

Tadeusz M. Zielonka

Department and Unit of Family Medicine, Medical University of Warsaw, Poland

A debate: Can we recommend electronic cigarettes to our patients? Opinion 1

The author declare no financial disclosure

Abstract

A discussion about disadvantages of electronic cigarettes (e-cigarettes) has recently broken out. There are even opinions that they are as harmful as regular cigarettes. However, this has not been proved, and theoretical premises suggest that e-cigarettes should be definitely less harmful as while using them, tobacco is not burned and harmful substances, in particular carcinogens are not produced. Certain premises assume that e-cigarettes may be used as a new form of nicotine replacement therapy, but this has not been confirmed yet. Therefore, further research into harmfulness and safety of the use of e-cigarettes is required. This paper presents solely reasons for the possibility of recommending e-cigarettes to people addicted to nicotine.

Key words: tobacco, electronic cigarette, nicotine replacement therapy, passive smoking

Adv Respir Med 2017; 85: 35–39

Introduction

A discussion about electronic cigarettes (the so-called e-cigarettes) has been held for some time now. A special issue of *Tobacco Control* (2014 Suppl 2) has been devoted to the problem. Callahan-Lyon concluded in one of the study [1] that scientific evidence concerning impact of e-cigarettes on human health is limited, and although their aerosol includes less harmful substances compared to regular cigarettes, researches evaluating their influence on health are inconclusive and the American Food and Drug Administration (FDA) does not allow them to be used as treatment for nicotine dependence due to lack of sufficient evidence. The impact of the passive use of e-cigarettes on health of people from the environment of e-cigarettes users is unknown either. More and more researches focus on the issue but there are no long-term randomized double-blinded multicentre studies assessing large populations that would provide respectively strong and reliable arguments

for and against the use of e-cigarettes. At present we have solely experts' opinions that are not confirmed with evidence that would enable unanimous recommendations. These doubts will be certainly soon resolved. This paper presents only suggestions concerning the possibility of recommending e-cigarettes to individuals addicted to nicotine.

Composition of tobacco smoke and e-cigarette aerosol

To begin with, we compare cigarette smoke with e-cigarette aerosol. A cigarette is a tobacco product, in which tobacco leaves are wrapped in thin tissue paper. While smoking a cigarette, tobacco is burned and the smoker is inhaling smoke including approximately 4 thousand of chemical substances such as benzopyrene, tarry substances, carbon monoxide, acetone, butane, vinyl chloride, ammonia, arsenic, toluidine, formaldehyde, phenols, hydrocyanic, naphthylamine, carbinol, 2-benzoacridine, dichlorodiphenylotri-

chloroethane, dimethylnitrosamine, cadmium, polonium, urethane [2].

E-cigarette is a device that enables the user to inhale nicotine. The main difference lies in the lack of tobacco combustion that produces so many harmful to health substances. Liquid used in e-cigarettes contains propylene glycol, glycerine, nicotine and flavourings [3]. It is heated up to the temperature allowing transition from liquid to gaseous phase, which then is inhaled to the lungs. Trace amounts of toxic substances were found in e-cigarette vapours but the levels of toxicants were 9-450 times lower than in cigarette smoke and did not exceed the levels authorised for use [4]. They came from contaminated tobacco, which was used in the production of nicotine and then utilised in e-cigarette.

Cigarette smoke and e-cigarette aerosol — harmfulness to health

Recent decades have provided powerful evidence for the harmfulness of nicotine smoking [5, 6]. There is no doubt that the addiction is the cause of many fatal diseases, it shortens life of million of people, causes inability to work and generates huge direct and indirect costs. Tobacco became a big killer in the 20th century and it brought death to more people than any war. Popularity of tobacco smoking lead to a dramatic increase in prevalence of cancer. At least 40 components of tobacco smoke (e.g. tarry substances, cadmium, benzopyrene, vinyl chloride, 2-benzacridine, toluidine, naphthylamine) impact on development of malignant cancer [7]. It has been proved that nicotine smoking affects development of leukaemia and cancer in various organs such as the lungs, larynx, throat, oesophagus, stomach, kidney, urinary bladder, pancreas, liver, nose, uterine cervix [8]. Due to popularity of tobacco smoking, lung cancer is the most frequent malignant cancer causing 30% of all cases of deaths because of this condition [9]. Harmful influence of tobacco smoking on health is not limited to carcinogenic effects. It also causes diseases of the respiratory tract such as chronic bronchitis, chronic obstructive pulmonary disease (COPD), emphysema, bronchial asthma etc. [10]. Cigarette smoke has also an effect on diseases of the cardiovascular system, in particular atherosclerosis, arterial hypertension, ischaemic heart disease, myocardial infarction, aortic aneurysm and diseases of the nervous system such as cerebral stroke, cerebral thrombosis and subarachnoid haemorrhage [11, 12]. Each year over 4 million

