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Vaping – A Beneficial Alternative to Traditional Cigarettes or an Unexplored Danger?

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1. Abstract:

The aim of this study is to assess the risks associated with e-cigarette use, particularly in the context of cardiovascular and respiratory health. In addition, the article addresses the social aspect of vaping as a significant challenge faced by national public health institutions, with a special focus on the prevalence of addiction among youth.

Methods:

We carried out a comprehensive review using PubMed and Google Scholar, with a primary focus on literature published within five to eight years.

The searches were performed using “vaping”, “e-cigarettes”, “smoking”, “COPD”, “nicotine replacement therapy” and the names of its components as search terms to retrieve relevant articles. Furthermore, references cited in the selected articles were also included in the analysis.

Results:
The current evidence suggests that while e-cigarettes may pose a lower risk than traditional cigarettes, they are not risk-free. Dual use of cigarettes and e-cigarettes increases cardiovascular risk and is comparable to the risks associated with exclusive cigarette smoking. Studies suggest that long-term e-cigarette use may result in increased aortic stiffness, elevated heart rate, heightened risk of atherosclerosis and diminished lung function, increased airway resistance, especially in individuals with pre-existing conditions like asthma. Exposure to aerosolized chemicals present in e-liquids poses risks of chronic respiratory diseases.
Conclusions:
The precise impact of e-cigarette use on health needs further research and long-term observations. Particular concern arises from the unregulated composition of e-liquids, which are gaining popularity among youth, thereby promoting early nicotine addiction and normalizing the use of tobacco products. Efforts to regulate the composition of e-liquids and the use of harmful additives are crucial to mitigate the potential health risks associated with vaping.

Keywords: vaping, e-cigarettes, smoking, COPD, nicotine replacement therapy

2. Introduction

E-cigarettes are battery-powered nicotine delivery devices. Nicotine is released when the liquid is heated, creating an inhalable aerosol (vapor). The liquid, also referred to as e-liquid or e-juice, contains a mixture of solvents, flavours and other substances like: nicotine or cannabinoids (tetrahydrocannabinol (THC) and cannabinoid (CBD) oils) [1,2].

E-cigarettes are the most common type of electronic nicotine delivery system. They usually resemble traditional cigarettes in appearance and size. Despite differences in the designs of individual models between manufacturers, the overall scheme remains common. The devices usually contain a power source (typically a lithium battery), a heating element, and a reservoir for the “e-liquid”. The e-liquid typically consists of a solvent (propylene glycol or vegetable glycerin), flavoring’s (eg. tobacco, mint, fruit, bubblegum), and, often, nicotine at variable concentrations, including zero [1,3,4].

In next-generation devices, a larger battery is built in, allowing for higher heating temperatures. This enables them to release a greater amount of nicotine and form additional toxicants such as formaldehyde. Unfortunately, standards to reduce the risks associated with usage have not yet been introduced, regulating aspects such as design, capacity for safely holding e-liquid, and e-liquid packaging [3,4].

Since e-cigarette vapor is not produced through the process of tobacco pyrolysis, vaping is often touted as a safer alternative to smoking, or at the very least, a less harmful option. However, studies examining the chemical composition of both e-cigarette liquids and the vapor they produce have revealed that many of the same toxic substances and carcinogens found in tobacco smoke are also present in e-cigarette vapor. These harmful compounds are typically found in lower concentrations compared to those in traditional cigarette smoke, but their presence raises concerns about the long-term health risks associated with vaping.

2.1. Epidemiology

The prevalence of e-cigarette use in Poland is difficult to estimate. Sales, as estimated by the Institute for Economic Forecasts and Analysis in 2023, reached around 100 million [5]. According to the report "Reduction of Cigarette Smoking and E-Cigarette Use, Particularly Among the Younger Generation of Poles" by the Public Health Committee of the Polish Academy of Sciences, 4.8% of Poles use e-cigarettes, and 4% use heated tobacco products [6]. A worrying trend is the increasing popularity of this habit among school-aged youth. The data on daily cigarette use among youth varies. According to the PolNicoYouth study, conducted on a representative sample of 16,712 young people from 200 secondary schools, one in ten respondents admitted to daily smoking, while according to the Lung Cancer Fighting Association, Szczecin branch, nearly half of the respondents reported daily use [7,8].

