $p<0.01$ - marked **, and $p<0.05$ - marked *). In this case, the distribution of the variable deviates significantly from the normal distribution.

Spearman's rho correlation coefficient was calculated to check whether ordinal or quotient variables, whose distribution significantly deviates from normal, correlate with each other in a statistically significant, linear manner. Three levels of statistical significance were adopted (from highest to lowest: $p<0.001$ - marked ***, $p<0.01$ - marked **, and $p<0.05$ - marked *). If the correlation is statistically significant, the rho coefficient is also interpreted. Its theoretical range is from -1 to +1. The further away from 0 and closer to 1, the stronger the correlation between the variables. A negative rho coefficient means that as the value of one variable increases, the value of the other variable decreases. A positive rho coefficient means that as the value of one variable increases, the value of the other variable also increases.

The Mann-Whitney test was performed to check whether there is a statistically significant difference between the two groups in terms of ordinal variables or in terms of ratio variables that deviate significantly from the normal distribution. The tables with this test use the following abbreviations: N – group size, Min – lowest score in the group, Max – highest score in the group, M – arithmetic mean, Me – median, SD – standard deviation, Z – test statistic, p – test significance. Three levels of statistical significance were adopted (from highest to

lowest: p<0.001 – marked with ***, p<0.01 – marked with **, and p<0.05 – marked with *). In this case, the groups differ from each other in a statistically significant manner. The Kruskal-Wallis test was performed to check whether there is a statistically significant difference between more than two groups in terms of ordinal variables or in terms of quotient variables that deviate significantly from the normal distribution. The following abbreviations were used in the tables with this test: N – group size, Min – lowest score in the group, Max – highest score in the group, M – arithmetic mean, Me – median, SD – standard deviation, H – test statistic, p – test significance. Three levels of statistical significance were adopted (from highest to lowest: p<0.001 – marked with ***, p<0.01 – marked with **, and p<0.05 – marked with *). In this case, at least two groups differ from each other in a statistically significant way. Since more than two groups were compared and the test shows a significant difference between at least two of them, it is also necessary to determine exactly which groups differ significantly. To achieve this, a multiple comparison test was used, and its results are presented using the abbreviation S.I.D. (Statistically Significant Differences), indicating between which groups there is a significant difference and what its direction is (< or >).

Characteristics of the study group

The study involved 310 secondary school students from the Podkarpackie Province.

Table 1. Characteristics of the study group (Integer=310)

Study group Integer=310 (100%)		Integer	%
Sex	Women	163	52,58
	Men	147	47,42
Age	15-16	43	13,87
	17	68	21,94
	18	116	37,42
	19	83	26,77
Type of secondary school	General secondary school	161	51,94
	Technical school	77	24,84
	Vocational school	72	23,23
Residence	City up to 15,000	70	22,58
	City up to 50,000	66	21,29
	City up to 200,000	76	24,52
	Village	98	31,61
Smoking status	Ex-smoker (traditional smoking)	18	5,81

	Ex-smoker (e-cigarettes)	13	4,19
	Passive smoker	24	7,74
	Traditional cigarettes	35	11,29
	E-cigarettes	74	23,87
	Tobacco heaters	10	3,23
	Snus	17	5,48
	I don't smoke	119	38,39
Duration of smoking	Less than a year	28	9,03
	1-2 years	73	23,55
	2-5 years	42	13,55
	6-10 years	3	0,97
	I don't smoke	164	52,90

Among the respondents, there were 163 women (52.58%) and 147 men (47.42%). The largest group, numbering 161 people (51.94%), were students of a general secondary school, followed by a technical secondary school (77 people, 24.84%) and a vocational school (72 people, 23.23%).

The respondents were residents of rural areas and cities. The largest group (98 people; 31.61%) were rural residents. City residents were divided according to city size. Seventy students (22.58%) lived in small towns with up to 15,000 inhabitants, 66 students (21.29%) lived in medium-sized towns with up to 50,000 inhabitants, and 76 students (24.52%) lived in large towns with over 150,000 inhabitants.

Nearly 40% of the students surveyed declared that they do not smoke either traditional or electronic cigarettes and are not passive smokers (38.39% - 119 people). Among smokers, the largest group are those who smoke e-cigarettes (74 people; 23.87%). Traditional smokers number 35 people (11.29%). The use of snus was confirmed by 17 people (5.48%) and tobacco heaters by 10 people (3.23%). The study group also included ex-smokers (5.81% - former traditional smokers, 4.19% - former electronic smokers) and passive tobacco smokers (24 students - 7.74%).