people die due to tobacco smoking [13]. Cigarette smoking leads to greater vulnerability to bacterial and viral infections, including tuberculosis [14, 15]. It has been also shown that tobacco smoking impacts negatively on the development of diseases of the alimentary tract such as chronic gastric and duodenal ulcer disease, gastroesophageal reflux, Lesniowski-Crohn disease, ulcerating inflammation of the large intestine, intestinal hernia [16, 17]. Furthermore, tobacco smoking has been found to influence the development of osteoporosis, parodontopathy, cataract, macular degeneration, early skin aging [18–20]. Cigarette smoking has a negative effect on the reproductive system, resulting in small birth weight of the newborn, premature detachment of the placenta or rupture of the membranes, difficulty in becoming pregnant and early menopause [21, 22].

When the disadvantages of nicotine smoke are recalled, e-cigarettes seem to be much safer to health. They include merely several mentioned substances with nicotine having the most significant harmful effect on health. Nicotine adversely impacts on the cardiovascular system as it causes shrinkage of the walls of the blood vessels (including also the coronary vessels), increases blood pressure, accelerates the frequency of heart beating, leads to heart rhythm disorders and rises the risk of thrombosis [23]. It is also a powerful neurotoxin. Additionally, it indirectly affects the growth of neoplasms because it negatively influences the p53 gene, which hinders uncontrollable development of neoplastic cells [24]. Therefore, harmful effect of nicotine smoke on health is incomparably greater than that of e-cigarette aerosol. Electronic cigarette aerosol induces significantly less cytotoxicity than tobacco smoke [25]. Although many flavourings used in e-cigarettes are generally recognised as safe when used in food products, concerns have been raised about the potential inhalation toxicity of these chemicals [26]. Benzaldehyde, which is a key ingredient in natural fruit flavours, has been shown to cause irritation of respiratory airways in animal and occupational exposure studies [26].

The lesser of two evils principle

Analysis of the causes of unsuccessful cessation of tobacco smoking was the basis for invention of a device delivering nicotine *via* inhalation - the so-called e-cigarette. Many people who smoke cigarettes are nicotine dependent, which is only one of many harmful components of cigarette smoke. Thus, in accordance with the

lesser of two evils principle, the idea of the use of nicotine, which is the cause of addiction, without other toxic, in particular carcinogenic chemical substances was generated. The Polish *Consensus on the Diagnostics and Treatment of Tobacco Dependence* includes a statement that although, in the opinion of both smokers and doctors, the use of nicotine is controversial, harmfulness of small doses of pure nicotine is slight and incomparable to effects exerted by thousands of chemical substances included in tobacco smoke [27]. It was stated that even pregnancy and past myocardial infarction should not be treated as contraindication for nicotine replacement therapy [27].

Such a standpoint puts doctors in a position that does not allow them to oppose the use of e-cigarette as they may be suspected of being inconsistent, recommending delivery of nicotine *via* chewing gum, nicotine patches, tablets or inhalers, and simultaneously disapproving of delivery of nicotine with the help of e-cigarette. The opponents of e-cigarettes discuss the problem of uncontrollable use of high doses of nicotine, but such risk is also involved in other forms of nicotine replacement therapy, as they may be purchased without prescription and high price may be the only obstacle to acquire them.