The easy availability, variety of flavors (including fruit flavors), and affordable price (below 30 PLN) contribute to the rapid growth in popularity - a nearly threefold increase in sales compared to 2022 [5]. More than 40% of respondents claim that e-cigarettes and heated tobacco products are less harmful than regular cigarettes [7]. Perceived by many users as safer, e-cigarettes contribute to the development of poly-use patterns - where individuals use multiple forms of tobacco.

According to the study commissioned by the Ombudsman for Children and conducted by the Pollster Research Institute on a representative sample of 1,012 Polish internet users aged 16 to 19, students are more likely to reach for e-cigarettes than traditional cigarettes. Despite this fact, it has been found that vaping among youth who have not previously been smokers may ultimately lead to the initiation of traditional cigarette use. The main motivation of young people who start vaping is to reduce stress and improve their well-being [4, 9, 10]. About one-third of respondents admitted that e-cigarettes help them connect with others and improve concentration. Over three-quarters of respondents admitted to smoking e-cigarettes at home, and more than a third reported doing so at school. [11] According to their responses, they did not encounter difficulties in purchasing e-cigarettes. Despite the formal legal ban, according to PolNicoYouth nearly half of the respondents buy e-cigs on their own, 16,5% obtain them with the help of their friends. Only about 5% of respondents declare that they were refused a sale [7].

Despite over 90% of users choosing fruit flavor, their attachment to it is weak. In the event that their favorite flavor was no longer available, the majority declared they would switch to another flavor, 5% would switch to traditional cigarettes, and 5% would quit smoking.

What is most concerning is that more than half of the smoking youth have no intention of quitting. Only about 35% want to break free from the addiction [8,11].

2.2. Mechanism

E-cigarettes are portable devices designed to mimic the act of smoking by heating a liquid to generate an inhalable aerosol (vapor). The heater is activated when air is drawn in. This creates a negative pressure inside the device, which closes the switch. The temperature then converts part of the liquid into an aerosol, which is inhaled. [1]. The liquid contains a solvent, typically glycerin or propylene glycol, as well as flavoring substances. Currently, there are over 700 different e-liquid flavors available on the Polish market. [5]

Depending on the flavor, they may have varying compositions, and consequently, different levels of toxicity. Although most of the substances used are not harmful when consumed orally, their impact on health during inhalation is not fully understood [11]. Heating the e-liquid, depending on the manufacturer, to around 200-250°C causes the release of an aerosol that can have irritating or even carcinogenic effects. The concentration of detected chemicals depends on energy used to generate the aerosol [3]. Studies conducted on the content of the aerosol have shown the presence of carcinogens, including formaldehyde, acetone, acrolein, diacetyl and metals such as chromium, cadmium, nickel, and lead [3,13]. In studies conducted using e-liquid and the generated aerosol, possible pro-inflammatory effects, increased oxidative stress, as well as suppression of genes associated with immune response in the nasal mucosa were observed. Cells exposed to fruit-flavored e-liquid demonstrated a higher susceptibility to DNA damage. In an in vitro study, more than half of the e-juices tested showed cytotoxic effects on the cells [3,13,14].

3. Consequences

The long-term consequences of using e-cigarettes are not yet well understood and require further research. Many users consider them to be safer or less harmful alternatives to traditional nicotine products. However, the unregulated composition of e-liquids, usage patterns leading to poly-use, as well as the concerning prevalence of vaping among school-aged youth, may result in negative health and social consequences.

Conditions such as chronic obstructive pulmonary disease (COPD) might develop due to vaping, manifesting even after several years. It is related to exacerbating the existing burden associated with smoking.

