

**Я.С. Будевский, А.А. Степанова**

## **ЭЛЕКТРОННЫЕ СИГАРЕТЫ: НЕ БОЛЕЕ БЕЗОПАСНАЯ АЛЬТЕРНАТИВА, А ПУТЬ К ПОСТОЯННОЙ ЗАВИСИМОСТИ**

*Научный руководитель: канд. филол. наук, доц. М.Н. Петрова*

*Кафедра иностранных языков*

*Белорусский государственный медицинский университет, Минск*

**Y.S. Budevskii, A.A. Stepanova**

## **E-CIGARETTES: NOT SAFER ALTERNATIVE, BUT A GATEWAY TO PERMANENT ADDICTION**

*Tutor: PhD in Philology, associate professor M.N. Petrova*

*Department of Foreign Languages*

*Belarusian State Medical University, Minsk*

**Резюме.** Рост вейпинга среди подростков вызывает беспокойство. Описаны механизмы никотиновой зависимости, токсичность аэрозолей и болезни: EVALI, «попкорновая болезнь», липоидная пневмония. Данные опровергают заявления производителей: среди молодёжи вейпы популярнее сигарет.

**Ключевые слова:** электронные сигареты, никотиновая зависимость, EVALI.

**Abstract.** Vaping among teenagers has grown a lot. This paper describes nicotine addiction, toxicity of e-cigarette aerosols, and health issues: EVALI, popcorn lung, lipoid pneumonia. The data show that more young people vape than smoke cigarettes. This contradicts manufacturer claims about quitting smoking [2].

**Keywords:** electronic cigarettes, nicotine addiction, EVALI.

**Relevance.** In recent years, the number of individuals, including both adults and adolescents, who use Electronic Nicotine Delivery Systems has increased substantially. Overall, e-cigarette consumption is developing into an epidemic that may produce numerous negative health consequences, particularly among younger population. Therefore, the problem of smoking involving both traditional tobacco cigarettes and electronic cigarettes, continues to hold significant relevance in contemporary public health discourse.

**Aim:** to analyze nicotine dependence from e-cigarettes, assess health risks of vaping, and compare youth ENDS use data with manufacturer claims about smoking cessation.

### **Tasks:**

1. Describe the biochemical mechanism of nicotine dependence and the vicious cycle of addiction.
2. Identify toxic substances in e-cigarette aerosols and their role in EVALI, popcorn lung, and lipoid pneumonia.
3. Compare youth vaping rates with traditional cigarette use and evaluate claims about cessation efficacy.

**Materials and methods.** This study analyzed peer-reviewed literature on ENDS biochemistry, toxicology, and epidemiology. Data included clinical reports of vaping-associated lung injuries, cross-sectional surveys of adolescent use, and animal studies of e-cigarette aerosol toxicity.

**Results and their discussion.** At the biochemical level, the development of dependence proceeds through a relatively simple mechanism. Nicotine enters systemic

circulation through the pulmonary system, subsequently travelling to the brain where it diffuses into neural tissue and binds to nicotinic cholinergic receptors. This binding process triggers the release of dopamine. Consequently, dopamine production becomes chemically dependent upon nicotine administration. The fundamental problem resides in the fact that vapers become accustomed to a specific dosage that subsequently ceases to generate pleasurable sensations. However, without nicotinic stimulation, dopamine production does not occur. Thus, a vicious cycle emerges: the vaper experiences no satisfaction yet remains incapable of discontinuing use. The adverse consequences of Electronic Nicotine Delivery Systems use manifest as defects affecting virtually all organ systems, particularly the cardiovascular, respiratory, and nervous systems [1]. These effects possess a cumulative nature and become apparent only after approximately one year of use, which convinces smokers that they may cease use at any moment.

Toxic substances identified in electronic cigarettes include chemicals, nanoparticles, heavy metals, and various toxins. The overall effects comprise elevated levels of reactive oxygen species, deoxyribonucleic acid damage, inflammatory processes, and alterations of cellular mechanisms essential for disease pathogenesis. Diacetyl, frequently added to enhance flavour profiles, induces inflammation and may produce permanent scarring in the bronchioles, a condition known as popcorn lung or bronchiolitis obliterans, which compromises respiratory function. Other compulsory components of e-liquids include fatty acids that, upon inhalation, cause lipid pneumonia development. All diseases resulting from vaping present substantial challenges for assessment, as these products have not been available for a sufficiently extended period to permit comprehensive studies.

Scientific investigations have documented that e-cigarette aerosols contain numerous toxic transformation products, including formaldehyde, acetaldehyde, acrolein, and various heavy metals such as nickel, chromium, and lead. These substances are associated with oxidative stress, deoxyribonucleic acid damage, inflammation, and altered cellular mechanisms essential for disease development. Vitamin E acetate, frequently used as a thickening agent in tetrahydrocannabinol-containing vaping products, has been closely associated with the outbreak of e-cigarette or vaping product use-associated lung injury. Analysis of bronchoalveolar lavage fluid from affected patients demonstrates the presence of vitamin E acetate. Health authorities have identified over 2800 cases of this lung injury, with 15 % involving individuals under 18 years. The severity of this condition ranged from mild cough that resolved with discontinuation of Electronic Nicotine Delivery Systems use to respiratory failure with hypoxia requiring prolonged intensive care.