The possibility of the use of e-cigarette in treatment of nicotine dependence

There are premises that e-cigarettes may be used in nicotine replacement therapy. They have been the most popular, best investigated and used for 25 years now method of pharmacological treatment of tobacco dependence [27]. It replaces nicotine included in tobacco smoke with “pure nicotine” in order to appease the lack of nicotine at the moment of smoking cessation [27]. Marketing information underlines that e-cigarettes help to quit smoking or reduce the number of cigarettes used. However, this has been confirmed by few researches [28–30]. They showed that the use of e-cigarettes allowed to reduce the number of regular cigarettes. Such survey was also conducted in Poland [31]. It included approximately 200 people, of whom 66% stopped smoking, and 25% smoked less than 5 cigarettes a day [31]. However, the obtained data are not reliable enough to allow FDA to recommend e-cigarette for nicotine replacement therapy. In randomized controlled trials and multiple cohort studies, still differential association between e-cigarette use and cessation rates was seen [32].

Reduction of negative effects of passive tobacco smoking

Cigarette smoking is dangerous not only for smokers alone but also for people from their environment (the so-called passive smokers) [33, 34]. The contents of e-cigarette aerosol released to the environment during exhalation is changeable and depends on the technique used and other factors such as air temperature [35]. Nicotine from aerosol may remain on various surfaces for many weeks or even months [35]. It is difficult to clearly assess the impact on individuals not using e-cigarettes but to date no evidence for their harmfulness in passive smokers was provided. The absolute impact from passive exposure to e-cigarettes vapour has the potential to lead to adverse health effects, however the risk is likely to be less than the risk from passive exposure to conventional cigarette smoke [36].

E-cigarettes and children

The issue of the use of e-cigarettes by children and adolescents is under discussion [37, 38]. Data about harmful effect of e-cigarettes on children are limited. Available facts show rapid growth in the use of e-cigarettes by adolescents [38]. However, the thesis that nicotine dependence in youth results in tobacco use in the future has not been proved. Restricting the range of e-cigarette flavors (e.g., eliminating sweet flavors, like fruit and candy) may benefit youth and young adult prevention efforts [39].

Evidenced harmfulness of e-cigarettes

The use of e-cigarettes causes irritation of the mucosa of the throat and oral cavity, and dry cough — but these symptoms are reduced with time [1]. Raised inflammatory markers [1] or changes in blood morphology [40] were not observed. The use of e-cigarette did not impact on spirometry of the lungs but these findings come from observations of short duration [41]. Other results concern reduced amounts of nitrogen oxide in exhaled air and increase in respiratory impedance and resistance in the bronchial tree similar to the effects after the use of regular cigarettes [42]. Whereas on echocardiography, no changes in the heart functions [43] or significant changes in the number of heartbeats were observed [44].

For and against the use of e-cigarette

It has to be admitted that most arguments against tobacco smoking cannot be applied in the case of e-cigarettes. There are no data showing increased prevalence of serious diseases or health consequences in people using them. No sensation of fatigue, lack of sleep or worse physical condition due to worse oxygenation of the organism were noted. The use of e-cigarettes does not lead to yellow teeth, bad breath, poor condition of skin, hair and nails, development of lipodystrophy or rapid skin aging. They do not leave unpleasant smell on clothes, home, hands or mouth, which is so important for women when they consider smoking cessation. Contrary to cigarettes, increased risk of osteoporosis, earlier menopause or difficulties in becoming pregnant were not shown. In men, tobacco smoking reduces sexual function and fertility, which was not observed after the use of e-cigarette. Cough and hoarseness are considerably less intensive, compared to cigarette smoking. For in the majority of countries there are no regulations limiting the use of e-cigarettes, their use is not associated with uncomfortable ban on smoking at work or in public places, or anxiety over lack of cigarettes or impossibility of smoking. The use of e-cigarette does not provoke conflict between nonsmoking persons, it does not bring remorse caused by poisoning other people or a such evident negative example for children.

But the problems related to nicotine dependence such as compulsion to smoke, limited freedom, the feeling of being a mentally weak person still remain. Cigarette smoking is also connected with loss of time. In the case of a person smoking one packet of cigarettes a day it equals 100 minutes per day. Although e-cigarettes are less expensive than traditional cigarettes, the use of them is associated with unnecessary expenses.