There is also concern about the negative impact of e-cigarettes on susceptibility to viral infections; they may increase the virulence of certain microorganisms and elevate the risk of pneumonia. Studies conducted on mice have shown a negative impact of vaping on the respiratory system.

Exposure to the aerosol caused the development of inflammation, leading to organ fibrosis. Additionally, the induction of angiogenesis in the heart muscle was also documented [13].

Regular vaping may negatively affect lung function compared to non-smokers. A study conducted on a group of men who used e-cigarettes daily showed a statistically significant decrease in spirometry test parameters compared to a control group of non-smokers. Similarly, another study showed that even a single exposure to e-cigarettes had a negative impact on respiratory function, with the effect being more pronounced in participants with asthma [16,17].

3.1. Respiratory System

Respiratory system is particularly vulnerable to the effects of inhaled aerosol from e-cigarettes. Studies conducted on animal models have shown that exposure to vapour containing nicotine and flavorings leads to an increase in the number of macrophages in bronchoalveolar lavage (BAL) [17]. The content of flavoring substances in e-liquids may raise concerns. Although most substances used as ingredients are considered safe when consumed orally, the consequences of inhalation remain unclear. One example is diacetyl, which has been detected in many e-liquids and may cause bronchiolitis obliterans ("popcorn lung").

However, there is insufficient evidence to directly link the use of e-cigarettes with the occurrence of this condition. Furthermore, traditional cigarettes, which may also contain diacetyl, often in higher concentrations, do not appear to cause such consequences [18]. In a study conducted on a group of patients with asthma, assessing respiratory function immediately after a single exposure to e-cigarettes, a significant increase in respiratory system resistance was observed, with a more pronounced effect in smokers with asthma. However, it should be noted that the study was conducted on a small group of approximately 50 individuals and showed only short-term effects on the respiratory system [16,19]. In a similar study measuring spirometric parameters in individuals who are not current nor former traditional tobacco users, values for forced expiratory volume in the first second (FEV1), forced expiratory ratio (FEV1/FVC), forced expiratory flow - 25%, (FEF50%), (FEF75%), (FEF25%–75%), and (FEF75%–85%) were compared, showing significantly worse results in the group exposed to e-cigarettes [15].

One of the most concerning consequences of e-cigarette use is VALI (vaping-associated lung injury). In 2019, over 2,000 cases were reported in the USA, mainly men under the age of 34. Among the reported cases, the most common additive in the e-liquids used by the affected individuals was tetrahydrocannabinol (THC), although some also used nicotine-only. One of the factors that may cause VALI, detected in high concentrations in e-cigarettes used by patients, is vitamin E acetate. [3] Vitamin E, alongside nicotine and THC, was also detected in the majority of bronchoalveolar lavage (BAL) samples obtained from patients diagnosed with VALI [13]. The standard clinical presentation of patients with VALI included systemic symptoms such as fever, as well as respiratory symptoms such as non-productive cough, shortness of breath, and chest pain. In laboratory tests, elevated levels of C-reactive protein, white blood cells, and transaminases are characteristic.

In imaging diagnostics, patients presented diffuse bilateral ground glass opacities, often with accompanying consolidations [20,21]. Cytological studies obtained from bronchoalveolar lavage showed a significant predominance of inflammatory cells, particularly macrophages containing small vacuoles of similar sizes. Characteristic of the condition is the pattern of acute lung injury, acute fibrinous pneumonitis, diffuse alveolar damage, and the coexistence of bronchiolitis [13,22]. The diagnostic criteria for VALI include the necessity of e-cigarette use within the 90 days preceding the onset of illness, the presence of typical changes in chest imaging, and the exclusion of other probable diagnoses. EVALI can present a wide range of symptoms, with the most severe form manifesting as acute respiratory distress syndrome. In some patients, the disease and respiratory changes resolve completely; however, some individuals exhibit residual symptoms following EVALI and the presence of fibrotic changes in the lungs. Therefore, the possibility of developing chronic fibrotic changes in survivors cannot be excluded. Confirmation of this hypothesis will require further long-term studies [21].

