REVIEW ARTICLE

A Perspective on Alternative Forms of Tobacco

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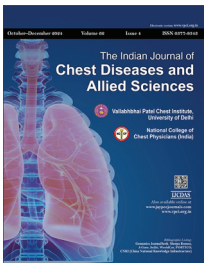

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Abstract

Tobacco use is a global epidemic. Smoking claims more than 8 million lives annually across the globe. Further, it even poses a threat to nonsmokers who are exposed to cigarette smoke. Tobacco is most commonly used in the form of cigarette smoking across the world. The COVID-19 pandemic has impacted smoking habits, leading to visible differences in smoking rates. The current paper highlights and discusses alternative forms of smoking. Undoubtedly in the recent years, there is an advent of forms of alternative smoking, and a variety of tobacco products have been gaining popularity beyond traditional cigarettes. These products are preferred widely by the youth. Noteworthy to mention, these alternatives raise concerns about potential health risks and addiction. There is a paucity of research on the impact of alternative form tobacco usage on human health. The paper will provide an impetus for the researchers to explore further on the perspective of alternative forms of tobacco. It will also provide some essential leads to implement measures to mitigate the impact of alternative forms of tobacco usage on human health.

Keywords: Alternative forms of tobacco, Electronic nicotine delivery systems, Heated tobacco products, Herbal cigarettes, Oral nicotine products.

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Abbreviations used in this Article

ENDS = Electronic nicotine delivery systems; HTPs = Heated tobacco products; ONPs = Oral nicotine products.

Introduction

Tobacco use, primarily cigarette smoking, is a global epidemic. It is the leading cause of preventable diseases and deaths around the world. Smoking claims more than 8 million lives annually across the globe. Further, it even poses a threat to nonsmokers who are exposed to cigarette smoke. Around 1.3 million nonsmoker deaths are attributed to second-hand smoking. Smoking affects multiple organs of human body. It causes cancer of lung, mouth, throat, esophagus, pancreas, bladder, and kidney. Several respiratory infections, such as chronic obstructive pulmonary disease, asthma, and interstitial lung disease, are due to smoking. Noteworthy to mention, smoking is considered to be a prominent risk factor for cardiovascular diseases. Around 80% of world's tobacco users are from countries of the south. Tobacco is one of the major factors driving people toward poverty in these countries.[1] Using any type of tobacco is harmful, and there is no amount of tobacco exposure that is safe. Tobacco is most commonly used in the form of cigarette smoking across the world; however, in India, additionally bidi and hookah are also prevalent. A large majority of smokers start smoking in their youth.[2] Global Adult Tobacco Survey conducted in India in the year 2016–2017 identified that in India there are over 26.7 crore tobacco consumers, which accounts for 29% of adult population of the country.[3] According to a study by Mishra et al., approximately 1 million deaths in India are linked to smoking.[4] Strikingly, smokeless tobacco claims approximately 2,30,000 lives in India every year. Tobacco is responsible for 9.5% of overall deaths in India annually.[5] As per a 2021 study, tobacco usage costs India 1.04% of its gross domestic product, while the excise tax revenue from tobacco in the year 2020 amounted to merely 12.2% of its total economic costs.[6] The direct medical costs were 5.3% of total expenditure on health.[7]

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The COVID-19 pandemic has impacted smoking habits, leading to noticeable differences in smoking rates, especially among individuals with lower education levels. This trend contributes to widening social inequality gaps.[2,7] To combat the tobacco crisis, strong tobacco control and prevention measures have been implemented worldwide, including comprehensive laws and public policies. Several laws and international agreements like the Framework Convention on Tobacco Control, as well as national laws, such as the Cigarettes and Other Tobacco Products Act in India, have been put into effect. Additionally, initiatives like MPOWER focus on tobacco control. Furthermore, there have been significant advancements in both pharmacological and nonpharmacological treatments for tobacco control in recent years.[8–12] In response to these efforts, the influential tobacco lobby has devised new strategies, shifting their attention to vulnerable youth populations. Consequently, there has been an emergence of appealing smoking alternatives in the market.[13]

Alternative Smoking and Types

Over the recent years, there is an advent of forms of alternative smoking, and a variety of tobacco products have been gaining popularity beyond traditional cigarettes. These products are preferred widely by the youth. However, these alternatives raise concerns about potential health risks and addiction. The current review discusses the diverse forms of alternative smoking and the factors driving their emergence. Furthermore, it also throws light on the ongoing debate regarding their long-term health effects. Table 1 enlists the major smoking alternatives that are becoming prominent among the youth.

