

Review Article

Impact of Tobacco and Electronic Nicotine Delivery Systems on Periodontal Health

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Abstract: Tobacco smoking remains one of the most significant risk factors influencing the susceptibility to and progression of periodontal disease, as it adversely affects host immune response and compromises treatment outcomes. Emerging evidence suggests that electronic nicotine delivery systems (ENDS) may exert biological effects on oral tissues comparable to those associated with conventional tobacco smoking. The use of ENDS has risen markedly in recent years, particularly among adolescents and current or former tobacco users. This growing prevalence underscores the urgent need to increase awareness among healthcare professionals and the general population regarding the risks associated with nicotine exposure and its potential impact on oral health. Tobacco use continues to represent a substantial global public health burden. This narrative review provides a comprehensive overview of tobacco and nicotine-containing products, highlighting their role in the pathogenesis of periodontal disease and discussing their implications for clinical management.

Keywords: Tobacco, Nicotine, Periodontium, Periodontal Disease, Toxicity, Electronic Nicotine Delivery Systems.

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INTRODUCTION

Periodontal health is defined as the absence of inflammatory periodontal disease, meaning no clinical signs of gingivitis, periodontitis, or other periodontal conditions. The European Federation of Periodontology (EFP) has identified modifying factors defined as agents or conditions that alter an individual's response to subgingival biofilm including systemic diseases, tobacco use, and certain medications (Vargas Casillas & Yáñez Ocampo, 2021).

Tobacco use remains the leading cause of preventable morbidity and mortality worldwide, surpassing all other behavioral risk factors. Its harmful effects extend to oral health, where tobacco users exhibit a higher prevalence of periodontal diseases and often demonstrate poorer responses to periodontal therapy compared with non-smokers (Chaffee *et al.*, 2021).

In recent years, nicotine-containing products have diversified, with electronic cigarettes emerging as one of the most widely used alternatives to conventional tobacco products. Over the past decade, these devices have experienced a marked increase in popularity and are

frequently perceived as a less harmful alternative to traditional smoking. Some evidence also suggests that they may assist in smoking cessation, although their long-term health effects remain under investigation (Holliday *et al.*, 2021).

From an epidemiological perspective, tobacco consumption continues to represent a significant public health concern. According to the 2022 National Health and Nutrition Survey (ENSANUT), the prevalence of tobacco use among adolescents in Mexico was 4.6%, with higher rates reported in males (6.7%) than in females (2.5%). Additionally, 3.7% of adolescents reported the use of electronic cigarettes. Among adults, tobacco consumption remains considerable, reinforcing the persistent burden of nicotine-related products on population health (González & Fernández, 2018).

Several studies have examined the association between different tobacco products and periodontal conditions. Evidence indicates that various patterns of tobacco use are linked to a higher prevalence of gingival disease and poorer periodontal health compared with individuals who have never smoked. These findings are consistent with previous research demonstrating a strong

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relationship between tobacco exposure and the development and progression of gingival and periodontal diseases (Vora & Chaffee, 2019).

Therefore, the aim of this review is to identify and synthesize the effects of tobacco product use on periodontal health. To achieve this objective, a literature search was conducted in the PubMed/MEDLINE database, and 27 articles published between 2019 and 2024 met the predefined inclusion criteria.

Electronic Nicotine Delivery Systems (ENDS): Characteristics and Public Health Concerns

ENDS are devices composed of a power source, a heating element, and a reservoir or cartridge containing a liquid solution with nicotine and flavoring agents. Their popularity has increased substantially, particularly among young adults aged 18 to 24 years, a trend partly attributed to marketing strategies in retail settings and social media platforms. Nicotine exposure during brain development may lead to long-term neurobiological changes, increasing susceptibility to addiction (Kumar *et al.*, 2019; Rahal *et al.*, 2019).