The largest number of students who smoke (73 people; 23.55%) have been doing so for 1-2 years. 13.55% of respondents declare that they have been smoking for 2-5 years. 28 students (9.03%) have been smoking for less than a year, and three students (0.97%) have been smoking for more than 6 years. An in-depth analysis of the relationship between smoking experience and student gender revealed that male students had the longest smoking experience (42.7% have been smoking for 2-5 years). Female students (60.9%) were more likely to report 1-2 years of smoking experience than male students (41.5%).

Behaviors related to tobacco use/smoking and selected sociodemographic variables

The analysis of the relationship between selected sociodemographic characteristics of the respondents (gender, age, type of school, place of residence, and education of both parents) and their behaviors related to e-cigarettes and other substitutes for traditional tobacco smoking was compared:

with data on:

•the smoker/tobacco user status of the student,

•length of smoking history,

•smoker/tobacco user status of parents (mother and father), siblings (brothers, sisters)

and possible romantic partners,

•respondent's declaration regarding approval of smoking by their future child.

Table 2. Gender and tobacco-related status

Tobacco Status	Sex				In total	
	Women		Men			
	Integer	%	Integer	%	Integer	%
I am an ex-smoker (traditional smoking)	10	6,1	8	5,4	18	5,8
I am an ex-smoker (e-smoking)	8	4,9	5	3,4	13	4,2
I am a passive smoker	15	9,2	9	6,1	24	7,7
I smoke traditional cigarettes	11	6,7	24	16,3	35	11,3
I smoke e-cigarettes	41	25,2	33	22,4	74	23,9
I use tobacco heaters	3	1,8	7	4,8	10	3,2
I use snus	4	2,5	13	8,8	17	5,5
I have never smoked	71	43,6	48	32,7	119	38,4
In total	163	100,0	147	100,0	310	100,0
Test Chi-2: Chi-2=18,141, p=0,011*, V Cramera=0,242						

It has been shown that a significantly higher percentage of women (43.6%) than men (32.7%) have never smoked. On the other hand, men (16.3%) were much more likely than women (6.7%) to smoke traditional cigarettes, and male students (8.8%) were also more likely than female students (2.5%) to use snus. These differences were statistically significant.

Table 3. Age and tobacco-related status

Tobacco Status	Age in years	In total

	15-16		17		18		19			
	Integer	%	Integer	%	Integer	%	Integer	%	Integer	%
I am an ex-smoker (traditional smoking)	2	4,7	3	4,4	6	5,2	7	8,4	18	5,8
I am an ex-smoker (e-smoking)	1	2,3	3	4,4	4	3,4	5	6,0	13	4,2
I am a passive smoker	1	2,3	6	8,8	10	8,6	7	8,4	24	7,7
I smoke traditional cigarettes	4	9,3	5	7,4	14	12,1	12	14,5	35	11,3
I smoke e-cigarettes	8	18,6	15	22,1	33	28,4	18	21,7	74	23,9
I use tobacco heaters	5	11,6	3	4,4	0	0,0	2	2,4	10	3,2
I use snus	4	9,3	3	4,4	7	6,0	3	3,6	17	5,5
I have never smoked	18	41,9	30	44,1	42	36,2	29	34,9	119	38,4
In total	43	100,0	68	100,0	116	100,0	83	100,0	310	100,0
Test Chi-2: Chi-2=24,753, p=0,258										

No significant correlation was found between age and tobacco-related status. Regardless of age, the largest percentage of respondents had never smoked tobacco.

Table 4. School and tobacco-related

Tobacco Status	Type of secondary school			In total
	General secondary school	Technical school	Vocational school	

	Integer	%	Integer	%	Integer	%	Integer	%
I am an ex-smoker (traditional smoking)	12	7,5	4	5,2	2	2,8	18	5,8
I am an ex-smoker (e-smoking)	9	5,6	2	2,6	2	2,8	13	4,2
I am a passive smoker	11	6,8	8	10,4	5	6,9	24	7,7
I smoke traditional cigarettes	8	5,0	10	13,0	17	23,6	35	11,3
I smoke e-cigarettes	36	22,4	20	26,0	18	25,0	74	23,9
I use tobacco heaters	4	2,5	0	0,0	6	8,3	10	3,2
I use snus	2	1,2	5	6,5	10	13,9	17	5,5
I have never smoked	79	49,1	28	36,4	12	16,7	119	38,4
In total	161	100,0	77	100,0	72	100,0	310	100,0
Test Chi-2: Chi-2=57,336, p<0,001***, V Cramera=0,304								

