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THE HEALTH STATUS OF CHILDREN AND YOUTH DEPENDING ON TOBACCO SMOKING STATUS

Abstract. Electronic nicotine delivery devices (e-cigarettes) have been the subject of research and debate among scientists and the public over the past decades. This innovative alternative to traditional smoking has gained widespread popularity, promoting itself as a less harmful or even safe alternative to tobacco. However, the question of the impact of electronic cigarettes on the human body remains incomplete in knowledge and requires further study. Objective: to assess the impact of tobacco smoking on the health of children and adolescents. Materials and Methods: The study involved 2,202 children from grades 5 to 11 in six schools in the city of Dnipro, with 115 of them participating in the second part. All children had their smoking status and exposure to tobacco smoke determined, and some respondents underwent spirometry, a test for hidden bronchospasm, and a bronchoprovocation test with physical exertion.

Results and Discussion. Of the 2,202 children aged 10-17, 2,039 (92.6%) experienced some degree of negative impact from tobacco smoke. There were 652 (29.6%) active smokers, 1,387 (63.0%) passive smokers, and only 163 children (7.4%) were non-smokers. Chronic pathologies were found in 71 (61.7%) of the comprehensively examined children. Among those with chronic pathologies, chronic tonsillitis was registered in 36 (50.7%), allergic rhinitis in 7 (9.8%), non-dysfunctional thyroid gland hyperplasia (euthyroid state) in 7 (9.8%), vegetative-vascular dysfunction syndrome in 53 children (74.7%), and chronic gastritis and duodenitis in 9 (21.7%) children. No significant difference in the presence of "hidden bronchospasm" between groups of children with different smoking statuses was found. Conclusions: Among older school-age children, 92.6% are affected by tobacco smoking. 29.6% of schoolchildren are active smokers, while 63.0% are passive smokers. Chronic gastritis and duodenitis are significantly more common in

children exposed to tobacco smoke ($p < 0.01$). The vegetative dysfunction syndrome contributes to the disruption of the functional state of β2-adrenoceptors in the bronchi of children exposed to tobacco smoke. The negative impact of tobacco smoke in childhood manifests as a regulation disorder of bronchial patency by the autonomic nervous system: bronchospasm during physical exertion was three times more common in smoking children compared to non-smokers.

Keywords: children, adults, smoking, risk factors, respiratory infections, tobacco heating systems.

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СТАН ЗДОРОВ'Я ДІТЕЙ ТА МОЛОДІ В ЗАЛЕЖНОСТІ ВІД СТАТУСУ ТЮТЮНОПАЛІННЯ

Анотація. Електронні засоби доставки нікотину (електронні сигарети) стали предметом досліджень та суперечок науковців та громадськості протягом останніх десятиліть. Ця інноваційна альтернатива традиційному курінню здобула широку популярність, пропагуючи себе менш шкідливою або навіть безпечною альтернативою тютюну. Проте, питання про вплив електронних сигарет на організм людини залишається містить багато пробілів в знаннях і потребує подальшого вивчення. Мета: оцінити вплив тютюнопаління на здоров'я дітей та молоді. Матеріали і методи. Участь у дійсному дослідженні взяло 2202 дитини 5 – 11 класів шести шкіл м. Дніпро, 115 із них були залучені у другу частину. Всім дітям проводилось визначення статусу курця і рівня навантаження тютюновим димом, частині респондентів було проведено спірометрію з проведенням тесту на прихований бронхоспазм та бронхопровокаційний тест з фізичним навантаженням. Результати та обговорення. Негативного впливу тютюнового диму тією чи іншою мірою зазнає 2039 із 2202 дітей (92,6%) віком 10-17 років. Активними курцями були 652 (29,6%) дитини, пасивними курцями - 1387 (63,0%) і некурцями лише 163 дитини (7,4%). Хронічна патологія була виявлена у 71 (61,7%) комплексно обстежених дітей. Серед всіх, що мали хронічну патологію дітей хронічний тонзиліт реєструвався у 36 (50,7 %), алергічний риніт - у 7 (9,8%), гіперплазія