The determination of the impact of e-cigarettes on the occurrence of lung cancer requires the conduct of long-term studies. In animal model studies, the results suggested a potential increased risk of carcinogenesis in mice [12].

3.2. Cardiovascular diseases

The understanding of the relationship between vaping, cardiovascular health, and homeostasis remains in its early stages with a clear need for additional research to define susceptibility of cardiac structure and function to vaping.

Studies conducted on animal models have demonstrated the negative impact of e-cigarettes on the structure of the cardiovascular system, including increased angiogenesis in the myocardial tissue and fibrosis. Similar to traditional cigarettes, electronic counterparts in the murine model led to an increase in arterial stiffness and an enlargement of the left ventricle. Components present in e-cigarettes resulted in elevated levels of fatty acids and exacerbated inflammatory processes, contributing to the progression of atherosclerosis [12]. Studies conducted in young adults using e-cigarettes have confirmed suspicions raised by animal model research. Even short-term use leads to increased oxidative stress. Long-term exposure may result in increased aortic stiffness, heightened sympathetic nervous system activity with elevated heart rate, and increased blood pressure [19, 23]. Changes in these factors may serve as a risk factor for the development of serious cardiovascular diseases as a consequence of e-cigarette use. In prospective studies comparing changes in cardiovascular function between traditional cigarette smokers and e-cigarette users, it was observed that transitioning to e-cigarettes may sometimes lead to improvements in function (including vascular stiffness and heart rate). However, this trend was mainly seen in short-term smokers with a shorter history of smoking. For long-term smokers, the benefits of switching to e-cigarettes were less pronounced or not observed at all [24].

The latest analysis of cardiovascular disease (CVD) risk, limited by the small number of CVD events in the e-cigarette user group, found that exclusive e-cigarette use was not associated with a statistically significant difference compared to non-smokers. On the other hand, combining traditional cigarette smoking with e-cigarette use was associated with a significant increase in CVD risk, comparable to the risk observed in individuals who smoked only traditional cigarettes [25].

4. Quitting smoking

Smoking traditional cigarettes is an established risk factor not only for lung diseases, but also for cardiovascular diseases and cancer. Quitting smoking at a young age can extend life by as much as 10 years [26]. There are many forms of nicotine replacement therapy available on the market, some of which are available over-the-counter, including gums, patches, aerosols, and tablets. A Cochrane review showed their effectiveness, reflected in a 50% increase in the smoking cessation rate–[27, 28]. E-cigarettes are considered less harmful compared to traditional counterparts. Manufacturers advocate for recognizing vaping as a smoking cessation method. However, there is insufficient data to substantiate the health benefits of transitioning from traditional cigarettes to e-cigs. Campagna et al found no beneficial health effects in smokers who partially substituted conventional cigarettes for e-cigarettes [18]. Many studies found that smokers use e-cigarettes to maintain their habit instead of quitting entirely. Satisfying habitual reflexes associated with tobacco smoking, such as hand movements or inhaling the aerosol, may be responsible for the slightly greater effectiveness of vaping compared to other nicotine replacement therapies [29].

In a study conducted by Hajek et al 886 smokers were randomized to e-cigarette or nicotine replacement products of their choice. After 1 year, 18% of e-cigarette users had stopped smoking, compared with 9.9% of nicotine replacement product users. However, 80% of the e-cigarette users were still using e-cigarettes after 1 year, while only 9% of nicotine replacement product users were still using nicotine replacement therapy products after 1 year [30]. In a randomized study conducted on 657 smokers randomly assigned to groups receiving e-cigarettes, nicotine patches, or placebo (nicotine-free e-cigarettes), abstinence rates were similar in the e-cigarette and nicotine patch groups, and nicotine e-cigarettes were "moderately effective" in helping people quit smoking [31].

