



Nicotine-Induced Biological Masking and Oral Health: Investigating Diagnostic Silence and Disease Progression Among Young E-Cigarette Users

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Abstract

The increasing use of electronic nicotine delivery systems (ENDS) among adolescents has raised concerns about nicotine dependence and oral health. This review examines how repeated vaping and nicotine-induced physiological changes may contribute to a state of “diagnostic silence,” in which oral disease progresses without being fully recognized by the user. Chemically complex e-cigarette aerosols can generate reactive oxygen species that contribute to oxidative stress and cellular damage, while nicotine-induced vasoconstriction can reduce visible inflammatory signs such as gingival bleeding. This biological masking may contribute to a perception gap between how young users assess their oral health and their clinical condition. In one study of young e-cigarette users in Pakistan, most participants rated their dental health positively despite objective clinical evidence of dental and periodontal disease. Evidence from other populations also indicates substantial oral health concerns among e-cigarette users. Together, these findings suggest that nicotine dependence, biological masking, and limited risk awareness may allow oral deterioration to progress while reducing users’ recognition of their own risk. This highlights the importance of proactive dental assessment and communication that helps young users understand that the absence of noticeable symptoms does not necessarily indicate good oral health.

Introduction

Electronic nicotine delivery systems (ENDS), commonly referred to as vapes, present a growing concern for youth oral health because many users perceive them as a safer alternative to traditional tobacco, largely due to the absence of plant material combustion. The vaporization process exposes users to chemically complex aerosols and nicotine that disrupt biological processes within the oral cavity at the cellular level (Iacob et al., 2024). Despite these physiological risks, ENDS use has become increasingly common among adolescents and young adults. Currently, 20.6% of young adults aged 18-24 in Victoria, Australia, have reported vaping, illustrating the widespread use of ENDS among younger populations (Better Health Victoria, n.d.). Adolescents and young adults in the US and Europe exhibit similar patterns, indicating that vaping has transitioned from an emerging behavior to a common habit among younger groups (Gentzke et al., 2019; Kristjansson et al., 2019).

The most alarming aspect of youth vaping is that changes such as microbial imbalance, impaired tissue maintenance, and periodontal inflammation may develop before the individual notices any changes in their mouth. Khattak et al. (2024) reported a significant disparity between self-perception and objective findings, with over four-fifths of young vapers rating their dental health positively despite presenting with measurable indicators of oral disease.

The oral cavity contains both hard tissues, such as the teeth, and soft tissues that support and protect them. One of these tissues is the gingiva, or gum tissue, which surrounds the teeth and

helps protect the underlying periodontal structures. Together, saliva, oral microorganisms, immune responses, and tissue repair contribute to oral homeostasis, the stable biological environment required to maintain oral health. Disruptions to this balance, including microbial imbalance and impaired tissue maintenance, may develop before individuals notice changes in their oral health. This disconnect between perceived and clinical oral health status poses a significant challenge for prevention of vaping-associated oral disease, since individuals do not recognize the necessity to change their habits. However, nicotine dependence can reinforce repeated vaping behaviors, increasing exposure to aerosols and gradually disrupting these protective mechanisms, allowing biological changes to accumulate before noticeable deterioration occurs (Iacob et al., 2024).

This review will analyze how vaping status and nicotine dependence influence oral health outcomes by demonstrating that the risk of ENDS use extends beyond direct exposure to aerosol components. It first examines the cellular and physiological mechanisms through which vaping disrupts oral tissues, including oxidative stress, inflammatory dysfunction, microbial imbalance, and impaired salivary function. Drawing on clinical findings from Khattak et al. (2024), this review addresses a gap in current research by examining the connection between nicotine-induced biological masking and the resultant behavioral perception gap among young users. While existing research has documented both vaping-related oral damage and users' perceptions of their oral health, less attention has been given to how these factors interact to create a state of 'diagnostic silence,' allowing disease to progress without being recognized. By connecting physiological changes, nicotine dependence, and risk perception, this review highlights the importance of clinical risk transparency for the prevention of vaping-associated oral disease, specifically the accumulation of periodontal damage and dental caries, among young e-cigarette users across different populations.