Battery malfunction in electronic cigarettes has been associated with explosions and burns affecting the oral cavity. These findings highlight the need for public health policies that promote smoking cessation while restricting marketing strategies, such as point-of-sale product displays that may undermine efforts to quit (Rossheim *et al.*, 2019; Mantey *et al.*, 2019).

Effects on the Periodontal Microbiota

Toxic substances present in tobacco smoke alter the immune system. Tobacco smoke contains small amounts of microbial components, including bacterial lipopolysaccharide (LPS), which may further modulate host immune responses to exogenous antigens. These elements promote chronic inflammation of the mucosal membranes and alter the innate immune response to foreign substances. The effects on immunity may be both inflammatory and suppressive, and the overall outcome depends on several factors, including the quantity and type of tobacco used, the route of exposure, and the presence of other interacting factors that influence immune cell function. Furthermore, tobacco smoke negatively affects the immune response in the oral cavity, contributing to the development of periodontal disease and oral cancer (Lee *et al.*, 2012).

Smoking is known to have significant effects on the oral microbiota, which may contribute to the deterioration of oral health. Under normal conditions, the oral cavity harbors hundreds of bacterial species—both commensal and pathogenic—that form well-balanced polymicrobial communities adhering to oral surfaces as biofilms. However, the persistent habit of smoking disrupts this microbial balance. Common commensal streptococcal species include *Streptococcus gordonii*, *Streptococcus mitis*, and *Streptococcus oralis*. These

microorganisms live in symbiosis with the host and act as antagonists against pathogenic strains. Several studies have shown that smoking reduces salivary flow, alters its composition, and lowers salivary pH, thereby promoting the proliferation of *Streptococcus mutans* and *Porphyromonas gingivalis*. In dental caries, *S. mutans* plays a predominant role in its development, whereas *P. gingivalis* is strongly associated with the progression of periodontitis. (Nelson *et al.*, 2019).

Based on demographic data and tobacco-related habits, including the use of electronic cigarettes (vaping devices), oral colonization by *Candida albicans* was found to be significantly higher among conventional cigarette smokers and electronic cigarette users compared with individuals who had never smoked. These findings highlight the importance of investigating the effects of vaping on oral health. Although electronic nicotine delivery systems (ENDS) are often considered a less harmful alternative to conventional tobacco, they may still disrupt the oral microbial balance and promote opportunistic infections such as candidiasis (Mokeem *et al.*, 2019).

Infection with *Porphyromonas gingivalis* is observed in most individuals, regardless of smoking status. In contrast, *Treponema denticola* infection shows a higher prevalence among smokers. Smoking cessation in patients with periodontal disease may contribute to restoring a more favorable microbial balance, which is essential for maintaining oral health (Hanioka *et al.*, 2019).

Saliva is the first biological fluid to come into contact with tobacco smoke and electronic cigarette aerosols and plays a critical role as a primary defensive barrier against potentially harmful chemical and microbial components. Both smoking and vaping can alter the salivary microbiota, reduce its antibacterial properties, and promote the growth of pathogenic microorganisms. This microbial imbalance not only negatively affects the oral cavity but may also have systemic implications. Some studies have reported reductions in diastolic blood pressure and pulse rate, possibly related to the vasodilatory effects of nicotine and other chemical compounds present in these products. (Cichońska *et al.*, 2019; Veldheer *et al.*, 2019).

Effects on the Periodontium and Adverse Symptoms

Electronic cigarettes may cause visible changes in tooth color, affecting dental aesthetics. The aerosol generated from e-liquids containing varying levels of nicotine and flavoring agents has been shown to alter enamel color. For example, menthol- and tobacco-flavored e-liquids may reduce the yellowish tone of enamel compared with unflavored liquids, whereas conventional tobacco smoke is more commonly associated with enamel staining (Pintado-Palomino *et al.*, 2019).