Time will verify doubts connected with the use of e-cigarettes. The results of the conducted researches will show the harmfulness of the use of e-cigarettes to the users and people from their environment, and to what extent they may be used in treatment of nicotine dependence. It is worth remembering that the name of nicotine originates from the name of a French doctor who recommended tobacco as medication.

Conflict of interest

The author declares no conflict of interest.

References:

- Callahan-Lyon P. Electronic cigarettes: human health effects. *Tob Control*. 2014; 23 Suppl 2: ii36–ii40, doi: [10.1136/tobacco-control-2013-051470](https://doi.org/10.1136/tobacco-control-2013-051470), indexed in Pubmed: [24732161](https://pubmed.ncbi.nlm.nih.gov/24732161/).
- Jenkins RA, Guerin MR, Tomkins BA. Chemistry of environmental tobacco smoke: composition and measurement. 2. Boca Raton (FL): CRC Press LLC. Mainstream and sidestream cigarette smoke 2000: 49–75.
- Goniewicz ML, Kuma T, Gawron M, et al. Nicotine Levels in Electronic Cigarettes. *Nicotine & Tobacco Research*. 2012; 15(1): 158–166, doi: [10.1093/ntb/nts103](https://doi.org/10.1093/ntb/nts103).
- Goniewicz ML, Knysak J, Gawron M, et al. Levels of selected carcinogens and toxicants in vapour from electronic cigarettes. *Tob Control*. 2014; 23(2): 133–139, doi: [10.1136/tobaccocontrol-2012-050859](https://doi.org/10.1136/tobaccocontrol-2012-050859), indexed in Pubmed: [23467656](https://pubmed.ncbi.nlm.nih.gov/23467656/).
- World Health Organization. WHO Report on the Global Tobacco Epidemic 2008. Geneva: World Health Organization. doi: [10.4324/9780203029732](https://doi.org/10.4324/9780203029732).
- Smoking & Tobacco Use — Centers for Disease Control and Prevention, U.S. Department of Health & Human Services. <http://www.cdc.gov/Tobacco/>
- Zaridze DG, Safaev RD, Belitsky GA, et al. Carcinogenic substances in Soviet tobacco products. *IARC Sci Publ*. 1991(105): 485–488, indexed in Pubmed: [1855902](https://pubmed.ncbi.nlm.nih.gov/1855902/).
- Boyle P. Cancer, cigarette smoking and premature death in Europe: a review including the Recommendations of European Cancer Experts Consensus Meeting. Helsinki, October 1996. *Lung Cancer*. 1997; 17(1): 1–60, doi: [10.1016/s0169-5002\(97\)-00648-x](https://doi.org/10.1016/s0169-5002(97)-00648-x), indexed in Pubmed: [9194026](https://pubmed.ncbi.nlm.nih.gov/9194026/).
- Peto R, Lopez AD, Boreham J. Mortality from smoking in developed countries 1950–2000. Oxford, Oxford University Press, 1994; <https://rum.ctsu.ox.ac.uk/research/mega-studies/mortality-from-smoking-in-developed-countries-1950-2010>
- Śliwiński P, Górecka D, Jassem E, et al. Zalecenia Polskiego Towarzystwa Chorób Płuc dotyczące rozpoznawania i leczenia przewlekłej obturacyjnej choroby płuc. *Pneumonologia i Alergologia Polska*. 2014; 82(3): 227–263, doi: [10.5603/piap.2014.0030](https://doi.org/10.5603/piap.2014.0030).