щитовидної залози без порушення функції (еутериоїдний стан) - у 7 (9,8%), синдром вегето-судинної дисфункції - 53 дитини (74,7%), хронічний гастродуоденіт – 9 (21,7%) дітей. Вірогідної різниці у наявності «прихованого бронхоспазму» між групами дітей з різним статусом курця виявлено не було. Висновки. Серед дітей старшого шкільного віку впливу тютюнопаління зазнають 92,6%. Активно палять 29,6% школярів, пасивно - 63,0%. Хронічний гастродуоденіт зустрічається достовірно частіше в дітей, які зазнають впливу тютюнового диму ($p<0,01$). Синдром вегетативної дисфункції сприяє порушенню функціонального стану β2-адренорецепторів бронхів у дітей, що зазнають впливу тютюнового диму. Негативний вплив тютюнового диму в дитячому віці проявляється порушенням регуляції бронхіальної прохідності з боку вегетативної нервової системи: у дітей-курців бронхоспазм фізичного навантаження виявлявся в 3 рази частіше порівняно з некурцями.

Ключові слова: діти, дорослі, тютюнопаління, фактори ризику, респіраторні інфекції, системи нагрівання тютюну.

Introduction. The increasing rates of respiratory illnesses worldwide necessitate the active identification of adverse factors affecting health, particularly among children and young people, one of which is the influence of tobacco [5]. Today, tobacco smoking is the most prevalent harmful habit in the world, having reached epidemic proportions and affecting men, women, and children alike [1]. Tobacco smoke was officially declared a carcinogen as far back as 2002, with no safe level of exposure recognized. Annually, 7 million people die from smoking-related diseases, 890,000 of whom are passive smokers [2,3,4]. According to estimates from the World Health Organization (WHO) in 2016, approximately 40% of the child population is exposed to passive smoking due to their parents' active smoking [7]. Literature suggests that all forms of tobacco, including cigarette, cigar, pipe, hookah, chewing, and snuff tobacco, significantly impact morbidity and premature mortality [5].There is a wealth of research demonstrating that both passive and active smoking have equally negative effects on human health because active and passive smokers inhale the same quantity of toxins. Researchers have found that the concentration of the primary marker of exposure to tobacco smoke, cotinine, is elevated in 55% of children [6,7,8]. Furthermore, a concerning fact is that tobacco smoking is highly prevalent among adolescents and children, and they quickly develop nicotine dependence: every third adolescent aged 12–14 years and every second adolescent older than 15 years smoke cigarettes. Nearly 80% of people start smoking before the age of 18 [11]. According to the World Health Organization (WHO) data, the highest number of smokers is found in Eastern European, North African, and Asian countries. This applies to Ukraine, which continues to hold a leading position among European countries in terms of adult smoking prevalence [9].

However, according to the Global Adult Tobacco Survey (GATS) conducted in 2017, the prevalence of adult smoking in Ukraine has decreased compared to

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2010: from 49.6% to 39.7% in men and from 10.5% to 8.8% in women [10]. Indeed, in recent years, there has been a positive trend in our country towards reducing the prevalence of traditional cigarette smoking among adolescents and young people. Nevertheless, alternative forms of smoking, such as electronic cigarettes (e-cigarettes) and heated tobacco devices (IQOS), are becoming popular. Today, 75% of the global e-cigarette market (excluding the US and China) is dominated by Germany, the UK, France, Poland, South Korea, and Russia. The number of vapers is rapidly increasing; in 2013, there were 2.8 million users, whereas in 2015, there were already 5.1 million. The largest share of electronic smoking device users resides in England and France. However, there are countries where the sale of e-cigarettes is prohibited, such as Denmark, Israel, Canada, Brazil, Australia, and some US states [14]. In Ukraine, the percentage of adolescents who smoked electronic cigarettes was 18.4% (boys – 22.6%, girls – 14.0%, $p < 0.05$), which is twice the percentage of daily traditional cigarette smokers – 9.2% of those surveyed (10.8% of boys and 7.7% of girls) in 2017 [9,12,13].Thus, in Ukraine, a situation of higher prevalence of electronic cigarette smoking than traditional cigarettes is observed, which aligns with overall European and global trends [18].