There is a statistically significant relationship and a moderately strong correlation between the type of school and tobacco-related status. Nearly half of high school students (49.1%) have never smoked, and 22.4% smoke e-cigarettes. Only a few people indicated a different "tobacco status." In contrast, among technical school students, significantly fewer did not smoke, only 36.4% of respondents. On the other hand, 26% of them smoke e-cigarettes. Among vocational school students, only 16.7% have never smoked. In turn, 25% smoke e-cigarettes and as many as 23.6% smoke traditional cigarettes. There is also a clear difference in the use of snus, which is used by significantly more vocational school students (13.9%) than high school students (1.2%).

Table 5. Place of residence and tobacco status

Tobacco Status	Residence								In total	
	Village		City up to 15,000		City up to 15,000-50,000		City up to 50,000-200,000			
	Integer	%	Integer	%	Integer	%	Integer	%	Integer	%

I am an ex-smoker (traditional smoking)	6	6,1	4	5,7	5	7,6	3	3,9	18	5,8
I am an ex-smoker (e-smoking)	6	6,1	2	2,9	3	4,5	2	2,6	13	4,2
I am a passive smoker	4	4,1	4	5,7	8	12,1	8	10,5	24	7,7
I smoke traditional cigarettes	9	9,2	8	11,4	6	9,1	12	15,8	35	11,3
I smoke e-cigarettes	17	17,3	23	32,9	14	21,2	20	26,3	74	23,9
I use tobacco heaters	3	3,1	1	1,4	3	4,5	3	3,9	10	3,2
I use snus	3	3,1	2	2,9	6	9,1	6	7,9	17	5,5
I have never smoked	50	51,0	26	37,1	21	31,8	22	28,9	119	38,4
In total	98	100,0	70	100,0	66	100,0	76	100,0	310	100,0
Test Chi-2: Chi-2=25,550, p=0,224										

There is no statistically significant correlation between place of residence and tobacco-related status. However, it is worth noting that the smaller the town, the higher the percentage of respondents who have never smoked tobacco.

Table 6. Mother's education and tobacco-related status

Tobacco Status	Mother's education						In total	
	Primary		Secondary		Higher			
	Integer	%	Integer	%	Integer	%	Integer	%
I am an ex-smoker (traditional smoking)	4	13,3	8	6,2	6	4,0	18	5,8

I am an ex-smoker (e-smoking)	0	0,0	10	7,7	3	2,0	13	4,2
I am a passive smoker	1	3,3	7	5,4	16	10,7	24	7,7
I smoke traditional cigarettes	8	26,7	17	13,1	10	6,7	35	11,3
I smoke e-cigarettes	5	16,7	31	23,8	38	25,3	74	23,9
I use tobacco heaters	0	0,0	4	3,1	6	4,0	10	3,2
I use snus	3	10,0	8	6,2	6	4,0	17	5,5
I have never smoked	9	30,0	45	34,6	65	43,3	119	38,4
In total	30	100,0	130	100,0	150	100,0	310	100,0
Test Chi-2: Chi-2=29,259, p=0,010*, V Cramera=0,217								

The study found that the higher the mother's education level, the higher the percentage of young people who had never smoked, but also of passive smokers, and students who smoked e-cigarettes and used tobacco heaters. Conversely, the lower the mother's education, the higher the percentage of respondents who smoke traditional cigarettes and ex-smokers of traditional cigarettes, as well as people who use snus. The differences were statistically significant.