- Burns DM. Epidemiology of smoking-induced cardiovascular disease. *Prog Cardiovasc Dis*. 2003; 46(1): 11–29, doi: [10.1016/s0033-0620\(03\)00079-3](https://doi.org/10.1016/s0033-0620(03)00079-3), indexed in Pubmed: [12920698](https://pubmed.ncbi.nlm.nih.gov/12920698/).
- Hawkins BT, Brown RC, Davis TP. Smoking and ischemic stroke: a role for nicotine? *Trends Pharmacol Sci*. 2002; 23(2): 78–82, doi: [10.1016/s0165-6147\(02\)01893-x](https://doi.org/10.1016/s0165-6147(02)01893-x), indexed in Pubmed: [11830264](https://pubmed.ncbi.nlm.nih.gov/11830264/).
- The World Health Organization on the Global Tobacco Epidemic. *Population and Development Review*. 2008; 34(1): 188–194, doi: [10.1111/j.1728-4457.2008.00214.x](https://doi.org/10.1111/j.1728-4457.2008.00214.x).
- Arcavi L, Benowitz NL. Cigarette smoking and infection. *Arch Intern Med*. 2004; 164(20): 2206–2216, doi: [10.1001/archinte.164.20.2206](https://doi.org/10.1001/archinte.164.20.2206), indexed in Pubmed: [15534156](https://pubmed.ncbi.nlm.nih.gov/15534156/).
- Bates MN, Khalakdina A, Pai M, et al. Risk of tuberculosis from exposure to tobacco smoke: a systematic review and meta-analysis. *Arch Intern Med*. 2007; 167(4): 335–342, doi: [10.1001/archinte.167.4.335](https://doi.org/10.1001/archinte.167.4.335), indexed in Pubmed: [17325294](https://pubmed.ncbi.nlm.nih.gov/17325294/).
- Goodwin RD, Keyes KM, Stein MB, et al. Peptic ulcer and mental disorders among adults in the community: the role of nicotine and alcohol use disorders. *Psychosom Med*. 2009; 71(4): 463–468, doi: [10.1097/PSY.0b013e3181988137](https://doi.org/10.1097/PSY.0b013e3181988137), indexed in Pubmed: [19443694](https://pubmed.ncbi.nlm.nih.gov/19443694/).
- Wahed M, Goodhand JR, West O, et al. Tobacco dependence and awareness of health risks of smoking in patients with inflammatory bowel disease. *Eur J Gastroenterol Hepatol*. 2011; 23(1): 90–94, doi: [10.1097/MEG.0b013e32834108ce](https://doi.org/10.1097/MEG.0b013e32834108ce), indexed in Pubmed: [21030867](https://pubmed.ncbi.nlm.nih.gov/21030867/).
- Abate M, Vanni D, Pantalone A, et al. Cigarette smoking and musculoskeletal disorders. *Muscles Ligaments Tendons J*. 2013; 3(2): 63–69, doi: [10.11138/mltj/2013.3.2.063](https://doi.org/10.11138/mltj/2013.3.2.063), indexed in Pubmed: [23888288](https://pubmed.ncbi.nlm.nih.gov/23888288/).
- Swanson MW. Smoking deception and age-related macular degeneration. *Optom Vis Sci*. 2014; 91(8): 865–871, doi: [10.1097/OPX.0000000000000315](https://doi.org/10.1097/OPX.0000000000000315), indexed in Pubmed: [24978870](https://pubmed.ncbi.nlm.nih.gov/24978870/).
- Ortiz A, Grando SA. Smoking and the skin. *Int J Dermatol*. 2012; 51(3): 250–262, doi: [10.1111/j.1365-4632.2011.05205.x](https://doi.org/10.1111/j.1365-4632.2011.05205.x), indexed in Pubmed: [22348557](https://pubmed.ncbi.nlm.nih.gov/22348557/).