The impact of tobacco smoking when using traditional cigarettes has been extensively studied. It is already known that smokers are more susceptible than non-smokers to a multitude of chronic illnesses and conditions, including stroke, cardiovascular diseases, chronic obstructive pulmonary disease (COPD), bronchial asthma, multiple cancers, periodontal disease, hypertension, impotence, and osteoporosis. However, smokers are also significantly more susceptible to multiple bacterial infections than non-smokers. Such infections can be life-threatening, and both active smokers and those exposed to the toxins of passive smoking are at an increased risk [15].

In the literature, the number of studies examining the impact of tobacco smoking when using e-cigarettes or vaping devices is increasing, but it still requires further investigation due to conflicting data.

Some studies that explored the impact of electronic cigarettes and health status, conducted among young people, showed that the use of electronic cigarettes is associated with an increased likelihood of asthma, COPD, and ACOS (combination of asthma and COPD) among those who have never smoked traditional cigarettes. The odds of ACOS were twice as high among electronic cigarette users compared to those who had never smoked regular cigarettes [16]. Overall, the lack of a sufficient number of studies regarding the dangers of smoking electronic devices for human health, especially for children, the insufficient public awareness of the harm of electronic cigarettes, and the absence of legislatively defined restrictions on the use of these devices by children should be considered a threat to public health. This necessitates the consideration of these aspects in the planning and implementation of health education activities, especially among children and young people. Moreover, conducting in-depth epidemiological and toxicological studies

aimed at assessing the harm of tobacco smoking and the level of health risk for the younger generation is advisable [17].

Therefore, the aim of this study was to assess the impact of tobacco smoking on the health of children and young people.

Materials and Methods: A total of 2202 children from 5th to 11th grades in six schools in Dnipro city participated in the study. The survey included 1039 (47.2%) boys and 1163 (52.8%) girls.

Among the schoolchildren who participated in the survey, 115 children were involved in the second part of the study. The age of the children ranged from 10 to 17 years, including 56 boys and 59 girls. In addition to answering the questionnaire to determine their smoking status and exposure to tobacco smoke, the children underwent general clinical examinations and functional diagnostic methods, including spirometry with a test for hidden bronchospasm and a bronchial provocation test with physical exercise.

Based on the children's exposure to tobacco smoke, they were divided into three groups according to their smoking status. Smoking status was determined based on the following terms: "passive smokers," "active smokers," and "non-smokers." The first group, non-smokers, included 22 children who had never smoked themselves and had not been exposed to tobacco smoke from adult smokers. The second group, passive smokers, consisted of 74 children living in environments where the atmosphere was constantly polluted by tobacco smoke from parents and friends who smoked. The third group, active smokers, included 19 children who actively smoked.

Furthermore, the examined children were also divided into a group of respiratory asymptomatic (RA) patients, comprising 82 (71.3%), and another group of children (28.7%) who were on follow-up due to recurrent bronchitis (RB). At the time of examination, all children were free from acute respiratory illnesses or exacerbations of RB (Table 1).

Table 1

Distribution of RA and RB children by groups depending on smoking status

Smoker status	Respiratory asymptomatic		Children with recurrent bronchitis in remission		Total	
	n	%	n	%	n	%
Non-smokers	13	15,9	9	27,3	22	19,1
Passive smokers	52	63,4	22	66,7	74	64,4
Active smokers	17	20,7	2	6,0	19	16,5
Total	82	100	33	100	115	100

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Statistically, there was no significant difference in the frequency of recurrent bronchitis between the groups of children with different smoking statuses, despite the fact – statistical data analysis was conducted using both parametric and non-parametric methods.