Table 7. Father's education and tobacco-related status

Tobacco Status	Father's education						In total	
	Primary		Secondary		Higher			
	Integer	%	Integer	%	Integer	%	Integer	%
I am an ex-smoker (traditional smoking)	2	5,4	11	5,8	5	6,0	18	5,8
I am an ex-smoker (e-smoking)	0	0,0	11	5,8	2	2,4	13	4,2
I am a passive smoker	1	2,7	16	8,4	7	8,4	24	7,7
I smoke traditional cigarettes	8	21,6	18	9,5	9	10,8	35	11,3
I smoke e-cigarettes	10	27,0	43	22,6	21	25,3	74	23,9
I use tobacco heaters	2	5,4	6	3,2	2	2,4	10	3,2
I use snus	5	13,5	8	4,2	4	4,8	17	5,5
I have never smoked	9	24,3	77	40,5	33	39,8	119	38,4
In total	37	100,0	190	100,0	83	100,0	310	100,0
Test Chi-2: Chi-2=17,018, p=0,255								

However, no correlation was found between the father's education and the student's status in relation to tobacco. It is worth noting that while among children of fathers with secondary education (40.5%) and higher education (39.8%), the majority of students had never smoked, among children of fathers with primary education (40.5%), the majority of students had never smoked. It is worth noting that while among children of fathers with secondary education (40.5%) and higher education (39.8%) the majority of students had never smoked, among children of fathers with primary education the majority of students (27%) smoked traditional cigarettes.

It has been shown that the family environment has a very clear influence on behaviors related to tobacco use/smoking. As it turned out, the highest number of non-smoking mothers are found among non-smokers (81.7%), the highest number of mothers who smoke traditional cigarettes are found among traditional smokers (30.3%), and the highest number of mothers who smoke e-cigarettes (19%) and snus/heaters (2%) are found among people who smoke cigarettes other than traditional ones. Also, the highest number of non-smoking fathers are found among non-smokers (70.6%), the highest number of fathers who smoke traditional cigarettes are found among traditional smokers (57.6%), and the highest number of fathers who smoke e-cigarettes (5.1%) and snus/heaters (5.1%) are found among people who smoke non-traditional cigarettes.

Non-smokers have the most non-smoking siblings (66.4%), the highest number of brothers who smoke traditional cigarettes are found among traditional smokers (60.7%), and the highest number of brothers who smoke e-cigarettes (37.2%) and snus/heaters (15.4%) are found among people who smoke cigarettes other than traditional ones. Non-smokers also have the most non-smoking sisters (78.3%), traditional smokers have the most sisters who use snus/heaters (8.7%), traditional smokers have the most sisters who smoke traditionally (13%), and smokers of non-traditional cigarettes have the most sisters who smoke e-cigarettes (43.4%) are found among people who smoke non-traditional cigarettes.

The most boyfriends/girlfriends who are non-smokers are found among non-smoking students (76.7%), and, respectively, the largest group of traditional smokers (37.5%) declared that their boyfriend/girlfriend is also a traditional tobacco smoker. A similar situation was also observed in the group of students who smoke e-cigarettes (69.3%) and snus/heaters (5.3%). Their romantic partners also smoke cigarettes other than traditional ones.

Health awareness and knowledge of the respondents

Based on a series of questions, general indicators of young people's awareness and knowledge of the risks associated with smoking e-cigarettes and other substitutes for traditional tobacco smoking were calculated.

The index of young people's knowledge about the risks of smoking e-cigarettes and other substitutes for traditional tobacco smoking was calculated on the basis of questions 21-23, with one point awarded for each correct answer, i.e., NEGATIVE. Thus, each respondent could score between 0 and 84 points on the knowledge index in this area. The more points, the higher the level of knowledge.

Calculating the index of young people's awareness of the risks of smoking e-cigarettes and other substitutes for traditional tobacco smoking was much more complicated. Due to the fact that this index consisted of a series of differently constructed questions, a method of calculating the level of knowledge was proposed, as shown in the table below, while being aware that it may be debatable. Ultimately, each respondent could score between 0 and 21 points on the awareness index in this area. The more points, the higher the level of awareness.

Table 8. Descriptive statistics and normality tests of the distributions of awareness and knowledge indicators related to the risks of smoking e-cigarettes and other substitutes for traditional tobacco smoking

Indicators	Integer	Min	Maks	M	Me	SD	K-S	p
knowledge (0-21)	310	1	20	10,30	10,00	3,49	0,081	<0,001***
awareness (0-84)	310	4	84	57,65	59,00	20,35	0,098	<0,001***

In terms of knowledge, the respondents scored between 1 and 20 points out of a possible 21. The average score was 10.3 points. The standard deviation indicates moderate diversity within the group in terms of knowledge about the risks associated with smoking e-cigarettes and other substitutes for traditional tobacco smoking. Based on the mean and median, it can be said that the level of knowledge in the study group is quite low. The Kolmogorov-Smirnov test showed that the distribution of this variable deviates significantly from normal.