21. Roelands J, Jamison MG, Lyerly AD, et al. Consequences of smoking during pregnancy on maternal health. *J Womens Health (Larchmt)*. 2009; 18(6): 867–872, doi: [10.1089/jwh.2008.1024](https://doi.org/10.1089/jwh.2008.1024), indexed in Pubmed: [19514829](https://pubmed.ncbi.nlm.nih.gov/19514829/).
22. Polańska K, Hanke W. Wpływ palenia w czasie ciąży na zdrowie dziecka – przegląd badań epidemiologicznych. *Przegl Epidemiol*. 2005; 59: 117–23.
23. Adamopoulos D, van de Borne P, Argacha JF. New insights into the sympathetic, endothelial and coronary effects of nicotine. *Clin Exp Pharmacol Physiol*. 2008; 35(4): 458–463, doi: [10.1111/j.1440-1681.2008.04896.x](https://doi.org/10.1111/j.1440-1681.2008.04896.x), indexed in Pubmed: [18307741](https://pubmed.ncbi.nlm.nih.gov/18307741/).
24. Schaal C, Chellappan SP. Nicotine-mediated cell proliferation and tumor progression in smoking-related cancers. *Mol Cancer Res*. 2014; 12(1): 14–23, doi: [10.1158/1541-7786.MCR-13-0541](https://doi.org/10.1158/1541-7786.MCR-13-0541), indexed in Pubmed: [24398389](https://pubmed.ncbi.nlm.nih.gov/24398389/).
25. Azzopardi D, Patel K, Jaunky T, et al. Electronic cigarette aerosol induces significantly less cytotoxicity than tobacco smoke. *Toxicol Mech Methods*. 2016; 26(6): 477–491, doi: [10.1080/15376516.2016.1217112](https://doi.org/10.1080/15376516.2016.1217112), indexed in Pubmed: [27690199](https://pubmed.ncbi.nlm.nih.gov/27690199/).
26. Kosmider L, Sobczak A, Prokopowicz A, et al. Cherry-flavoured electronic cigarettes expose users to the inhalation irritant, benzaldehyde. *Thorax*. 2016; 71(4): 376–377, doi: [10.1136/thoraxjnl-2015-207895](https://doi.org/10.1136/thoraxjnl-2015-207895), indexed in Pubmed: [26822067](https://pubmed.ncbi.nlm.nih.gov/26822067/).
27. Zatoński W. (red). Konsensus dotyczący rozpoznawania i leczenia zespołu uzależnienia od tytoniu. *Med Prakt. (wyd. spec.)* 2006: 1–24.
28. Etter JF. Electronic cigarettes: a survey of users. *BMC Public Health*. 2010; 10: 231, doi: [10.1186/1471-2458-10-231](https://doi.org/10.1186/1471-2458-10-231), indexed in Pubmed: [20441579](https://pubmed.ncbi.nlm.nih.gov/20441579/).
29. Siegel MB, Tanwar KL, Wood KS. Electronic cigarettes as a smoking-cessation: tool results from an online survey. *Am J Prev Med*. 2011; 40(4): 472–475, doi: [10.1016/j.amepre.2010.12.006](https://doi.org/10.1016/j.amepre.2010.12.006), indexed in Pubmed: [21406283](https://pubmed.ncbi.nlm.nih.gov/21406283/).
30. Bullen C, McRobbie H, Thornley S, et al. Effect of an electronic nicotine delivery device (e cigarette) on desire to smoke and withdrawal, user preferences and nicotine delivery: randomised cross-over trial. *Tob Control*. 2010; 19(2): 98–103, doi: [10.1136/tc.2009.031567](https://doi.org/10.1136/tc.2009.031567), indexed in Pubmed: [20378585](https://pubmed.ncbi.nlm.nih.gov/20378585/).
31. Goniewicz ML, Lingas EO, Hajek P. Patterns of electronic cigarette use and user beliefs about their safety and benefits: an internet survey. *Drug Alcohol Rev*. 2013; 32(2): 133–140, doi: [10.1111/j.1465-3362.2012.00512.x](https://doi.org/10.1111/j.1465-3362.2012.00512.x), indexed in Pubmed: [22994631](https://pubmed.ncbi.nlm.nih.gov/22994631/).
32. Ghosh S, Drummond MB. Electronic cigarettes as smoking cessation tool: are we there? *Curr Opin Pulm Med*. 2017; 23(2): 111–116, doi: [10.1097/MCP.0000000000000348](https://doi.org/10.1097/MCP.0000000000000348), indexed in Pubmed: [27906858](https://pubmed.ncbi.nlm.nih.gov/27906858/).
33. Rostron B. Mortality risks associated with environmental tobacco smoke exposure in the United States. *Nicotine Tob Res*. 2013; 15(10): 1722–1728, doi: [10.1093/ntr/ntt051](https://doi.org/10.1093/ntr/ntt051), indexed in Pubmed: [23852001](https://pubmed.ncbi.nlm.nih.gov/23852001/).