Among individuals who smoke, the most frequently reported symptoms include cough, dry mouth or throat irritation, dizziness, headache, shortness of breath, and altered taste perception. Tobacco use has also been associated with changes in the oral mucosa and the oral microbiome. A nationally representative cross-sectional telephone survey conducted among 4,964 U.S. adults aged 18 years and older found that most electronic cigarette users reported at least one symptom, most commonly cough, dry mouth, and throat irritation (King *et al.*, 2019). Individuals who had quit smoking and were using electronic cigarettes were less likely to report adverse symptoms compared with current smokers; however, differences were also observed when compared with never-smokers (King *et al.*, 2019; Yang *et al.*, 2020).

Cytotoxic substances released during tobacco inhalation directly affect the periodontium through exposure to smoke and indirectly through harmful compounds transported via the bloodstream. These substances induce both local and systemic alterations that exert a cumulative effect on periodontal tissues. Their impact is generally described through three principal mechanisms: microbiological, immunological, and physiological (Vora & Chaffee, 2019).

Clinical and radiographic parameters associated with periodontal and peri-implant health tend to be more unfavorable in both electronic cigarette users and conventional smokers compared with non-smokers. Additionally, elevated levels of proinflammatory cytokines (IL-1, IL-6, IL-8, TNF- α , IL-12, IFN- γ , and IL-18) have been reported in these individuals (Huilgol *et al.*, 2019).

Interaction of Inflammatory Cytokines and Immunological Changes Associated with Tobacco and ENDS Use

Cytokines play a central role in the inflammatory processes associated with tobacco use.

Interleukin-1 β (IL-1 β) promotes both local and systemic inflammation by activating macrophages and recruiting inflammatory cells. Interleukin-6 (IL-6) exhibits both proinflammatory and anti-inflammatory properties, and elevated levels have been associated with cardiovascular and pulmonary diseases in smokers. Interleukin-8 (IL-8), a chemokine responsible for neutrophil recruitment, contributes to tissue damage in the respiratory system. Tumor necrosis factor-alpha (TNF- α), which increases with tobacco exposure, promotes pulmonary tissue destruction and is involved in the development of chronic obstructive pulmonary disease (COPD). Interleukin-12 (IL-12) and interferon-gamma (IFN- γ) further aggravate chronic inflammation through activation of T cells and macrophages, while interleukin-18 (IL-18) stimulates the production of IFN- γ and other cytokines. Collectively, these immunological alterations are associated with chronic lung damage, increased cardiovascular risk, oxidative stress, and exacerbation of generalized tissue injury (de Oliveira *et al.*, 2012).

Tobacco use and vaping have significant effects on periodontal health, including alterations in the oral microbiota and immune response. Vaping has been shown to negatively affect periodontal tissues through the release of toxic metals such as nickel, lead, and chromium from device components, directly influencing inflammation and tissue repair (Rule & Olmedo, 2018). Chronic exposure to these metals may induce vascular inflammation, increase oxidative stress, and impair endothelial function, all of which are key factors in the development of cardiovascular and periodontal damage. Inhalation of metal contaminated aerosols can also trigger systemic inflammatory responses that may exacerbate pre-existing inflammatory conditions, including periodontal diseases (Rule & Olmedo, 2018).