E-cigarettes

Electronic nicotine delivery systems (ENDS), referred as e-cigarettes, are electronic devices powered by batteries that allow users to inhale or vape a flavored liquid solution containing nicotine. The e-cigarette was marketed as a mechanism for smoking cessation. Nicotine (which is extracted from tobacco), a highly addictive compound present in traditional tobacco products, is also a key component in these devices. The cartridges of e-cigarettes mainly contain liquid nicotine. However, additional flavors and other subsidiary compounds are also added for value addition.[13–15] These electronic devices have witnessed a global rise in popularity, extending to India. The Indian e-cigarette market reached a value of $7.8 million in 2018, projecting a substantial compound annual growth rate of 26.4% from 2019 to 2024.[16–19] The concentration of nicotine and other substances in these products can vary significantly, leaving users uncertain about their exact composition. Biochemical analysis of these nicotine solutions has revealed presence of harmful levels of potential carcinogens, including acetaldehyde, formaldehyde, and acetone. The solutions used in these devices also contain harmful chemicals and metals linked to various health issues, including cancer and other health issues of heart, lungs, and brain.[20,21] The ENDS come in different varieties, with the e-cigarette being the most prevalent, producing a vaporized blend of flavored liquids and nicotine for inhalation. A cross-sectional survey involving 3,000 participants using e-cigarettes from eight largest Metropolitan cities of India revealed that family/friends is the major source of information regarding e-cigarettes, followed by Internet. As far as the frequency of use is concerned, highest proportion of participants used e-cigarettes daily. Additionally, majority of the participants purchased e-cigarettes from online shopping forums followed by street-based shops.[22]

Heated Tobacco Products (HTPs)

Heated tobacco products work by heating tobacco to about 350°C, which is lower than that in conventional cigarettes. This creates aerosols with nicotine and ancillary chemicals. Most HTP Heated tobacco products use battery-powered heating. Heated tobacco products offer a smoking experience similar to that of conventional cigarettes which involves inhaling the aerosols through mouth making them very addictive. Heated tobacco products are different from e-cigarettes in the way that the former heats up the tobacco to generate an aerosol containing nicotine, whereas the latter heats up an e-liquid to generate an aerosol that may or may not contain nicotine. "I Quit Ordinary Smoking" by Philip Morris International (PMI) is one of the most popular HTPs. The mechanism involves placing a specially designed cigarette in an electronic heating device that heats up the tobacco to generate the aerosol. The HTPs were introduced to market as a less-harmful substitute to conventional cigarettes. Effects of long-term use of HTPs on human health are not yet clearly understood. However, the preliminary findings confirm that they are not a safer choice to smoking. An article by Znyk et al. elucidates the harmful effects of HTPs on health.[23] The review included 25 articles identified from PubMed, Scopus, Elsevier, and Clinical Key published between 2015 and 2021. A majority of the included studies were *in-vitro* and mostly funded by tobacco industries. The authors commented that there is insufficient literature to firmly ascertain that HTPs are a safer alternative to conventional cigarettes. Further, it recommends that there is a need of longitudinal studies involving human subjects to determine the toxic effects of prolonged use of HTPs. The review concludes that there is no strong evidence to claim that HTPs are safer than the mainstream cigarettes. In the article by Upadhyay et al., the authors mention that HTPs are gaining wide popularity among individuals of the age-group 15–24 years, and their sale may increase by seven times in the year 2027 as compared with 2020.[24] In conclusion, HTPs are sold in more than 50 countries worldwide.