I. Physiological Impact of Vaping on Oral Health

The physiological impact of vaping begins with the direct exposure of oral tissues to aerosolized nicotine and other chemical constituents. Repeated exposure can disrupt cellular function, oxidative balance, salivary protection, and the microbial environment of the oral cavity, creating conditions that may contribute to disease development before obvious clinical changes become apparent (Iacob et al., 2024; Aljoghaiman et al., 2026).

Chemical Exposure and Disruption of the Oral Environment

Vaping can disrupt the oral environment through repeated exposure of oral tissues to chemically complex aerosols that interfere with normal cellular processes. Although e-cigarettes eliminate many toxic byproducts associated with tobacco combustion, heating e-liquids can still generate volatile organic compounds and reactive carbonyl compounds, including formaldehyde, acetaldehyde, and acrolein (Iacob et al., 2024; Aljoghaiman et al., 2026). These compounds can increase the production of reactive oxygen species (ROS), creating oxidative stress when the resulting cellular damage exceeds the oral tissues' antioxidant defenses (Iacob et al., 2024). This is important because the harm is not limited to the presence of chemicals in the mouth; repeated exposure can begin changing how oral cells function and maintain themselves.

At the cellular level, excessive ROS can damage proteins, lipids, and DNA, interfering with the processes required for cell survival, repair, and tissue maintenance (Iacob et al., 2024). DNA damage is particularly relevant because oral tissues must continuously replace and repair cells to maintain the barriers that protect the oral cavity. When oxidative damage accumulates, these repair processes can become less effective, placing greater stress on cells and reducing their ability to maintain healthy tissue (Iacob et al., 2024). In this way, repeated aerosol exposure can shift the oral cavity from a state of normal maintenance toward one in which cellular damage is occurring faster than tissues can adequately recover. This helps explain why vaping-related effects may begin at the cellular level before more obvious clinical deterioration becomes apparent.

These cellular changes can also extend beyond individual cells by altering the conditions that normally keep the oral environment stable. Sustained oxidative stress has been associated with microbial dysbiosis, an imbalance in which disease-associated microorganisms become more prominent relative to a healthy microbial community (Iacob et al., 2024; Aljoghaiman et al., 2026). At the same time, reduced salivary flow and altered salivary function are vaping consequences that can limit the mouth's ability to buffer acids, remove microorganisms, and support tissue maintenance (Khattak et al., 2024; Iacob et al., 2024). The significance of these changes is that several protective mechanisms can become impaired at the same time: cells are experiencing greater oxidative stress while saliva becomes less effective at maintaining the conditions needed for oral homeostasis. Together, these processes create an environment increasingly favourable to microbial imbalance and disease development.

Once oral homeostasis is disrupted, the oral cavity becomes less capable of protecting itself against pathogenic microorganisms. Unregulated saliva production, reduced flow, and xerostomia prevent the oral tissues from naturally repairing, buffering excessive acids, remineralizing the tissues, and removing bacteria from the oral cavity (Khattak et al., 2024; Iacob et al., 2024). As these protective mechanisms weaken, cariogenic bacteria such as *Streptococcus mutans* can proliferate in the biofilm and cause an increase in dental caries (Aljoghaiman et al., 2026). Bacterial attachment may be promoted further through flavouring and other components by creating sticky surface deposits that encourage biofilm accumulation (Better Health Victoria, n.d.; Maple Dental Health, 2024). Importantly, many of these changes occur at the cellular and microbial level before producing obvious clinical symptoms, meaning that oral tissues may already be experiencing oxidative damage, impaired maintenance, and microbial disruption while the changes remain difficult for users to recognize. However, the limited visibility of this damage is not only because many changes occur at the cellular level. Nicotine can also alter blood flow and inflammatory responses within the gingiva, reducing some of the clinical signs that might otherwise draw attention to developing tissue damage. This relationship between ongoing biological disruption and reduced clinical visibility is examined in the following section (Aljoghaiman et al., 2026; Iacob et al., 2024).