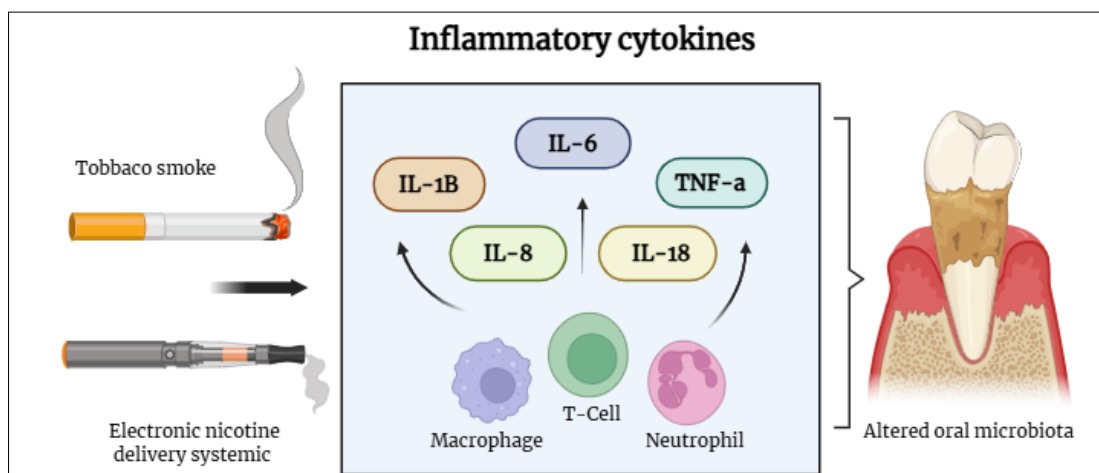


Fig. 1: Interaction of inflammatory cytokines associated with tobacco smoke and electronic nicotine delivery systems (ENDS)

DISCUSSION

The Experimental Tobacco Marketplace, an online research platform designed to simulate purchasing behaviors using a virtual budget, has provided valuable insights into tobacco product consumption patterns. This tool allows researchers to evaluate potential harm reduction strategies and assess how alternative nicotine products, including electronic cigarettes, may influence smokers' decisions to substitute or reduce conventional cigarette consumption (DeHart *et al.*, 2019).

An increasing body of evidence suggests that some adult smokers use electronic cigarettes in attempts to quit smoking or reduce conventional cigarette consumption (Berry *et al.*, 2019). However, electronic cigarette use has also been associated with poorer perceptions of physical and mental health, particularly among younger adults. Vaping has been linked to negative self-reported health status, reduced emotional support, dissatisfaction, and perceived stress. Nicotine exerts multiple effects on the central nervous system that explain its highly addictive nature. One of its primary mechanisms involves stimulation of dopamine release, producing sensations of pleasure and well-being. This neurochemical response plays a central role in the development of nicotine dependence (Al Rifai *et al.*, 2020).

This phenomenon may represent an emerging public health concern associated with tobacco and nicotine product use. Its impact extends beyond pulmonology and involves multiple medical disciplines that were not previously directly associated with tobacco-related conditions (Tzortzi *et al.*, 2020).

Due to the well-established health risks of smoking, many countries have implemented tobacco control policies that restrict or prohibit tobacco use in public spaces. These measures not only protect non-smokers from secondhand smoke exposure but also create supportive environments for individuals attempting to quit smoking (Jeong *et al.*, 2020).

The impact of tobacco and vaping on periodontal health remains a subject of ongoing debate. Both conventional tobacco products and ENDS pose significant threats to periodontal tissues, although through partially distinct mechanisms. This literature review synthesizes current evidence regarding the global effects of these substances on periodontal health.

Given this evidence, it is essential for dental professionals to be well informed about the risks associated with tobacco and nicotine-containing products. Understanding their impact on periodontal health is critical for early identification of at-risk patients, appropriate risk assessment, and the implementation of preventive and therapeutic strategies aimed at reducing tobacco-related oral health complications.

CONCLUSION

The reviewed evidence indicates that both conventional cigarette smokers and electronic cigarette users are at increased risk of developing periodontal disease. Published reports highlight that tobacco smoke and electronic nicotine delivery systems exert similar periodontal and systemic effects. The European Federation of Periodontology (EFP) supports this position, emphasizing that both forms of nicotine consumption are harmful to oral and gingival health. It is essential that healthcare professionals are adequately trained to address these risks and to actively promote smoking and vaping cessation among their patients.