Epidemiological data demonstrate that e-cigarette use among youth is on an increase. The number of young people who vape is approximately 5 times higher than those who smoke traditional cigarettes exclusively [2]. This finding directly contradicts manufacturer's claims that electronic cigarettes function as smoking cessation tools. The tobacco industry's advertisements and promotional activities have been established as causal to the onset of smoking in youth and young adults.

Evidence-based adverse health effects of vaping are reflected in the defects of absolutely all organ systems, in particular: cardiovascular, respiratory and nervous systems. The cumulative toll spans multiple systems. In the nervous system, disruption of the blood-brain barrier increases risks of seizures and stroke. The respiratory system shows chronic inflammation, airway constriction, and impaired immune response. Oral health declines

through limited gingival blood flow, nicotine stomatitis, tooth decay, and tongue lesions. The cardiovascular system develops arterial stiffness, dyslipidemia, and persistent high blood pressure. Mechanisms of lung injury include lipoid pneumonia from inhaled fatty acids, popcorn lung from diacetyl, and hypoxic respiratory failure from vitamin E acetate. Even without contaminants, chronic vaping alters alveolar macrophage function, increases susceptibility to influenza, and contributes to the development of COPD. Stem cell-derived endothelial cells exposed to e-liquid show decreased viability and increased inflammatory cytokines. Neurologically, nicotine compromises the blood-brain barrier and is linked to seizures. Research indicates that adolescents who use electronic cigarettes exhibit levels of toxic volatile organic compounds in their urine up to three times greater than controls. Nicotine exposure during adolescence can adversely affect brain development, particularly concerning memory, attention, learning, and impulse control, as the human brain continues developing until approximately age 25. Seizures have been reported as a potential side effect of nicotine toxicity, with health authorities receiving reports of over one hundred cases of seizures related to vaping within a 3-month period alone, the majority involving adolescents or young adults.

The problem of vaping during pregnancy has also emerged as a growing concern. Studies have documented that nicotine use during pregnancy can produce adverse health outcomes on offspring immune systems, neural development, lung function, and cardiac function. Prevalence of Electronic Nicotine Delivery Systems use during pregnancy has been estimated between 0.6 % and 15 % across different studies. Unintentional exposures to e-liquids have increased substantially, with children below two years of age accounting for nearly half of such cases. A retrospective analysis found that the monthly number of exposures associated with Electronic Nicotine Delivery Systems products increased by approximately 15% over a 4-year period. Children accidentally exposed to these products demonstrated more than 5 times higher odds of healthcare facility admission and more than 2 and a half times higher odds of severe outcomes compared to those exposed to traditional cigarettes. The most commonly reported symptoms following unintentional ingestion included vomiting, rapid heartbeat, diarrhea, lethargy, jitteriness, agitation, nausea, and oral mucosal irritation.

Animal studies have provided additional evidence of Electronic Nicotine Delivery Systems toxicity [1]. Rodent models exposed to e-cigarette aerosols demonstrated redox imbalance and increased inflammatory responses in pulmonary tissues. Chronic exposure studies identified the development of lung adenocarcinomas, suggesting carcinogenic potential. Nicotine-containing e-cigarette aerosol increased symptoms of chronic obstructive pulmonary disease pathology, including airway hyper-reactivity, distal airspace enlargement, increased inflammatory cytokine and protease expression, and production of mucin. Chronic exposures over several months caused increased fibrosis in the liver, kidney, and cardiovascular system, reduced renal function, and gene expression signatures consistent with a pro-fibrotic phenotype. Maternal exposure to e-cigarette aerosols during gestation produced detrimental health effects on offspring pulmonary systems, including structural changes to the lungs associated with downregulation of developmental signalling pathways. Offspring of mothers exposed to nicotine-containing e-cigarette aerosol during and after pregnancy exhibited short-term memory deficits and hyperactive behaviours.

Investigations identified significant epigenetic changes including global deoxyribonucleic acid hypomethylation and alterations to chromatin modifiers in offspring brains, as well as several global gene expression changes associated with adverse neurobiological and behavioural outcomes.

Numerous methods exist for discontinuing vaping, but a universal method does not exist. Among the most important recommendations are the following: establishing limits on e-cigarette application, securing family support, maintaining an optimistic mood, developing new hobbies, utilizing lollipops as oral substitutes, employing mobile applications, or maintaining a diary to monitor progress. If these approaches prove ineffective, consultation with a psychologist is reasonable.

**Conclusions.** Smoking causes severe health outcomes and generates strong dependence; consequently, avoiding initiation is considerably preferable. Electronic cigarettes are not safer than traditional tobacco products [1]. They produce severe nicotine addiction, damage the lungs through popcorn lung and lipid pneumonia, and harm cardiac and cerebral function due to toxic chemicals and heavy metals. Because health problems emerge slowly, users falsely believe they may cease use at any time. Although various cessation methods exist, the optimal advice remains never to begin vaping at all. More than forty countries have implemented some type of ban on vaping, either on possession and use, sales, importation, or a combination thereof. The existing evidence overwhelmingly indicates that e-cigarette use is profoundly hazardous.

#### Literature

1. The chemistry and toxicology of vaping / E. Bonner [et al.] // Pharmacology & Therapeutics. – 2021. – Vol. 225. – P. 107837.
2. Why Our Youth Vape? A Trend Analysis Based on Cross-Sectional Annual Surveys of Middle and High School Students in the U.S. / J.E. Hill [et al.] // Medicina. – 2024. – Vol. 62. – Issue 1. – P. 223.