Nicotine-Mediated Vascular Dysfunction and Inflammatory Changes

Maintaining healthy oral tissues depends on a coordinated immune response to the constant presence of dental biofilm. Inflammation is a normal protective response to microbial accumulation and tissue damage, in which inflammatory cytokines help coordinate immune

activity while increased blood flow allows immune cells such as neutrophils to reach affected tissues and support defense and repair (Iacob et al., 2024; Aljoghaiman et al., 2026).

Specific inflammatory mediators, including interleukin-1 β (IL-1 β) and interferon- γ , contribute to this immune response, while gingival fibroblasts support the maintenance and repair of periodontal tissues (Iacob et al., 2024; Khattak et al., 2024).

Nicotine-induced vasoconstriction reduces gingival blood flow, limiting the oxygen and nutrients available for normal tissue maintenance while also suppressing visible inflammatory responses such as gingival bleeding (Aljoghaiman et al., 2026; Maple Dental Health, 2024). In this review, biological masking refers to the process by which nicotine-induced vasoconstriction reduces visible signs of gingival inflammation, such as bleeding, potentially making underlying oral health problems less apparent during clinical examination. This suppression of visible inflammation does not mean that the underlying inflammatory process has stopped, as vapers have been found to exhibit increased concentrations of inflammatory biomarkers, including interleukin-1 β and interferon- γ , in gingival crevicular fluid (Figure 1) (Iacob et al., 2024). As a result, tissue injury and inflammation may continue while producing fewer of the clinical signs that would normally alert an individual to developing periodontal disease, contributing to the diagnostic silence examined in this review (Aljoghaiman et al., 2026; Maple Dental Health, 2024). Nicotine may also impair the function of gingival fibroblasts, periodontal ligament cells, and neutrophils, reducing the ability of these cells to repair damaged tissue and defend against pathogenic microorganisms (Aljoghaiman et al., 2026; Khattak et al., 2024). Consequently, periodontal disease may keep developing even after its most obvious clinical indicators lessen.

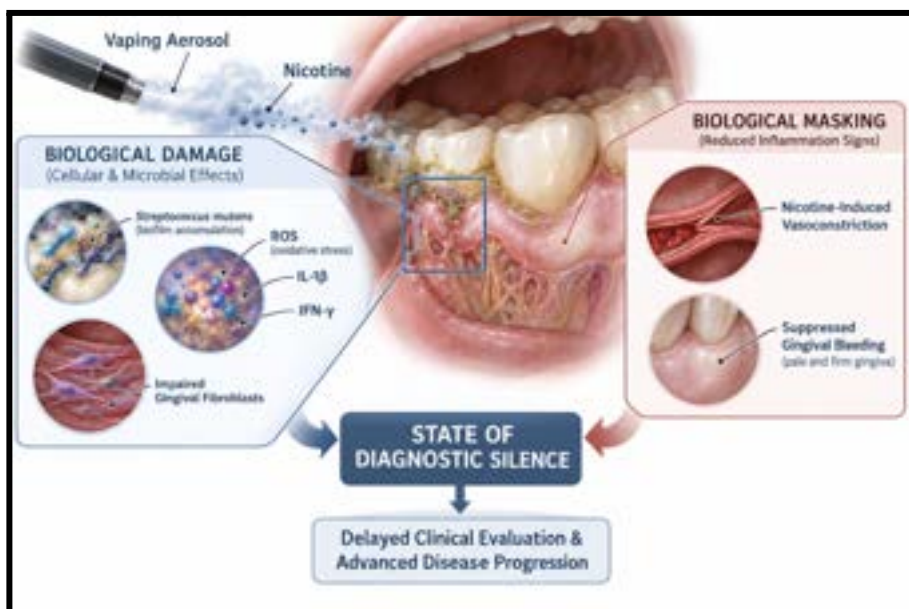


Figure 1: Proposed model of nicotine-induced biological masking and diagnostic silence. AI-generated illustration.

Clinical Manifestations and Disease Outcomes

Clinical evidence suggests that vaping is associated with measurable periodontal changes and a greater burden of dental caries among users. In a study conducted in Saudi Arabia among adults aged 18-65, periodontitis was diagnosed in 66.9% of the overall study population (Aljoghaiman et al., 2026). When the groups were examined separately, periodontitis affected 57.1% of exclusive e-cigarette users, compared with 35.0% of non-smokers. Exclusive e-cigarette users also had 4.74 times the adjusted odds of periodontal disease compared with non-smokers, although the wide confidence interval (95% CI: 0.84-26.80) makes this estimate uncertain.