In terms of awareness, the respondents scored between 4 and 84 points out of a possible 84. The average was 57.65 points. The standard deviation indicates a moderate diversity in the study group in terms of awareness of the risks associated with smoking e-cigarettes and other substitutes for traditional tobacco smoking. Based on the mean and median, it can be said that

the level of awareness in the study group is average. The Kolmogorov-Smirnov test showed that the distribution of this variable deviates significantly from normal.

Table 9. Gender and awareness and knowledge of the risks associated with smoking e-cigarettes and other substitutes for traditional tobacco smoking

Indicators	Sex	Integer	Min	Maks	M	Me	SD	Test U Manna-Whitneya
knowledge	Women	163	1	20	10,89	11,00	3,60	Z=-3,258
	Men	147	3	17	9,65	9,00	3,26	p=0,001**
awareness	Women	163	6	84	61,61	63,00	18,48	Z=-3,396
	Men	147	4	84	53,24	55,00	21,46	p=0,001**

The Mann-Whitney test showed that women have a statistically significantly higher level of knowledge and awareness of the risks associated with smoking e-cigarettes and other substitutes for traditional tobacco smoking than men.

Table 10. Age and awareness and knowledge of the risks associated with smoking e-cigarettes and other substitutes for traditional tobacco smoking

Indicators	Age in years	Integer	Min	Maks	M	Me	SD	Test Kruskala-Wallisa
knowledge	15-16	43	3	16	9,74	10,00	3,66	
	17	68	5	18	10,12	10,00	3,02	H=1,922
	18	116	1	20	10,34	10,00	3,45	p=0,589
	19	83	3	18	10,69	10,00	3,82	
awareness	15-16	43	11	84	50,56	53,00	18,92	
	17	68	9	84	57,43	62,00	22,91	H=6,663
	18	116	4	84	58,72	59,00	20,08	p=0,083
	19	83	6	84	59,99	62,00	18,70	

The Kruskal-Wallis test did not reveal any statistically significant differences between age groups in terms of awareness and knowledge of the risks associated with smoking e-cigarettes and other substitutes for traditional tobacco smoking.

Table 11. School and awareness and knowledge of the risks associated with smoking e-cigarettes and other substitutes for traditional tobacco smoking

Indicators	Type of secondary school	Integer	Min	Maks	M	Me	SD	Test Kruskala-Wallisa
knowledge	General secondary school (1)	161	3	20	10,89	11,00	3,46	H=18,062 p<0,001*** R.I.S.:1,2>3
	Technical school (2)	77	3	17	10,45	10,00	3,61	
	Vocational school (3)	72	1	16	8,82	8,50	3,00	
awareness	General secondary school (1)	161	24	84	63,27	63,00	14,93	H=44,019 p<0,001*** R.I.S.:1,2>3
	Technical school (2)	77	4	84	60,09	66,00	21,56	
	Vocational school (3)	72	6	84	42,46	38,50	22,16	

As shown by the Kruskal-Wallis test, vocational school students have a statistically significantly lower level of knowledge and awareness of the risks associated with smoking e-cigarettes and other substitutes for traditional tobacco smoking than technical school and high

school students. However, there is no significant difference between high school and technical school students.

Table 12. Place of residence and awareness and knowledge of the risks associated with smoking e-cigarettes and other substitutes for traditional tobacco smoking

Indicators	Residence	Integer	Min	Maks	M	Me	SD	Test Kruskala -Wallisa
knowledge	Village (1)	98	1	17	10,61	11,00	3,70	H=7,440 p=0,059
	City up to 15,000 (2)	70	3	18	10,90	11,00	3,46	
	City up to 15,000 - 50,000 (3)	66	4	20	10,00	10,00	3,26	
	City up to 50,000 - 200,000 (4)	76	4	16	9,62	9,50	3,36	
awareness	Village (1)	98	6	84	63,99	66,00	18,38	H=21,130 p<0,001*** R.I.S.:1,3>4 1>2
	City up to 15,000 (2)	70	18	84	57,14	57,00	17,60	
	City up to 15,000 - 50,000 (3)	66	13	84	58,08	57,50	21,52	
	City up to 50,000 - 200,000 (4)	76	4	84	49,55	47,50	21,54	

No statistically significant differences were found between respondents from rural areas, towns with up to 15,000 inhabitants, towns with 15,000 to 50,000 inhabitants, and towns with 50,000 to 200,000 inhabitants in terms of knowledge about the risks associated with smoking e-cigarettes and other substitutes for traditional tobacco smoking. On the other hand, residents of rural areas and towns with a population of 15,000 to 50,000 have a statistically significantly higher level of awareness in this regard than residents of towns with a population of 50,000 to

200,000, and residents of rural areas have a higher level of awareness than residents of towns with a population of up to 15,000.