Oral Nicotine Products (ONPs)

Oral smokeless products include nicotine pouches, chewing tobacco, and snus. Oral nicotine pouches are now emerging as a new "modern oral" nicotine product. Oral nicotine products consist

Table 1: Alternative forms of tobacco smoking

S. No.	*Alternative forms of tobacco smoking*	*Example*	*Process*
1.	ENDS	E-cigarettes, vape devices, hookahs	Devices heat nicotine-containing liquid to produce an inhalable aerosol
2.	HTPs	1. I-Quit-Ordinary-Smoking 2. Glo by British American Tobacco 3. LIL by KT&G 4. TAAT Beyond Tobacco by TAAT Global Alternatives	Products heating tobacco without an open flame, generating an aerosol with nicotine and other chemicals
3.	ONPs	Products like snuff, chewing tobacco, and snus	Oral nicotine products (ONPs) are tobacco-free pouches that deliver nicotine through the oral mucosa. The nicotine is absorbed into the bloodstream through the mucous membranes.
4.	Herbal cigarettes	1. Honeyrose herbal cigarettes 2. Ecstacy herbal cigarettes 3. Djarum Cigarillos (Bali's best) 4. Magic 25 herbal cigarettes	Herbal cigarettes are marketed as a nicotine-free alternative made from a blend of herbs, such as marshmallow and passion flower, aiming to provide a smoking experience without the harmful effects of tobacco

of a permeable pouch and a nontobacco substrate to which nicotine and flavors are added.[25] Oral Nicotine products are different from traditional smokeless tobacco products as they do not contain any tobacco leaf.[26,27] Noteworthy to mention, flavored ONPs increase the risk of dual- or polytobacco products among young adults, further increasing the adverse risk on the health of periodontium. Nevertheless, given the recent growth of users, further studies are needed to elucidate the impact of ONPs.[25]

Herbal Cigarettes

The World Health Organization (WHO) reports a shift in the focus of tobacco companies toward targeting youth. In response to heightened antitobacco initiatives, companies are introducing nicotine-free and tobacco-free herbal alternatives, such as herbal cigarettes, cigars, and hookahs. Herbal cigarettes, positioned as tobacco-free or nicotine-free alternatives, have gained popularity among the youth, especially as perceived aids for nonsmoking. These are promoted somewhat like an aid to quit tobacco smoking, as they are believed to be nonhabit-forming and do not lead to any withdrawal symptoms. Additionally, unsupervised marketing strategies of alternative smoke have made the youth susceptible to herbal smoke.[21,22] Crafted from a blend of various herbs, herbal cigarettes aim to mitigate the perceived hazards associated with traditional smoking. Despite their increasing popularity, the safety of herbal cigarettes raises concerns, as their potential health risks have not been extensively studied. The quality of the reported research on these herbal tobacco products is difficult to ascertain, as the news articles, tobacco documents, and company websites do not provide more than general summaries of the studies evaluating these products. The mainstream smoke of herbal cigarettes contains toxic components, with some found to induce mutagenicity, suggesting a potential for genetic mutations comparable with traditional cigarettes.[23] Research on herbal cigarettes also indicates that the levels of detrimental compounds, such as carbon monoxide, polyaromatic hydrocarbons, and volatile aldehydes, in the emissions from "tobacco-free" herbal cigarettes are comparable with or even higher than those found in hookahs containing tobacco; this impacts the blood cells' ability to transport oxygen and potentially causes fatal poisoning.[28,29] The lack of compelling evidence supporting the positive effects of herbal cigarettes on public health further contributes to the uncertainty surrounding their long-term consequences.[30]

Potential Harmful Effects (Table 2)

A systematic review found that e-cigarette use was associated with 28% reduced chances of quitting. Undoubtedly, there is evidence based on the meta-analysis done that the usage of e-cigarettes leads to the use of conventional cigarettes. Furthermore, there is a reverse temporal association also that usage of combustible tobacco cigarettes at the baseline was positively associated with the use of e-cigarettes.[31,32]

Reports show that the effect of e-cigarettes on periodontal tissues is similar to that of conventional cigarettes. Some vaping formulations may be highly carcinogenic, especially those with sweet flavors. The vapor produced by vaping devices is thick and viscous and is retained on oral tissues. There are around 10,000 different vaping liquids, including some that contain tetrahydrocannabinol and vitamin E-acetate. Vaping clearly has the potential to negatively affect general health and periodontal health, and accelerates the development of caries.[32–34] There are evidence to suggest that teenagers are being attracted to vaping in astonishing numbers. Accounts of e-cigarette- or vaping-associated lung injury raises concerns regarding their adverse health effects. Few studies have specifically explored the neurotoxicity of e-cigarettes, especially in terms of neurodevelopmental impacts. A study conducted on BALB/c mice examined how exposure to e-cigarette vapors, both with and without nicotine, during and after pregnancy affected the cognitive abilities of the offspring. The findings revealed impairments in short-term memory and a decrease in anxiety levels.[30,33,34]

Herbal cigarettes produce tar and carbon monoxide. Research has shown that alternative cigarettes are not safe as they deliver more tar than nicotine, carbon monoxide and thus are worse than regular tobacco products and later may lead to tobacco smoking and addiction.[35] Furthermore, Table 2 summarizes the short-term and long-term effects of tobacco alternatives.