Similar oral health concerns have also been documented among younger populations, particularly regarding dental caries. Decayed, Missing, and Filled Teeth (DMFT) is a metric that estimates the number of teeth that have been lost due to decay, required filling, or remained decayed (Yohana et al., 2021). According to the estimates provided by a study of young electronic cigarette users in Indonesia, participants had a mean DMFT score of 7.06, which indicates that these individuals experienced a considerable burden of dental caries despite being relatively young (Yohana et al., 2021). The study further identified additional oral health changes among vapers, including alterations in salivary characteristics and dental conditions, suggesting that vaping may contribute to an oral environment more susceptible to disease development (Yohana et al., 2021). Although the Yohana et al. (2021) study did not include a non-smoking control group for direct comparison, its findings remain valuable for demonstrating the extent of oral health problems observed among young e-cigarette users.

II. Nicotine Dependence as a Behavioral Driver

While the physiological effects of vaping contribute directly to oral tissue damage, nicotine dependence can sustain these effects by encouraging repeated and continued use. This section examines how adolescent brain development and changes in nicotine delivery, particularly the introduction of nicotine salts, can increase the potential for dependence among young users. It then considers how this dependence may contribute to behaviors that prolong exposure to the oral effects of vaping.

Developmental and Technological Foundations of Nicotine Dependence

Adolescence is an important period for studying nicotine dependence because the reward, impulsivity, and decision-making brain circuits are still developing (Hammond et al., 2021). At the same time, ENDS have evolved considerably, progressing through four generations that differ in their design and nicotine delivery (Burrowes et al., 2024). Early “first-generation” devices, or cigalikes, were designed to resemble traditional cigarettes but generally produced lower blood nicotine levels (Iacob et al., 2024). These were followed by second- and third-generation tank systems, which were larger, refillable, and allowed users to modify features such as power output and aerosol production (Iacob et al., 2024). Today, fourth-generation “pod mods,” such as JUUL, are the most commonly used type of ENDS among youth and typically use nicotine salt formulations (Hammond et al., 2021; Iacob et al., 2024). Unlike earlier freebase nicotine products, nicotine salts allow higher nicotine concentrations to be inhaled with less

throat irritation, making repeated use easier to maintain (Hammond et al., 2021; Iacob et al., 2024).

This major shift in device design is particularly relevant to adolescents because easier access to higher nicotine concentrations can support more frequent use and contribute to dependence (Hammond et al., 2021). This repeated exposure is especially relevant during adolescence because nicotine can affect developing neural pathways involved in reward and dependence, potentially making continued use more difficult to control (Hammond et al., 2021). Therefore, the evolution of ENDS has changed not only how nicotine is delivered, but also the potential for repeated exposure to become established during a period of developmental vulnerability.

This technological shift is important for oral health because increased nicotine delivery can make frequent vaping easier to maintain, transforming vaping from an occasional behavior into a pattern that can become embedded within daily routines (Hammond et al., 2021; Iacob et al., 2024). The concern is therefore not a single interaction between vaping aerosols and oral tissues, but the repeated cycle of use that gives biological disruptions more opportunity to persist.

Measures of dependence quantitatively represent how much vaping is incorporated into teenage behavior. In a longitudinal study examining Canadian and U.S. youth aged 16-19, 35.3% of Canadian participants and 46.1% of U.S. participants reported experiencing strong urges to vape on most days or more frequently (Hammond et al., 2021). Similarly, 48.3% of Canadian youth and 53.1% of U.S. youth reported feeling “a little” or “very addicted” to e-cigarettes (Hammond et al., 2021). These trends show that vaping behavior is not always controlled by conscious decision making alone. According to Khattak et al. (2024), 80.3% of juvenile vapers in their sample started vaping before the age of 18. Because frequent nicotine use during adolescence can establish patterns of dependence before individuals fully recognize the difficulty of reducing their use, early initiation is particularly significant.