Table 13. Tobacco status and awareness and knowledge of the risks associated with smoking e-cigarettes and other substitutes for traditional tobacco smoking

Indicators	Tobacco status	Integer	Min	Maks	M	Me	SD	Test Kruskala -Wallisa
knowledge	Non-smokers (1)	174	3	20	11,02	11,00	3,50	H=17,635 p<0,001*** R.I.S.: 1>3
	Traditional smokers (2)	35	5	16	10,11	9,00	3,12	
	Other smokers (3)	101	1	17	9,14	9,00	3,29	
awareness	Non-smokers (1)	174	4	84	65,83	66,50	16,21	H=65,142 p<0,001*** R.I.S.:1>2,3
	Traditional smokers (2)	35	6	84	46,43	44,00	18,35	
	Other smokers (3)	101	6	84	47,43	44,00	21,09	

The Kruskal-Wallis test showed that non-smokers have a statistically significantly higher level of knowledge about the risks associated with smoking e-cigarettes and other substitutes for traditional tobacco smoking than smokers of non-traditional cigarettes. No significant differences were found between traditional smokers and other individuals. The Kruskal-Wallis test also showed that non-smokers have a statistically significantly higher level of awareness of the risks associated with smoking e-cigarettes and other substitutes for traditional tobacco smoking than smokers of other cigarettes and traditional cigarettes.

Discussion

Not enough time has passed since e-cigarettes first appeared on the market to accurately assess their long-term effects. Nevertheless, a growing body of research clearly indicates that e-cigarettes have a negative impact on health, particularly on the respiratory and immune systems and on the functioning of certain areas of the brain [14]. Furthermore, the nicotine content in e-cigarettes is not necessarily lower than in traditional cigarettes [21]. Users may smoke them at shorter intervals due to their ease of use, lack of unpleasant odor, and greater acceptance among bystanders [20]. In many social situations, it is also becoming common to

smoke e-cigarettes continuously, without interruption, which makes the amount of nicotine inhaled virtually immeasurable. As a result, in a short time, the equivalent of several or even a dozen traditional cigarettes can be introduced into the body. When it comes to the risk of addiction, it is even greater among e-cigarette users [41].

Access to e-cigarettes is much easier than buying traditional cigarettes. E-cigarette advertisements are available on the internet, in magazines, and we see them in the windows of shops selling e-smoking gadgets. We encounter the negative effects of this advertising in conversations among young people and, unfortunately, we see them in the hands of increasingly younger people in front of university buildings, schools, on sidewalks, at bus stops, and in groups of young people. Colorful advertisements, logos, and the products themselves are appealing and inform users in advance that substitutes for traditional smoking are healthier, better, and more interesting. They influence young people who, by consuming nicotine in this way, have a real impact on their health and lives [34]. Advertising strongly influences our awareness and perception of reality. Advertisements very often "think for us," suggest conclusions, form opinions and views, and we very often unconsciously succumb to their influence [35,36]. The play on words VELO (the name of snus products) LOVE evokes positive feelings and associations. Advertising smoking substitutes as a way to quit traditional cigarettes makes us perceive these substitutes as something good, pleasant, and helpful—without seeing the dangers they pose [13].

Research conducted by the Pollster Research Institute, commissioned by the Ombudsman for Children and published in December 2020, shows that 23% of Polish teenagers use e-cigarettes, with 72% of this group using them regularly. It was noted that young people who use e-cigarettes find it easy to purchase these products despite existing legal regulations [8]. Easy availability and discreet acceptance by those around them make e-cigarettes very popular among young people, including school and university students. One in five participants in the PolNicoYouth study believes that parents do not pay attention to whether their children smoke. An even larger number of respondents who took part in the study stated that their parents are unaware that they regularly use nicotine products – as many as 77% of respondents admitted that they smoke e-cigarettes at home [41].