REFERENCES

- Al Rifai, M., Mirbolouk, M., Obisesan, O. H., Jia, X., Nasir, K., & Merchant, A. T. (2020). The association of electronic cigarette use and the subjective domains of physical and mental health: The Behavioral Risk Factor Surveillance System survey. *Cureus*. <https://doi.org/10.7759/cureus.7088>
- Berry, K. M., Reynolds, L. M., Collins, J. M., Siegel, M. B., Fetterman, J. L., Hamburg, N. M., et al. (2019). E-cigarette initiation and associated changes in smoking cessation and reduction: The Population Assessment of Tobacco and Health Study, 2013–2015. *Tobacco Control*. <https://doi.org/10.1136/tobaccocontrol-2017-054108>
- Chaffee, B. W., Couch, E. T., Vora, M. V., & Holliday, R. S. (2021). Oral and periodontal implications of tobacco and nicotine products. *Periodontology 2000*, 87(1), 241–253.
- Cichońska, D., Kusiak, A., Kočańska, B., Ochocińska, J., & Świetlik, D. (2019). Influence of electronic cigarettes on selected antibacterial properties of saliva. *International Journal of Environmental Research and Public Health*, 16(22), 4433. <https://doi.org/10.3390/ijerph16224433>
- de Oliveira, S. T., da Costa, I. P., & de Lima, E. V. (2012). Serum levels of TNF- α , IFN- γ , IL-6, IL-8, IL-12, IL-17, and IL-18 in patients with active psoriasis and correlation with disease severity. *Anais Brasileiros de Dermatologia*, 87(6), 857–861. <https://doi.org/10.1590/S0365-05962012000600002>
- DeHart, W. B., Mellis, A. M., Kaplan, B. A., Pope, D. A., & Bickel, W. K. (2019). The Experimental Tobacco Marketplace: Narratives engage cognitive biases to increase electronic cigarette substitution. *Drug and Alcohol Dependence*, 197, 203–211. <https://doi.org/10.1016/j.drugalcdep.2019.01.020>
- González, C., & Fernández, E. (2018). Epidemiología del cigarrillo electrónico: La llegada de JUUL. *Open Respiratory Archives*, 2(3), 107–112.
- Hanioka, T., Morita, M., Yamamoto, T., Inagaki, K., Wang, P. L., & Ito, H. (2019). Smoking and