However, the presence of e-cigarettes on the market has led to the amplification of several trends that increase the use of tobacco products. One of these is the pattern of poly-use, where an addicted person alternately uses different devices that deliver nicotine. As a result, this may lead to an overall increase in the total nicotine intake. Furthermore, easily accessible e-cigarettes are widely spread among young people. They may increase the number of those addicted at school age and also lower the age of initiation. Studies conducted among Polish youth show that more than half of the respondents using e-cigarettes do not consider quitting [3].

5. Conclusions

Although e-cigarettes are often considered a less harmful alternative to traditional cigarettes, they are not without risks. Current research indicates that e-cigarettes can lead to serious health issues, particularly concerning respiratory and cardiovascular health. Chemical substances detected in e-cigarette aerosols, including formaldehyde, acrolein, and heavy metals, can have potential carcinogenic effects and pose health risks. E-cigarettes, despite having lower concentrations of toxins compared to traditional cigarettes, can still result in a decline in lung function, increased airway reactivity, and a risk of developing chronic respiratory diseases such as COPD. Another phenomenon is vaping-associated lung injury (VALI), which can cause significant inflammatory changes in the lungs and, in severe cases, may result in acute respiratory distress syndrome. E-cigarettes, much like traditional cigarettes, negatively impact the cardiovascular system, leading to increased blood pressure, arterial stiffness, and heightened risk of atherosclerosis. E-cigarettes pose a particular threat to younger generations. Easy access, a wide variety of flavors, and the perception of being less harmful contribute to the rising popularity of e-cigarette use among youth. The increasing number of young individuals addicted to nicotine due to e-cigarette use is a significant public health concern. While available studies suggest that e-cigarettes may be a less harmful alternative to traditional cigarettes, their long-term health effects remain unclear and require further investigation. Effective regulations are also needed to control the composition of e-liquids and limit harmful additives to minimize health risks. Public health strategies should focus on preventing the initiation of smoking and vaping among youth, reducing dual use, and regulating the e-cigarette market. Additionally, promoting effective smoking cessation methods, such as nicotine replacement therapies, and monitoring the long-term health effects of e-cigarette use are essential.

6. Disclosure

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Conceptualization: Paulina Błasiak, Aleksandra Ślusarska
Investigation: Paulina Błasiak, Aleksandra Ślusarska, Patryk Mikołajec
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References:

1. Besaratinia A, Tommasi S. Vaping epidemic: challenges and opportunities. Cancer Causes Control. 2020;31(7):663–667. https://doi.org/10.1007/s10552-020-01307-y
2. Jenssen BP, Walley SC. E-cigarettes and similar devices. Pediatrics. 2019;143(2):e20183652. https://doi.org/10.1542/peds.2018-3652
3. Dinardo P, Rome ES. Vaping: The new wave of nicotine addiction. Cleveland Clinic Journal of Medicine. 2019;86(12):789–798. https://doi.org/10.3949/ccjm.86a.19118
4. Bold KW, Krishnan-Sarin S, Soney CM. E-Cigarette Use as a Potential Cardiovascular Disease Risk Behavior. Am Psychol. 2018;73(8):955–967. https://doi.org/10.1037/amp0000231
5. Institute for Prevention and Economic Analysis (IPAG). E-cigarettes: Current Data, Challenges, and Perspectives. 2024. Dostępne pod adresem: https://www.ipag.org.pl/Content/Uploaded/files/2024_02_01_Raport_IPAG_e-papierosy.pdf
6. Balwicka-Szczyrba M, Balwicki Ł, Hanke W, Miller M, Tyrańska-Fobke A. Strategic Recommendations for 2023–2027: Reducing the Use of Tobacco and Other Nicotine-Containing Products, Especially Among the Young Generation of Poles. 2023. Dostępne pod adresem: https://pan.pl/wp-content/uploads/2023/03/PolskieZdrowie2.0_II.3_REDUKCJA-UZYWANIA-TYTONIU-I-INNYCH-PRODUKTOW-ZAWIERAJACYCH-NIKOTYNE-SZCZEGOLNIE-WSROD-MLODEGO-POKOL.pdf
7. National Institute of Public Health – National Institute of Hygiene. Final Report: Assessment of the Epidemiological Situation Regarding the Use of Psychoactive Substances in Poland. 2020. Dostępne pod adresem: https://www.pzh.gov.pl/wp-content/uploads/2021/03/Raport-koncowy-26.11.2020-1-po-G-i-po-M.pdf
8. Office of the Commissioner for Children's Rights. E-cigarettes Are a Plague Among Children and Adolescents: The Commissioner Supports Restricting Their Sale. 2024. Dostępne pod adresem: https://brpd.gov.pl/2024/02/27/e-papierosy-to-plaga-wsrod-dzieci-i-mlodziezy-rzeczniczka-popiera-ograniczanie-ich-sprzedazy/
9. Solecka M. A Sales Ban May Not Be Enough. Medycyna Praktyczna. 2024. Dostępne pod adresem: https://www.mp.pl/pacjent/pediatria/aktualnosci/badania/343094,zakaz-sprzedazy-moze-nie-wystarczyc