34. Hagstad S, Bjerg A, Ekerljung L, et al. Passive smoking exposure is associated with increased risk of COPD in never smokers. *Chest*. 2014; 145(6): 1298–1304, doi: [10.1378/chest.13-1349](https://doi.org/10.1378/chest.13-1349), indexed in Pubmed: [24356778](https://pubmed.ncbi.nlm.nih.gov/24356778/).
35. Schripp T, Markewitz D, Uhde E, et al. Does e-cigarette consumption cause passive vaping? *Indoor Air*. 2013; 23(1): 25–31, doi: [10.1111/j.1600-0668.2012.00792.x](https://doi.org/10.1111/j.1600-0668.2012.00792.x), indexed in Pubmed: [22672560](https://pubmed.ncbi.nlm.nih.gov/22672560/).
36. Hess IMr, Lachireddy K, Capon A. A systematic review of the health risks from passive exposure to electronic cigarette vapour. *Public Health Res Pract*. 2016; 26(2), doi: [10.17061/phrp2621617](https://doi.org/10.17061/phrp2621617), indexed in Pubmed: [27734060](https://pubmed.ncbi.nlm.nih.gov/27734060/).
37. Hurmowicz EL. The impact of electronic cigarettes on the paediatric population. *Tob Control*. 2014; 23 Suppl 2: ii41–ii46, doi: [10.1136/tobaccocontrol-2013-051468](https://doi.org/10.1136/tobaccocontrol-2013-051468), indexed in Pubmed: [24732163](https://pubmed.ncbi.nlm.nih.gov/24732163/).
38. Goniewicz ML, Zielinska-Danch W. Electronic cigarette use among teenagers and young adults in Poland. *Pediatrics*. 2012; 130(4): e879–e885, doi: [10.1542/peds.2011-3448](https://doi.org/10.1542/peds.2011-3448), indexed in Pubmed: [22987874](https://pubmed.ncbi.nlm.nih.gov/22987874/).
39. Harrell MB, Weaver SR, Loukas A, et al. Flavored e-cigarette use: Characterizing youth, young adult, and adult users. *Prev Med Rep*. 2017; 5: 33–40, doi: [10.1016/j.pmedr.2016.11.001](https://doi.org/10.1016/j.pmedr.2016.11.001), indexed in Pubmed: [27896041](https://pubmed.ncbi.nlm.nih.gov/27896041/).
40. Flouris AD, Poulianiti KP, Chorti MS, et al. Acute effects of electronic and tobacco cigarette smoking on complete blood count. *Food Chem Toxicol*. 2012; 50(10): 3600–3603, doi: [10.1016/j.fct.2012.07.025](https://doi.org/10.1016/j.fct.2012.07.025), indexed in Pubmed: [22858449](https://pubmed.ncbi.nlm.nih.gov/22858449/).
41. Flouris AD, Chorti MS, Poulianiti KP, et al. Acute impact of active and passive electronic cigarette smoking on serum cotinine and lung function. *Inhal Toxicol*. 2013; 25(2): 91–101, doi: [10.3109/08958378.2012.758197](https://doi.org/10.3109/08958378.2012.758197), indexed in Pubmed: [23363041](https://pubmed.ncbi.nlm.nih.gov/23363041/).
42. Vardavas C, Anagnostopoulos N, Kougas M, et al. Short-term Pulmonary Effects of Using an Electronic Cigarette. *Chest*. 2012; 141(6): 1400–1406, doi: [10.1378/chest.11-2443](https://doi.org/10.1378/chest.11-2443).
43. Farsalinos KE, Tsiapras D, Kyrzopoulos S, et al. Acute effects of using an electronic nicotine-delivery device (electronic cigarette) on myocardial function: comparison with the effects of regular cigarettes. *BMC Cardiovasc Disord*. 2014; 14: 78, doi: [10.1186/1471-2261-14-78](https://doi.org/10.1186/1471-2261-14-78), indexed in Pubmed: [24958250](https://pubmed.ncbi.nlm.nih.gov/24958250/).
44. Vansickel AR, Cobb CO, Weaver MF, et al. A clinical laboratory model for evaluating the acute effects of electronic „cigarettes”: nicotine delivery profile and cardiovascular and subjective effects. *Cancer Epidemiol. Biomarkers Prev*. 2010; 19(8): 1945–1953, doi: [10.1158/1055-9965.EPI-10-0288](https://doi.org/10.1158/1055-9965.EPI-10-0288), indexed in Pubmed: [20647410](https://pubmed.ncbi.nlm.nih.gov/20647410/).