Table 2: Potential harmful effects of tobacco alternatives

Aspect	*Short-term effects*	*Long-term effects*
E-cigarettes	Increased risk of lung cancer, heart disease, and cancer.	Potential long-term cardiovascular and respiratory risks.
	Problems with brain and heart health.	Uncertain impact on lung function and carcinogenic effects.
	Chemicals associated with lung diseases.	Possible renormalization and reglamorization of smoking.
Smokeless tobacco products	Increased risk of cancer and heart disease.	Continued risk of cancer and heart disease with prolonged use.
Heated tobacco products	Higher concentrations of nicotine, tar, and carbon monoxide.	Cancer-causing chemicals and high addiction potential.
	Improved lung function, reduced teeth staining, and better breath.	Not risk-free; potential for addiction and nicotine poisoning.
General considerations	Switching to smoke-free products may offer short-term benefits.	All tobacco and vapor products, including alternatives, carry health risks.
	Short-term exposure to lower carbon monoxide levels.	Increased risk of addiction and potential for nicotine poisoning.
	Benefits like easier breathing within days of switching.	Overall health risks must be considered despite short-term benefits.

Discussion and Conclusion

The present paper will provide an impetus for the researchers to explore further on the perspective of alternative methods of tobacco smoking. It will also provide some essential leads to implement measures to mitigate the impact of alternative forms of tobacco usage on human health.

The e-cigarettes, which were perceived as a safer substitute for traditional cigarettes are not entirely devoid of harmful elements. While they lack combustion byproducts and contain minimal amounts of specific harmful compounds like carbon monoxide and tobacco-specific nitrosamines, e-cigarettes can still introduce users to other potentially hazardous chemicals.[36] There has been a substantial rise in the use of e-cigarette use from 7,00,000 in 2013 to 2.9 million in 2017.[29,30] As both e-cigarettes and herbal cigarettes continue to gain popularity, addressing and monitoring their potential health risks through comprehensive research and regulatory measures become imperative. The evolving regulatory landscape and market dynamics will play pivotal roles in shaping the future of smoking alternatives in India. While alternative smoking may have some short-term benefits compared with traditional cigarettes, the long-term effects, including potential harm to cardiovascular and respiratory health, remain uncertain and require further research.[37] A cessation method is introduced to curb the number of fatalities related to tobacco use, whereas it has now resulted in newer forms of diseases that will take a substantial amount of time to decode and develop long-term implications on the human body. Smoking cessation practices have been put in place to control tobacco consumption, and that has created space for smoking alternatives in the market. The e-cigarettes and herbal cigarettes have gained particular impetus and have become popularized among the youth. Since the research on smoking alternatives is limited or ongoing, it is capable of creating a mirage of being safer than traditional tobacco smoking. Popularized as the "lesser evil," e-cigarettes have done more harm than good. To reduce exposure to second-hand e-cigarette aerosol, prohibiting e-cigarette use inside or near buildings, vehicles, and other enclosed spaces is recommended. Additional measures, such as ventilation, filtration, and air cleaning techniques, may also help reduce the release of potentially hazardous substances from e-cigarette use. However, it is crucial to note that more research is needed to fully understand emissions from e-cigarettes and their impact on human health. Also, flavorings in tobacco products can be harmful, and they increase the risk of health problems like blood vessel damage and cancer.[38] Noteworthy to mention, the ongoing National Tobacco Control Programme lay emphasis on raising awareness, reducing tobacco use, implementing WHO strategies, training, setting up cessation facilities, and school awareness programs. However, it has to be seen how these measures are implemented in the upcoming years.