It is also worth noting that e-cigarettes are another electronic gadget, alongside smartphones, iWatches, and wireless headphones, which are "trendy" and can make young people stand out

among their friends [41]. Fashion and being noticed are very important to young people. Living in the age of social media, idols in the form of influencers are new trends among young people.

The results of the presented study correspond with the results of Paweł Mroczek and co-authors, who found that the majority of young students in this study are e-cigarette smokers (52.4%). Over 90% of respondents smoke in rooms where there are non-smokers. Almost 91% of all respondents were passively exposed to e-cigarette fumes. When asked about the toxic compounds produced during the vaporization of liquid, almost half of the respondents (46.7%) answered: “I don't know.” [30]. A large American study involving 599 students from a state university in the US found that 29% of them admitted to having used e-cigarettes at some point, with 14% declaring that they had done so in the last 30 days [9]. The results of this team indicate that e-cigarettes may be another tool for young people to stimulate the nervous system, which they reach for the same reasons as other psychoactive substances. They are most often used by people who are prone to this type of substance," according to the authors of the study [38].

The results obtained in our research are referred to in the study by Grzegorz Brożek and co-authors, who, based on data obtained from 1,318 medical students (students of the Faculty of Medicine, Medical University of Silesia), determined the frequency and attitudes of students towards the use of traditional and electronic cigarettes. Traditional tobacco was smoked by 18.1%, e-cigarettes by 1.3%, and 2.2% were dual smokers. Compared to traditional tobacco users, e-smokers smoked for a shorter period of time, but the intensity of smoking was higher, and the number of e-cigarettes smoked per day was higher. Dual smokers used tobacco cigarettes more often than e-cigarettes, but smoked more e-cigarettes per day. The choice of e-liquid depended on taste (50.0%), nicotine concentration (21.7%), and price (7.6%). Nicotine-free e-cigarettes were used by 6.5% of smokers. Dual smokers were more likely to choose e-liquids with high nicotine concentration. The motives for e-smoking identified in this study were similar to those identified in our study: quitting traditional smoking (58.7%), less harmful effects on health (43.5%), and price (34.8%). E-smoking was perceived as safe for health by 6.0% of respondents (35.5% of e-smokers vs. 4.9% of non-smokers). In the cited study among medical students, e-smoking was less popular than smoking traditional tobacco cigarettes, and the respondents themselves considered e-cigarettes to be harmful and addictive [5].

A study by Doireann O’Brien and co-authors found that young people who had ever used an e-cigarette were ~4 times more likely to start smoking traditional cigarettes (compared to

those who had never used an e-cigarette). The authors' conclusions are clear: e-cigarettes can be a “gateway” to traditional smoking, which is a significant signal for public health [31].

Another study, referring to our results, confirmed the influence of smoking by parents, siblings, or friends on the smoking habits of the young people surveyed. The same conclusions as ours were reached, for example, by a team led by Dorota Kaleta, which studied 1,693 students attending 21 schools in the Piotrków County [16,17]. Paulina Kurdyś-Bykowska's team, through cross-sectional studies conducted in 2021, assessed the prevalence of smoking traditional cigarettes and e-cigarettes among teenagers aged 12-18 in Poland (a total of 10,388 teenagers, mainly from rural areas, participated in the study) and also identifying demographic risk factors associated with their use, showed that 12.3% of respondents smoked traditional cigarettes, of which 90% had smoked in the last month, while 14.9% were e-cigarette users, of which 84.7% had used them in the last month. People who used both types of products accounted for 6.4% of respondents. Non-smokers were younger, and e-cigarette users were more often boys from larger cities. The mothers of non-smokers tended to have a higher level of education than the mothers of traditional cigarette smokers [22].

Meanwhile, an American team consisting of Ruoyan Sun, David Mendez, and Kenneth E Warner studied the relationship between e-cigarette use and traditional cigarette smoking among teenagers. It was shown that among adolescents who had never smoked traditional cigarettes, those who had ever used e-cigarettes at the beginning of the study had a slight increase in smoking in the last 12 months or the last 30 days compared to those who had never used e-cigarettes, after taking into account behavioral risk factors [32].

There are many predictors of both traditional smoking and e-smoking among teenagers. These include demographic and behavioral factors, such as gender, poor knowledge of the harms, use of other tobacco products, or alcohol consumption, but also environmental factors. in the form of a higher risk of e-smoking among young people from disadvantaged backgrounds [32].