Unsuccessful attempts to stop vaping further highlight how tough it is to break nicotine dependence. Approximately 25% to 27% of young vapers across Canada and the U.S reported making an unsuccessful attempt to quit vaping in the past year (Hammond et al., 2021). These attempts demonstrate a tension between identifying potential harm and being unable to curtail the behavior that causes it continuously. This creates an additional obstacle to behavioral adjustment (Aljoghaiman et al., 2026). In terms of oral health, this means that the same reliance that sustains frequent vaping may also permit the conditions causing harm to persist without immediate behavioral correction.

III. Behavioral Gap: Perception vs. Clinical Reality

A major challenge in understanding the oral effects of youth vaping is that clinical deterioration does not always align with how young users perceive their own health. This occurs because young individuals often judge their oral condition through visible changes or physical discomfort, while many effects related to vaping develop microscopically, gradually beneath the surface.

The Paradox of Self-Perceived Oral Health

While there is limited research on the self-awareness of oral health, a 2024 study has one of the best datasets, specifically on adolescents' perception gaps regarding vaping. In the cross-sectional evaluation of 142 electronic cigarette users aged 16–25 in Islamabad, Pakistan, Khattak et al. (2024) examined whether young users' perceptions of their oral health aligned with clinical measurements. The study identified a clear separation between perceived and measured oral health, revealing that many participants viewed their condition more positively than clinical assessments indicated.

Although 80.3% of participants rated their dental health as “good” and 71.8% reported positive perceptions of their periodontal health, clinical assessments revealed signs of existing oral health problems, including a mean DMFT score of 5.66, gingival bleeding in 47.2% of participants, and plaque accumulation in 35.3% of the sample (Figure 2) (Khattak et al., 2024). Notably, participants' self-assessments were not significantly associated with their clinical findings, including gingival bleeding ($p = 0.167$), plaque accumulation ($p = 0.233$), or DMFT score ($p = 0.420$). These findings highlight a gap between how participants perceived their oral health and what clinical examinations revealed. In general, people may rely on noticeable symptoms, such as pain, discomfort, or visible bleeding, to recognize a potential health problem. However, vaping-related oral changes may develop gradually, and nicotine-induced vasoconstriction can reduce visible signs of inflammation. Without obvious warning signs, users may assume their oral health is good despite underlying problems, allowing disease to progress without prompting them to seek professional evaluation.

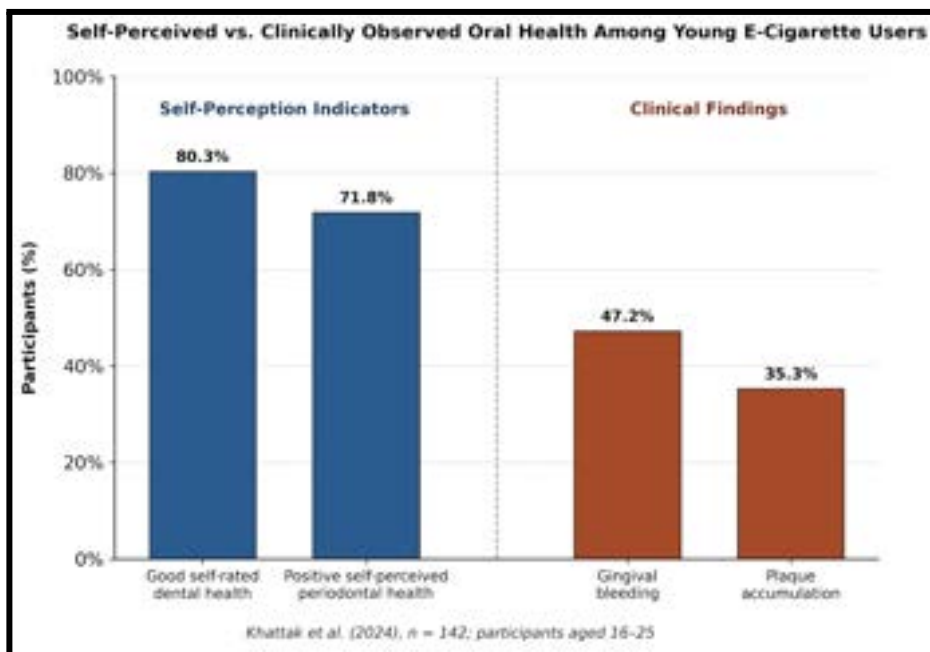


Figure 2. Self-perceived and clinically observed oral health among young e-cigarette users (adapted from Khattak et al., 2024).