References

1. Institute of Health Metrics. Global burden of disease [Internet]. Washington, DC: Institute of Health Metrics; 2019. Available from: https://www.healthdata.org/research-analysis/gbd. Accessed on December 17, 2023.
2. WHO. WHO global report on trends in prevalence of tobacco use 2000–2025. 4th ed. Geneva: WHO; 2021.
3. Sharma AD, Raghavan R, Garg S, et al. Challenges of secondhand smoke: Are we asking the right questions? Indian J Commun Health 2023;35(1):4–8. DOI: 10.47203/IJCH.2023.v35i01.002.
4. Mishra GA, Pimple SA, Shastri SS. An overview of the tobacco problem in India. Indian J Med Paediatr Oncol 2012;33(03):139–145. DOI: 10.4103/0971-5851.103139.
5. Campaign for tobacco-free kids. The toll of tobacco in India [Internet]. 2017. Available from: https://www.tobaccofreekids.org/problem/toll-global/asia/india.
6. Martins-Green M, Adhami N, Frankos M, et al. Cigarette smoke toxins deposited on surfaces: Implications for human health. PLoS One 2014;9(1):e86391. DOI: 10.1371/journal.pone.0086391.
7. John RM, Sinha P, Munish VG, et al. Economic costs of diseases and deaths attributable to tobacco use in India, 2017–2018. Nicotine Tob Res 2021;23(2):294–301. DOI: 10.1093/ntr/ntaa154.
8. Andersen AJ, Hecker I, Wallez S, et al. Are we equally at risk of changing smoking behavior during a public health crisis? Impact of educational level on smoking from the TEMPO cohort. BMC Public Health 2023;23(1):1016. DOI: 10.1186/s12889-023-15799-1.
9. Heydari G, Masjedi M, Ahmady AE, et al. A comparative study on tobacco cessation methods: A quantitative systematic review. Int J Prev Med 2014;5(6):673–678. PMID: 25013685.
10. Popova L, Ling PM. Alternative tobacco product use and smoking cessation: A national study. Am J Public Health 2013;103(5):923–930. DOI: 10.2105/AJPH.2012.301070.
11. WHO. WHO framework convention on tobacco control [Internet]. Available from: https://www.who.int/tobacco/framework/WHO_FCTC_english.pdf.
12. Legislation by country/jurisdiction India [Internet]. Available from: https://www.tobaccocontrollaws.org/files/live/India/India%20.%20COTPA%20.%20national.pdf.
13. Smoking alternatives [Internet]. Mouthhealthy.org. [cited 2024 Mar 17]. Available from: https://www.mouthhealthy.org/all-topics-a-z/smoking-alternatives.
14. Tobacco and nicotine products: Old, new & dangerous for kids [Internet]. Healthychildren.org [cited 2024 Mar 17]. Available from: https://www.healthychildren.org/English/health-issues/conditions/tobacco/Pages/Alternative-Forms-of-Tobacco.aspx.
15. Gravely S, Yong H-H, Reid JL, et al. An examination of quitting smoking as a reason for vaping by the type of nicotine vaping device used most often among adults who smoke and vape: Findings from the Canada, England and the United States 2020 ITC Smoking and Vaping Survey. Prev Med Rep 2023;33:102201. DOI: 10.1016/j.pmedr.2023.102201.
16. American Lung Association. What's in an E-cigarette? [Internet]. Lung.org [cited 2024 Mar 17]. Available from: https://www.lung.org/quit-smoking/e-cigarettes-vaping/whats-in-an-e-cigarette.
17. Jaswal N, Bhatt G, Goel S. Awareness of electronic cigarettes in India: Findings from the 2016–2017 Global Adult Tobacco Survey (GATS). Tob Prev Cessat 2023;9:03. DOI: 10.18332/tpc/156446.
18. India: E-cigarette and vaping sales volume [Internet]. Statista [cited 2024 Mar 17]. Available from: https://www.statista.com/statistics/1189383/india-electronic-cigarette-and-vaping-sales-volume/.
19. Psmarketresearch.com [Internet]. 2024. Available from: https://www.psmarketresearch.com/market-analysis/india-e-cigarette-market.
20. Sharan RN, Chanu TM, Chakrabarty TK, et al. Patterns of tobacco and e-cigarette use status in India: A cross-sectional survey of 3000 vapers in eight Indian cities. Harm Reduct J 2020;17(1):21. DOI: 10.1186/s12954-020-00362-7.
21. Mohanty VR, Chahar P, Balappanavar AY, et al. Electronic nicotine delivery systems (ENDS): Mapping the Indian online retail market. Nicotine Tob Res 2017;19(11):1386–1389. DOI: 10.1093/ntr/ntx044.
22. 6Wresearch. India E-cigarette market [Internet]. 6wresearch.com [cited 2024 Mar 17]. Available from: https://www.6wresearch.com/industry-report/india-e-cigarette-market-2019-2025-e-cig-forecast-by-device-type-demography-distribution.
23. Znyk M, Jurewicz J, Kaleta D. Exposure to heated tobacco products and adverse health effects, a systematic review. Int J Environ Res Public Health 2021;18(12):6651. DOI: 10.3390/ijerph18126651.
24. Upadhyay S, Rahman M, Johanson G, et al. Heated tobacco products: Insights into composition and toxicity. Toxics 2023;11:667. DOI: 10.3390/toxics11080667.