A review of 40 studies conducted by Timothy D Becker, Melanie K Arnold, Vicky Ro, Lily Martin, and Timothy R Rice indicates that e-cigarette use among adolescents is associated with a higher prevalence of mood disorders, anxiety, ADHD, and other mental health problems [3].

An international analysis by Nader Salari and co-authors indicates a growing (in many countries) prevalence of vaping among teenagers, with significant geographical and gender

differences (higher rates among boys in many countries) [33]. These results are consistent with our research.

In our study, we showed that in the surveyed group of secondary school students, both traditional smoking and e-smoking/tobacco heaters/snus are serious problems. This is confirmed by numerous evidence indicating that the use of e-cigarettes among young people is growing rapidly [23]. Fairly obvious predictors, such as parental smoking and belief in less harmful substitutes for traditional smoking, are important determinants of users of traditional tobacco smoking substitutes [40]. Heavily advertised products do not always reflect an attempt to reduce smoking of traditional cigarettes; on the contrary, they may exploit a general propensity to use psychoactive substances, especially among young adults. The surest form of cancer prevention remains complete cessation of smoking traditional cigarettes and inhaling smoke from e-cigarettes.

Despite this knowledge, few effective measures have been taken to date to investigate the impact of prevention programs on e-cigarette use among young people [28]. At the end of 2024, only one completed randomized controlled trial (RCT) with published results determining the prevention or cessation of e-cigarette use among young people had been identified [2]. Another 27 ongoing trials indicate a growing body of literature on this topic worldwide. Nevertheless, significant investments are being made to prevent e-cigarette use. For example, the Australian government has allocated $30 million to protect Australians from e-cigarette use [29]. Similarly, the UK government invests over £100 million annually in smoking cessation support, national campaigns, and enforcement [7]. Generating evidence on the effectiveness of e-cigarette prevention initiatives is therefore critical to guiding such investments and ensuring they have a beneficial impact [26].

Although many young people are aware that substitutes for traditional smoking contain nicotine and other chemicals, there is a tendency to downplay their long-term health effects. Educational programs, particularly those conducted in schools, are crucial in raising awareness of the risks associated with the use of tobacco substitutes.

In Poland, the sale of e-cigarettes/tobacco heaters/snus to persons under the age of 18 is prohibited, but these regulations are not always observed.

A large proportion of young people treat the use of e-cigarettes as an experiment or a momentary curiosity, which does not necessarily turn into a lasting addiction. Unfortunately, it should be emphasized that regular use of e-cigarettes/tobacco heaters/snus can lead to nicotine

addiction, which in turn increases the risk of reaching for other stimulants, as well as leaves the false hope that it is easy to stop using them.

Conclusions

The family and school play a key role in the prevention of e-smoking and the use of traditional smoking substitutes. Early education on the health effects and mechanisms of addiction is needed to build awareness among young people of the risks associated with their use. Campaigns aimed at illustrating the real health effects of using traditional smoking substitutes that are attractive to young people can have a major impact on changing their attitudes. The main areas of preventive action should be as follows:

1. Health education: Incorporating reliable information about the risks associated with e-cigarettes and other smoking substitutes into school curricula.
2. Updating staff knowledge: Teachers and nurses should have up-to-date knowledge about tobacco substitutes and their impact on health.
3. Promoting nicotine abstinence: Not just switching from traditional cigarettes to other products, but completely stopping nicotine use.
4. Health monitoring: Regularly monitoring e-cigarette users for health consequences and documenting their health history.
5. Interdisciplinary prevention: Cooperation between schools, parents, health services, and social institutions in the field of prevention and education.
6. Counteracting misinformation: Consistently correcting false beliefs about the safety of smoking substitutes.

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Supervision: not applicable

Project administration: not applicable

Fundraising: not applicable.

All authors have read and approved the published version of the manuscript.

Funding statement - This research receive no external funding.

Institutional Review Board System - Not applicable

Informed Consent Statement - Not applicable

Data Availability Statement: Not applicable

Acknowledgments

The authors of the study would like to thank all the students who participated in the study.

Conflict of Interest Statement: The authors declare that the reaserch was conducted in the absence of any commercial or financial relationship that could be construed as a potential conflict of interes.

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