10. Glasser A, Abudayyeh H, Cantrell J, Niaura R. Patterns of E-Cigarette use among youth and young adults: Review of the impact of E-Cigarettes on cigarette smoking. Nicotine & Tobacco Research. 2018;21(10):1320–1330. https://doi.org/10.1093/ntr/nty103
11. Medycyna Praktyczna. E-papierosy stały się nałogiem młodzieży. 2020. Dostępne pod adresem: https://www.mp.pl/pediatria/aktualnosci/255913,e-papierosy-staly-sie-nalogiem-mlodziezy,1
12. Marczylo T. How bad are e-cigarettes? What can we learn from animal exposure models? The Journal of Physiology. 2020;598(22):5073–5089. https://doi.org/10.1113/jp278366
13. McAlinden KD, Eapen MS, Lu W, Sharma P, Sohal SS. The rise of electronic nicotine delivery systems and the emergence of electronic-cigarette-driven disease. AJP Lung Cellular and Molecular Physiology. 2020;315(5):L662–L672. https://doi.org/10.1152/ajplung.00389.2017
14. Behar RZ, Wang Y, Talbot P. Comparing the cytotoxicity of electronic cigarette fluids, aerosols and solvents. Tobacco Control. 2017;27(3):325–333. https://doi.org/10.1136/tobaccocontrol-2016-053472
15. Meo SA, Ansary MA, Barayan FR, Almusallam AS, Almehaid AM, Alarifi NS, Alsohaibani TA, Zia I. Electronic cigarettes: impact on lung function and fractional exhaled nitric oxide among healthy adults. American Journal of Men's Health. 2018;13(1):1–7. https://doi.org/10.1177/1557988318806073
16. Lappas AS, Tzortzi AS, Konstantinidi EM, Teloniatis SI, Tzavara CK, Gennimata SA, Koulouris NG, Behrakis PK. Short-term respiratory effects of e-cigarettes in healthy individuals and smokers with asthma. Respirology. 2017;23(3):291–297. https://doi.org/10.1111/resp.13180
17. Glynos C, Bibli S, Katsaounou P, Pavlidou A, Magkou C, Karavana V, Topouzis S, Kalomenidis I, Zakynthinos S, Papapetropoulos A. Comparison of the effects of e-cigarette vapor with cigarette smoke on lung function and inflammation in mice. AJP Lung Cellular and Molecular Physiology. 2018; 315(5), L662–L672. https://doi.org/10.1152/ajplung.00389.2017
18. Campagna D, Amaradio MD, Sands MF, Polosa R. Respiratory infections and pneumonia: potential benefits of switching from smoking to vaping. Pneumonia. 2016;8(1):1–9. https://doi.org/10.1186/s41479-016-0001-2
19. Thirión-Romero I, Pérez-Padilla R, Zabert G, Barrientos-Gutiérrez I. Respiratory impact of electronic cigarettes and "low-risk" tobacco. Clinical and translational investigation. 2019;71:17-27. https://doi.org/10.24875/ric.18002616
20. Ali M, Khan K, Buch M, Ramirez MR, Sharma M, Patel S, Choudhury S, Anjum H, Khan A, Surani S. A case series of Vaping-Induced lung injury in a community hospital setting. Case Reports in Pulmonology. 2020;2020:1–7. https://doi.org/10.1155/2020/9631916
21. Smith ML, Gotway MB, Alexander LEC, Hariri LP. Vaping-related lung injury. Virchows Archiv. 2020;478(1):81–88. https://doi.org/10.1007/s00428-020-02943-0