Results and Discussion. The analysis of the survey results showed that, overall, 2039 out of 2202 children (92.6%) aged 10-17 years experienced some degree of negative influence from tobacco smoke. Further evaluation revealed that 652 children (29.6%) were active smokers, 1387 (63.0%) were passive smokers, and only 163 children (7.4%) were non-smokers.

The obtained data demonstrate a significant impact of tobacco on the child and adolescent population. Since children are more often passive smokers, there is every reason to believe that the main efforts to prevent health changes in children caused by tobacco smoke should focus on reducing the number of active teenage smokers as well as smokers among the adult population.

During further analysis of the examination results, concomitant chronic pathology was identified in 71 (61.7%) of the children who underwent comprehensive testing. Among all children with chronic pathology, chronic tonsillitis was registered in 36 (50.7%), allergic rhinitis in 7 (9.8%), hyperplasia of the thyroid gland without functional disorders (euteric state) in 7 (9.8%), and 53 children (74.7%) were on record for vegetative-vascular dysfunction syndrome, while 9 (21.7%) children were on record for chronic gastritis and duodenitis. The distribution of children with chronic pathology based on smoking status is presented in Table 2.

Table 2

Distribution of Children Based on Concomitant Pathology and Smoking Status

Pathology	Non-smokers (n=22)		Passive smokers (n=74)		Active smokers (n=19)		Total (n=115)	
	n	%	n	%	n	%	n	%
Chronic tonsillitis	5	22,7	23	31,1	8	42,1	36	31,3
Chronic gastroduodenitis	0*	0	4*	5,4	5*	26,3	9	7,8
Vegetative vascular dysfunction	8	36,4	37	50	8	42,1	53	46.1
Allergic rhinitis	2	9,1	5	6,8	0	0	7	6,1
Diffuse non-toxic goiter	0	0	6	8,1	1	5,3	7	6,1

$p < 0.01$, there was a statistically significant difference between groups with different smoking statuses.

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As shown in the table 2, chronic gastritis and duodenitis are more common among smokers, which supports the view of other authors on the role of tobacco smoke in the development and exacerbation of gastroenterological diseases [18, 19].

The examination of physical development showed that in the group of non-smokers, 13 (59%) children had average physical development, 8 (36.3%) were above average, and 1 child (4.5%) was below average. In the second group of passive smokers, 54 children had average physical development, which makes up 73%, 17 (23%) were above average, and 3 children (4%) were below average. Among active smokers, 13 children had average physical development (68%), and 6 were above average (32%). Harmonious physical development was observed in 96 (83.5%) children, while disharmonious development was found in 20 (17.4%) (12 had accelerated growth, and 7 had obesity). Statistical analysis did not reveal a significant relationship between the indicators of physical development and smoking status.

Based on the results of lung function tests, no airway obstruction was detected in any of the examined children.

In an attempt to address the question of whether initial changes in the functional state of β2-adrenergic bronchial receptors are a result of exposure to tobacco smoke, we conducted functional ventilation tests with the bronchodilator salbutamol. The test was considered positive when "hidden bronchospasm" was recorded. The distribution of children into groups based on their reactions to the bronchodilator is presented in Table 3.

Table 3

Distribution of Bronchial Reactions to Salbutamol Based on Smoking Status in Children

The reaction to a bronchodilator	Non-smokers (n=22)		Passive smokers (n=74)		Active smokers (n=19)		Total (n=115)	
	RA	RB	RA	RB	RA	RB	RA	RB
Positive	1*	0*	5*	1*	0*	1*	6*	2*
Negative	12*	9*	47*	21*	17*	1*	76*	31*
Total	13	9	52	22	17	2	82	33

* - likelihood of discrepancies $\chi 205=0.07-3.6$ or $p>0.05$; RB - individuals with recurrent bronchitis in remission stage, RA - children who are respiratory asymptomatic

The results of the functional ventilation tests with salbutamol showed that the hypothesis of potential negative effects of tobacco smoke on the functional state of β2-adrenergic receptors was not confirmed.