While the Khattak et al. (2024) study did not include a non-smoking control group, comparative evidence suggests that the perception gap observed among young vapers may be less prominent among non-users. Bali et al. (2025) found that non-smokers demonstrated higher oral health awareness scores (22.4 ± 4.9) compared with e-cigarette users (17.8 ± 5.2), suggesting that individuals without nicotine exposure may have a stronger understanding of periodontal risks. This disparity in awareness is particularly significant when compared to objective clinical outcomes; for instance, Aljoghaiman et al. (2026) reported a lower prevalence of periodontal disease among non-smokers (35.0%) compared with exclusive e-cigarette users (57.1%), indicating that non-users had a lower observed burden of periodontal disease in that study. Together, these findings suggest that while the Khattak et al. (2024) study cannot establish whether the perception gap is exclusive to vapers, comparative evidence indicates that young ENDS users may be particularly vulnerable to underestimating their oral health risks, leading to a disconnect between perceived oral health and underlying clinical disease.

Factors Contributing to the Perception Gap: Risk Perception and Biological Masking

The perception gap among young vapers is influenced by how users interpret the risks associated with ENDS. In the Khattak et al. (2024) study, 31.7% of participants reported beginning to vape because they believed it was a safer alternative to traditional smoking. This belief can shape how users evaluate the consequences of vaping, as a product perceived as lower risk may appear less connected to gradual oral changes. This was evident in the participants' comprehension of particular oral outcomes, with 51.4% not believing that vaping increased oral cancer risk and more than 70% remaining unsure or doubtful about its connection to dry mouth and bad breath (Khattak et al., 2024). These results imply that the problem is not just whether adolescent users are aware of the risks associated with vaping, but also whether they understand how those risks manifest clinically.

Disparities in health literacy are also reflected in the perception gap. In the Khattak et al. (2024) cohort, education level was the only variable significantly associated with vaping-related risk perception. Participants were categorized by primary (14.1%), high school (43.0%), and university-level education (43.0%). Among respondents who recognized specific oral health risks associated with vaping, those with a university-level education accounted for 65.1% of respondents who identified tooth decay as a risk, 60.3% of those who identified gum disease, and 60.0% of those who identified oral cancer. These findings suggest that formal education may influence how users understand the potential harms of vaping. Without a clear understanding of how vaping contributes to oral health changes, users may be less likely to connect symptoms or clinical findings with their behavior, particularly when these changes develop gradually and are not immediately visible.

The biological masking discussed in section one contributes to this misconception. Visual cues that often prompt individuals to identify periodontal abnormalities may be suppressed by nicotine-related reduction of inflammatory markers (Aljoghaiman et al., 2026; Iacob et al., 2024). Young users may then experience a combination of reduced risk perception and limited physical

cues about their condition. This interaction helps explain why many participants in the Khattak et al. (2024) study continued to view their oral health positively despite all the quantifiable clinical results. Overall, these factors can make developing oral problems harder for young users to recognize, potentially reducing the likelihood that they seek dental care or change their vaping habits.

Implications for Oral Hygiene and Professional Care

The perception gap created by vaping has direct consequences for prevention because young users may not seek care until they recognize a problem themselves. In the Khattak et al. (2024) study, only 34.5% of participants reported attending preventive dental check-ups regularly, while the majority rated their dental health positively. This may indicate that some participants did not perceive a need for regular dental care because they believed their oral health was satisfactory. However, clinical assessments revealed objective indicators of oral disease, showing that positive self-perceptions did not necessarily reflect their clinical condition (Khattak et al., 2024). Similar concerns about oral health awareness have been reported among e-cigarette users in other populations, with Bali et al. (2025) finding lower oral health awareness scores among e-cigarette users compared with non-smokers. Together, these findings suggest that limited awareness of vaping-related oral risks may reduce the likelihood of seeking preventive care. This creates a challenge for dental professionals because the absence of noticeable symptoms may be interpreted as reassurance rather than a reason for evaluation. Therefore, dental communication should move beyond simply informing patients that vaping carries risks and instead help them understand how their current perception may differ from their clinical condition.