25. Glasser AM, Collins L, Pearson JL, et al. Overview of electronic nicotine delivery systems: A systematic review. Am J Prev Med 2017;52(2):e33–e66. DOI: 10.1016/j.amepre.2016.10.036.
26. Royal Swag ayurvedic & herbal cigarette Frutta nicotine free & tobacco free cigarettes [Internet]. Accessed on 2020 Jun 02. Available from: https://www.amazon.in/dp/B07J5KY683/ref=sspa_dk_detail_3?psc=1&pd_rd_i=B07J5KY683&pd_rd_w=ilgqB&pf_.
27. Bak JH, Lee SM, Lim HB. Safety assessment of mainstream smoke of herbal cigarette. Toxicol Res 2015;31(1):41–48. DOI: 10.5487/TR.2015.31.1.041.
28. Rahman RTA, Kamal N, Mediani A, et al. How do herbal cigarettes compare to tobacco? A comprehensive review of their sensory characters, phytochemicals, and functional properties. ACS Omega 2022;7(50):45797–45809. DOI: 10.1021/acsomega.2c04708.
29. Marques P, Piqueras L, Sanz M-J. An updated overview of e-cigarette impact on human health. Respir Res 2021;22(1):151. DOI: 10.1186/s12931-021-01737-5.
30. Glantz SA, Bareham DW. E-cigarettes: Use, effects on smoking, risks, and policy implications. Annu Rev Public Health 2018;39:215–235. DOI: 10.1146/annurev-publhealth-040617-013757.
31. Farsalinos K. Electronic cigarettes: An aid in smoking cessation, or a new health hazard? Ther Adv Respir Dis 2018;12:1753465817744960. DOI: 10.1177/1753465817744960.
32. Dai H, Leventhal AM. Prevalence of e-cigarette use among adults in the United States, 2014–2018. JAMA 2019;322(18):1824–1827. DOI: 10.1001/jama.2019.15331.
33. Ruszkiewicz JA, Zhang Z, Gonçalves FM, et al. Neurotoxicity of e-cigarettes. Food Chem Toxicol 2020;138:111245. DOI: 10.1016/j.fct.2020.111245.
34. Irusa KF, Vence B, Donovan T. Potential oral health effects of e-cigarettes and vaping: A review and case reports. J Esthet Restor Dent 2020;32(3):260–264. DOI: 10.1111/jerd.12583.
35. Gan Q, Yang J, Yang G, et al. Chinese "herbal" cigarettes are as carcinogenic and addictive as regular cigarettes. Cancer Epidemiol Biomarkers Prev 2009;18(12):3497–3501. DOI: 10.1158/1055-9965.EPI-09-0620.
36. Ye D, Rahman I. Emerging oral nicotine products and periodontal diseases. Int J Dent 2023;2023:9437475. DOI: 10.1155/2023/9437475.
37. Robichaud MO, Seidenberg AB, Byron MJ. Tobacco companies introduce "tobacco-free" nicotine pouches. Tob Control 2020;29(e1):e145–e146. DOI: 10.1136/tobaccocontrol-2019-055321.
38. Kaur G, Muthumalage T, Rahman I. Mechanisms of toxicity and biomarkers of flavoring and flavor enhancing chemicals in emerging tobacco and non-tobacco products. Toxicol Lett 2018;288:143–155. DOI: 10.1016/j.toxlet.2018.02.025.