It turned out that "hidden bronchospasm" was diagnosed in 6 out of 74 children in the passive smoking group and in one child each in the active smoking

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and non-smoking groups. In the passive smoking group, 68 cases were "negative" while it was 18 among active smokers and 21 among non-smokers. Statistical analysis revealed no significant difference in the presence of "hidden bronchospasm" between groups of children with different smoking statuses ($\chi 2=0.58<\chi 205=5.99$ or $p>0.05$). Therefore, the influence of inhaled salbutamol on external lung function parameters in smokers and non-smokers is not significant, indicating the absence of bronchoconstriction, including "hidden bronchospasm," in children who have active or passive smoking status.

Hidden bronchospasm was also not found in groups with different smoking statuses among RA and children with a history of RB. Among active smoking children who are on dispensary records for RB, one child out of two had a positive functional ventilation test with salbutamol, and none among RA ($\chi 2=1.7<\chi 205=5.99$ or $p>0.05$). In the passive smoking group with RB, one out of 22 children had it, and five out of the RA group ($\chi 2=0.07<\chi 205=5.99$ or $p>0.05$). In the non-smoking group, "hidden bronchospasm" was recorded in only one RA child ($\chi 2=3.6<\chi 205=5.99$ or $p>0.05$). However, upon detailed analysis, it was found that the state of "hidden bronchospasm" among passive smokers was more commonly found in those with a vegetative dysfunction syndrome (5 out of 37 compared to 1 out of 37; $\chi 2=3.9<\chi 205=3.84$ or $p<0.05$). Therefore, our data suggest that vegetative dysfunction syndrome contributes to the disturbance of the functional state of β2-adreceptors of the bronchi in children exposed to tobacco smoke. To characterize the functional state of α-receptors (cholinoreceptors) of the bronchi and the characteristics of the autonomic nervous system's support for bronchial function in children exposed to the negative effects of tobacco smoke, bronchoprovocation tests with controlled physical loads were used.

When comparing groups of smokers (passive and active) and non-smokers, a significant difference in the frequency of diagnosing exercise-induced bronchospasm (EIB) was found ($\chi 2=4.5<\chi 205=3.84$ or $p<0.05$). Therefore, it can be considered that both active and passive smoking lead to the disruption of bronchial tone regulation by the central nervous system (CNS).

No significant difference was found between the groups of respiratory asymptomatic children and those with a diagnosed history of recurrent bronchitis who were in remission during the study. Specifically, the EIB condition was observed in 11 out of 33 children with recurrent bronchitis in remission and in 17 out of 82 respiratory asymptomatic children ($\chi 2=2.03<\chi 205=3.84$ or $p>0.05$).

Furthermore, no significant difference was established in the presence of EIB in respiratory asymptomatic children with a history of recurrent bronchitis in remission when analyzed separately within groups with different smoking statuses.

However, in children exposed to long-term tobacco smoke, there was a noticeable tendency towards more pronounced bronchomotor reactions in terms of amplitude. For example, the degree of EIB in 2 children not exposed to tobacco smoke was low, while among 22 passive smokers, it was low in 14 cases, of

moderate severity in 6 cases, and severe in 2 cases. In active smokers, EIB was most pronounced, with 1 case being mild and 3 cases being severe ($p<0.05$).

Conclusions. Among older school-age children, 92.6% are affected by smoking. 29.6% of schoolchildren actively smoke, while 63.0% are passive smokers. Chronic gastritis and duodenitis are significantly more common in children exposed to tobacco smoke ($p<0.01$). The vegetative dysfunction syndrome contributes to the impairment of the functional state of β2-adrenoceptors of the bronchi in children exposed to tobacco smoke. The negative impact of tobacco smoke in childhood manifests as a disruption in the regulation of bronchial patency by the autonomic nervous system: in smoking children, exercise-induced bronchospasm was observed three times more frequently than in non-smokers.

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