In some cases, concerns about reducing vaping may discourage patients from pursuing treatment they would otherwise want. This observation resonates with the study by Hammond et al. (2021), who reported that many adolescents experienced strong daily urges to vape, reflecting a level of nicotine dependence that may interfere with treatment adherence. As such, nicotine dependence may create an additional barrier to oral healthcare by reducing patients' confidence in their ability to follow treatment recommendations. This suggests that addiction may influence oral health not only through its direct physiological effects but also by discouraging patients from seeking and maintaining appropriate dental care.

The clinical differences observed among heavier users reinforce the importance of early intervention. Khattak et al. (2024) reported that individuals vaping more than 19 times per day had a mean DMFT score of 8.2, compared with lower scores among less frequent users. This implies that delaying preventive care could allow oral damage to progress to a stage where intervention becomes more difficult. Dental professionals should therefore prioritize early identification of vaping habits and initiate discussions before users begin to interpret developing oral changes as normal or unrelated to their behavior.

IV. Synthesis of Research Gaps and Clinical Future

The relationship between biological damage, nicotine dependence, and risk perception also reveals important limitations within current research and prevention strategies. This section

examines the gaps in existing evidence, particularly the limited longitudinal research on how vaping-related oral damage develops over time. It then considers how clinical practice, education, and public health strategies can better address these gaps through earlier recognition and clearer communication of vaping-related oral health risks.

Limitations Within the Current Evidence Base

While current evidence demonstrates an association between vaping and oral disease, the timeline through which these changes develop remains unclear (Khattak et al., 2024; Aljoghaiman et al., 2026). Notably, the studies conducted in Islamabad and Saudi Arabia were cross-sectional, meaning they provide a snapshot of oral health status rather than showing how damage related to vaping develops over time (Aljoghaiman et al., 2026; Khattak et al., 2024). For example, Khattak et al. (2024) found that the mean DMFT score increased from 4.2 among non-daily users to 8.2 among heavy users. Similarly, Aljoghaiman et al. (2026) reported that periodontal disease prevalence increased from 53.3% among users with shorter vaping duration (≤ 3 years) to 78.8% among users with longer vaping duration (≥ 3 years), indicating a potential relationship between cumulative exposure and periodontal deterioration. However, because both studies were cross-sectional, they cannot determine when these changes begin to develop or when users first recognize this deterioration. Longitudinal studies are therefore needed to establish the progression of vaping-related oral damage and determine whether recognition occurs early enough to influence behavior.

Future studies should examine how perceptions of oral health evolve as clinical disease progresses. An important question is whether young users recognize declining oral conditions as damage accumulates, or whether nicotine dependence and inaccurate risk perception allow them to continue viewing their health as unaffected. If nicotine dependence and risk perception allow them to believe that they are not negatively affected, then identifying these thresholds will be critical for behavioral intervention.

The evidence base is also limited by the reliance on localized cross-sectional studies, specifically Khattak et al. (2024), which examined young electronic cigarette users in Islamabad, Pakistan. While this work provides useful insight into the association between vaping, clinical deterioration, and health perception, the findings may not be generalizable to youth populations in different geographic and cultural settings. However, emerging evidence from other parts of the world suggests that similar oral health outcomes are being observed globally. For instance, an increased burden of dental caries has been reported among young electronic cigarette users in Indonesia (Yohana et al., 2021). Studies from Saudi Arabia reported an increased likelihood of periodontal disease among exclusive e-cigarette users (Aljoghaiman et al., 2026). These consistent findings across different populations suggest that the clinical consequences identified by Khattak et al. (2024) may reflect broader patterns associated with vaping rather than a region-specific phenomenon.