- periodontal microorganisms. *Japanese Dental Science Review*, 55(1), 88–94. <https://doi.org/10.1016/j.jdsr.2019.03.002>
- Holliday, R., Chaffee, B. W., Jakubovics, N. S., Kist, R., & Preshaw, P. M. (2021). Electronic cigarettes and oral health. *Journal of Dental Research*.
 - Huilgol, P., Bhatt, S. P., Biligowda, N., Wright, N. C., & Wells, J. M. (2019). Association of e-cigarette use with oral health: A population-based cross-sectional questionnaire study. *Journal of Public Health*, 41(2), 354–361. <https://doi.org/10.1093/pubmed/fdy082>
 - Jeong, W., Choi, D. W., Kim, Y. K., Lee, H. J., Lee, S. A., Park, E. C., et al. (2020). Associations of electronic and conventional cigarette use with periodontal disease in South Korean adults. *Journal of Periodontology*, 91(1), 55–64. <https://doi.org/10.1002/JPER.19-0060>
 - Kanmaz, B., Lamont, G., Danacı, G., Gogeneni, H., Buduneli, N., & Scott, D. (2019). Microbiological and biochemical findings in relation with clinical periodontal status in active smokers, non-smokers and passive smokers. *Tobacco Induced Diseases*, 17. <https://doi.org/10.18332/tid/104492>
 - King, J. L., Reboussin, B. A., Wiseman, K. D., Ribisl, K. M., Seidenberg, A. B., Wagoner, K. G., et al. (2019). Adverse symptoms users attribute to e-cigarettes: Results from a national survey of US adults. *Drug and Alcohol Dependence*, 196, 9–13. <https://doi.org/10.1016/j.drugalcdep.2018.11.030>
 - Kumar, P. S., Clark, P., Brinkman, M. C., & Saxena, D. (2019). Novel nicotine delivery systems. *Advances in Dental Research*, 30(1), 11–15. <https://doi.org/10.1177/0022034519872475>
 - Lee, J., Taneja, V., & Vassallo, R. (2012). Cigarette smoking and inflammation: Cellular and molecular mechanisms. *Journal of Dental Research*, 91(2), 142–149.
 - Mantey, D. S., Pasch, K. E., Loukas, A., & Perry, C. L. (2019). Exposure to point-of-sale marketing of cigarettes and e-cigarettes as predictors of smoking cessation behaviors. *Nicotine & Tobacco Research*, 21(2), 212–219. <https://doi.org/10.1093/ntr/ntx246>
 - Mokeem, S. A., Abduljabbar, T., Al-Kheraif, A. A., Alasqah, M. N., Michelogiannakis, D., & Samaranayake, L. P. (2019). Oral *Candida* carriage among cigarette- and waterpipe-smokers, and electronic cigarette users. *Oral Diseases*, 25(1), 319–326. <https://doi.org/10.1111/odi.12902>
 - Nelson, J. M., Cuadra, G. A., & Palazzolo, D. L. (2019). A comparison of flavorless electronic cigarette-generated aerosol and conventional cigarette smoke on the planktonic growth of oral commensal streptococci. *International Journal of Environmental Research and Public Health*, 16(24), 5004. <https://doi.org/10.3390/ijerph16245004>
 - Pintado-Palomino, K., de Almeida, C. V. V. B., Oliveira-Santos, C., Pires-de-Souza, F. P., & Tirapelli, C. (2019). The effect of electronic cigarettes on dental enamel color. *Journal of Esthetic and Restorative Dentistry*, 31(2), 160–165. <https://doi.org/10.1111/jerd.12436>
 - Ralho, A., Coelho, A., Ribeiro, M., Paula, A., Amaro, I., Sousa, J., et al. (2019). Effects of electronic cigarettes on oral cavity: A systematic review. *Journal of Evidence-Based Dental Practice*, 19(4), 101318. <https://doi.org/10.1016/j.jebdp.2019.04.002>
 - Rossheim, M. E., Livingston, M. D., Soule, E. K., Zeraye, H. A., & Thombs, D. L. (2019). Electronic cigarette explosion and burn injuries, US emergency departments 2015–2017. *Tobacco Control*, 28(4), 472–474. <https://doi.org/10.1136/tobaccocontrol-2018-054518>
 - Rule, A. M., & Olmedo, P. (2018). Lead and other toxic metals found in e-cigarette vapors. *Johns Hopkins Bloomberg School of Public Health*.
 - Tzortzi, A., Kapetanstrataki, M., Evangelopoulou, V., & Behrakis, P. (2020). A systematic literature review of e-cigarette-related illness and injury. *International Journal of Environmental Research and Public Health*, 17(7), 2248. <https://doi.org/10.3390/ijerph17072248>
 - Vargas Casillas, A. P., & Yáñez Ocampo, B. R. (2021). Clasificación de enfermedades y condiciones periodontales y periimplantarias 2018. *Universidad Odontológica*, 25(1), 12–25.
 - Veldheer, S., Yingst, J., Midya, V., Hummer, B., Lester, C., Krebs, N., et al. (2019). Pulmonary and other health effects of electronic cigarette use among adult smokers participating in a randomized controlled trial. *Addictive Behaviors*, 91, 95–101. <https://doi.org/10.1016/j.addbeh.2018.10.041>
 - Vora, M. V., & Chaffee, B. W. (2019). Tobacco-use patterns and self-reported oral health outcomes. *Journal of the American Dental Association*, 150(5), 332–344. <https://doi.org/10.1016/j.adaj.2018.12.004>
 - Yang, I., Sandeep, S., & Rodriguez, J. (2020). The oral health impact of electronic cigarette use: A systematic review. *Critical Reviews in Toxicology*, 50(2), 97–127. <https://doi.org/10.1080/10408444.2020.1713726>

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