22. Butt YM, Smith ML, Tazelaar HD, Vaszar LT, Swanson KL, Cecchini MJ, Boland JM, Bois MC, Boyum JH, Froemming AT, Khoor A, Mira-Avendano I, Patel A, Larsen BT. Pathology of Vaping-Associated lung injury. New England Journal of Medicine. 2019;381(18):1780–1781. https://doi.org/10.1056/nejmc1913069
23. Wold LE, Tarran R, Alexander LEC, Hamburg NM, Kheradmand F, St Helen G, Wu JC. Cardiopulmonary consequences of vaping in adolescents: a scientific statement from the American Heart Association. Circulation Research. 2022;131(3):E13–E25. https://doi.org/10.1161/res.0000000000000544
24. Tsai M, Byun MK, Shin J, Alexander LEC. Effects of e-cigarettes and vaping devices on cardiac and pulmonary physiology. The Journal of Physiology. 2020;598(22):5039–5062. https://doi.org/10.1113/jp279754
25. Berlowitz JB, Xie W, Harlow AF, Hamburg NM, Blaha MJ, Bhatnagar A, Benjamin EJ, Stokes AC. E-Cigarette use and risk of cardiovascular disease: A longitudinal analysis of the PATH Study (2013–2019). Circulation. 2022;145(20):1557–1559. https://doi.org/10.1161/circulationaha.121.057369
26. Bała MM, Cedzyńska M, Balwicki Ł, Czajkowska-Malinowska M, Jankowska-Zduńczyk A, Jassem J, Korycińska D, Lewandowska D, Mejza F, Pazik J, Puścińska E, Szymański J, Zając J, Jankowski P. Guidelines for Treating Nicotine Addiction: Introduction and Summary of Recommendations. Medycyna Praktyczna. 2022. Dostępne pod adresem: https://www.mp.pl/pulmonologia/artykuly-wytyczne/inne/299775,wytyczne-leczenia-uzaleznienia-od-nikotyny-podsumowanie-zalecen,1
27. Zaczek R. Pharmacotherapy for Nicotine Addiction. Choroby Serca i Naczyń. 2017;14(4):214-216. Dostępne pod adresem: https://journals.viamedica.pl/choroby_serca_i_naczyn/article/download/56408/42408
28. Hartmann-Boyce J, Chepkin SC, Ye W, Bullen C, Lancaster T. Nicotine replacement therapy versus control for smoking cessation. Cochrane Library. 2019; 2019(1):1–101. https://doi.org/10.1002/14651858.cd000146.pub5
29. Rehan HS, Maini J, Hungin APS. Vaping versus smoking: A quest for efficacy and safety of e-cigarette. Current Drug Safety. 2018;13(2):92–101. https://doi.org/10.2174/1574886313666180227110556
30. Hajek P, Phillips-Waller A, Przulj D, Pesola F, Smith KM, Bisal N, Li J, Parrott S, Sasieni P, Dawkins L, Ross L, Goniewicz M, Wu Q, McRobbie HJ. A Randomized Trial of E-Cigarettes versus Nicotine-Replacement Therapy. New England Journal of Medicine. 2019;380(7):629–637. https://doi.org/10.1056/nejmoa1808779
31. Bullen C, Howe C, Laugesen M, McRobbie H, Parag V, Williman J, Walker N. Electronic cigarettes for smoking cessation: a randomised controlled trial. The Lancet. 2013;382(9905):1629–1637. https://doi.org/10.1016/s0140-6736(13)61842-5