Finally, the current literature does not adequately account for the rapid evolution of vaping technology. With salt nicotine, adolescent users can enjoy greater nicotine satisfaction with less irritation compared to earlier liquid options (Hammond et al., 2021; Iacob et al., 2024). However, the combined impact of these unique formulations on oral health is poorly understood. Future

research should clarify how flavouring ingredients, nicotine salts, and aerosol residues interact with the oral microbiome, plaque accumulation, and enamel demineralization. (Better Health Victoria, n.d.; Maple Dental Health, 2024). This interaction is especially important because modern vaping products have changed not only nicotine delivery, but also the frequency and duration of exposure between these substances and oral tissues. Future studies need to identify how these patterns contribute to disease initiation and progression.

Reconsidering Clinical Prevention and Risk Communication

The perception gap identified throughout this review presents a challenge for current dental prevention strategies. In particular, the findings of Khattak et al. (2024) demonstrate a substantial mismatch between young vapers' positive perceptions of their oral health and the objective clinical evidence of disease. This evidence suggests that dental prevention should not rely solely on patients' perceptions of their own oral health, particularly when biological masking may make developing disease less noticeable. Instead, prevention should incorporate clinical risk transparency by explaining the biological processes that allow disease to develop before obvious symptoms appear.

This consideration is further supported by the observation that only participants with an adequate understanding of the vaping health consequences were able to provide an accurate assessment of their condition, which is reflected in the strong predictive power of the "educational level" factor (Khattak et al., 2024). Improving biological understanding may help young users recognize why apparently healthy gums do not necessarily indicate healthy periodontal tissues. Thus, the future preventive dentistry guidelines should not rely on a general warning about vaping's potential to cause damage but rather explain the relationship in detail so that the patients can identify hazardous actions and behaviors on their own.

The importance of Reforms Affecting Regulation, Accessibility, Education, and Messaging in Public Health and Medicine

When considering the prevention of vaping-associated oral disease, policymakers need to recognize that the problem stems from complex behavior patterns among young people. These patterns are influenced by both individual factors, such as risk perception, and external factors, such as vape accessibility. Because nicotine dependence can become established during adolescence, prevention efforts should address vaping before frequent use becomes a persistent behavioral pattern (Hammond et al., 2021). Therefore, if policymakers wish to reduce the development of vaping-associated oral disease, then they should consider restricting young people's access to e-cigarettes and educating them on the dangers of vaping.

As vaping technology continues to evolve faster than clinical understanding, young users remain vulnerable to oral deterioration that may not become apparent until extensive intervention is required. Addressing these research and policy gaps will be essential for preventing a future increase in restorative dental burden among young populations.

Conclusion

The oral consequences of vaping are not solely defined by the damage occurring within oral tissues, but by the critical disconnect between the onset of biological changes and users' recognition of those changes. While ENDS exposure disrupts the oral environment through microbial imbalance, impaired tissue maintenance, and increased susceptibility to disease (Iacob et al., 2024; Aljoghaiman et al., 2026), nicotine creates an additional challenge by reducing some visible inflammatory signals, such as gingival bleeding, that may normally encourage individuals to seek care (Aljoghaiman et al., 2026). As a result, vaping can create a state of "diagnostic silence," where biological deterioration progresses while users continue to perceive their oral health as acceptable. The findings of Khattak et al. (2024), in which the majority of young vapers rated their dental health positively despite objective evidence of dental and periodontal disease, demonstrate that the primary challenge is not only exposure to harm, but also the difficulty of recognizing damage as it develops.

Therefore, effective prevention must move beyond simply communicating that vaping is harmful and instead focus on clinical risk transparency by explaining why these effects may remain unnoticed. The association between increased exposure and greater disease burden, demonstrated by DMFT scores increasing from 4.2 among less frequent users to 8.2 among heavier users, suggests that delayed recognition may allow preventable damage to accumulate before intervention occurs (Khattak et al., 2024). Addressing youth vaping requires improving health literacy and helping users understand that the absence of pain or visible changes does not necessarily indicate a healthy oral environment. Ultimately, reducing the long-term impact of vaping requires closing the gap between biological reality and user perception, ensuring that individuals recognize oral deterioration before it progresses beyond opportunities for early intervention.

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