Research Article

Trends in Tobacco and Vaping use and their Oral Health Consequences in Adolescents

Alkananda Sahoo[1], Aprna Gupta[2,*], Saswati Siddhartha[2], Ipsita Mohanty[3], Rohit Kumar Sahu[4] and Jagadish Prasad Rajguru[2]

[1] Department of Oral and Maxillofacial Pathology, Kalinga Institute of Dental Sciences, KIIT Deemed to be University, Bhubaneswar, Odisha, India
[2] Department of Oral and Maxillofacial Pathology, Hi-Tech Dental College and Hospital, Odisha University of Health Sciences (OUHS), Bhubaneswar, Odisha 751010, India
[3] Department of Oral Pathology and Microbiology, Institute of Dental Sciences, Siksha 'O' Anusandhan (SOA) University, Bhubaneswar, Odisha 751003, India
[4] Department of Oral Medicine and Radiology, Hi-Tech Dental College and Hospital, Odisha University of Health Sciences (OUHS), Bhubaneswar, Odisha 751010, India

Aprna Gupta (draprnagupta@gmail.com)

Abstract

Background: The landscape of nicotine use among adolescents has shifted dramatically with the emergence of electronic cigarettes (e-cigarettes) and vaping products. While traditional tobacco use has declined, vaping prevalence has surged, raising concerns about potential oral health consequences that remain incompletely characterized in younger populations. **Objective:** This cross-sectional study aimed to examine current trends in tobacco and vaping use among adolescents and evaluate associated oral health consequences, including periodontal status, mucosal lesions, and xerostomia. **Methods:** A total of 612 adolescents aged 14–18 years were recruited from secondary schools and categorized into four groups: non-users (n=298), exclusive vapers (n=156), exclusive tobacco users (n=72), and dual users (n=86). Participants completed validated questionnaires assessing substance use patterns. Clinical oral examinations evaluated periodontal status using the Community Periodontal Index (CPI), oral mucosal lesions, xerostomia, and halitosis. Salivary flow rate was measured using unstimulated collection methods. **Results:** Overall nicotine product use prevalence was 51.3%, with vaping (39.5%) exceeding traditional tobacco use (25.8%). Exclusive vapers demonstrated significantly higher CPI scores (1.42 ± 0.68) com-pared to non-users (0.86 ± 0.54; $p<0.001$). Dual users exhibited the poorest periodontal status (CPI: 1.89 ± 0.72; $p<0.001$). Xerostomia prevalence was significantly elevated in vapers (42.3%) and dual users (58.1%) compared to non-users (14.8%; $p<0.001$). Oral mucosal lesions were observed in 18.6% of vapers and 31.4% of dual users versus 6.4% of non-users ($p<0.001$). Salivary flow rates were significantly reduced in all nicotine user groups. **Conclusion:** Vaping and tobacco use are associated with significant adverse oral health consequences in adolescents, including compromised periodontal health, xerostomia, and mucosal pathology. The high prevalence of vaping necessitates urgent preventive interventions and clinical awareness among dental professionals.

Keywords: Electronic cigarettes; vaping; tobacco; adolescents; oral health; periodontal disease; xerostomia

1. Introduction

The epidemiology of nicotine use among adolescents has undergone a profound transformation over the past decade. While sustained public health efforts have successfully reduced traditional cigarette smoking rates in youth populations, the emergence and rapid proliferation of electronic nicotine delivery systems (ENDS) have created new challenges [1]. Electronic cigarettes, commonly known as e-cigarettes or vapes, were initially marketed as smoking cessation aids for adults but have become increasingly popular among adolescents who have never used conventional tobacco products [2]. Electronic cigarettes function by heating a liquid solution typically containing propylene glycol, vegetable glycerin, flavorings, and variable concentrations of nicotine to produce an inhalable aerosol [3]. The appealing flavors, perceived reduced harm compared to combustible cigarettes, social media marketing, and discreet design of modern devices have contributed to their popularity among young people [4]. In the United States, the Surgeon General declared youth e-cigarette use an epidemic in 2018, reflecting the severity of this public health concern [5].Recent surveillance data indicate alarming trends in adolescent vaping. The National Youth Tobacco Survey reported that e-cigarette use among high school students increased from 1.5% in 2011 to over 27% by 2019, before modest declines attributed to regulatory actions and the COVID-19 pandemic [6]. Similar patterns have been observed internationally, with significant increases in vaping prevalence documented across Europe, Australia, and Asia [7]. Notably, many adolescent vapers report never having used traditional cigarettes, challenging the harm-reduction narrative that initially supported e-cigarette development [8]. The oral cavity represents the primary site of exposure to both tobacco smoke and e-cigarette aerosol, making oral tissues particularly vulnerable to their effects. Traditional tobacco

use is well established as a major risk factor for periodontal disease, oral cancer, delayed wound healing, and various mucosal conditions [9]. The mechanisms underlying tobacco-related oral pathology include direct cytotoxic effects, impaired immune function, altered microcirculation, and disruption of the oral microbiome [10]. These established consequences have been integral to tobacco prevention messaging and clinical counseling. However, the oral health effects of e-cigarettes remain incompletely understood, particularly in adolescent populations. Emerging laboratory evidence suggests that e-cigarette aerosol constituents can induce cellular damage, inflammatory responses, and oxidative stress in oral tissues. In vitro studies have demonstrated cytotoxicity of e-liquid flavorings to oral epithelial cells and fibroblasts [**?**]. Animal models have shown alterations in periodontal tissues following e-cigarette exposure. Yet translating these findings to clinical outcomes in human populations requires epidemiological investigation. Clinical studies examining e-cigarette effects on oral health have yielded concerning preliminary findings. Atuegwu et al. reported associations between e-cigarette use and poor self-rated oral health among adults. Calvo-Henriquez and colleagues observed increased xerostomia symptoms in vapers. Periodontal changes, including increased gingival inflammation and clinical attachment loss, have been documented in adult e-cigarette users. However, studies specifically examining these relationships in adolescents, who may exhibit different use patterns and susceptibilities, remain scarce. The phenomenon of dual use—concurrent use of both e-cigarettes and traditional tobacco products—adds complexity to understanding oral health consequences. Dual users potentially experience additive or synergistic harmful effects from both product categories. Among adolescents, dual-use patterns may reflect experimentation, failed cessation attempts, or situational preferences, with unclear implications for oral health outcomes. Significant research gaps persist in this rapidly evolving field. Most existing studies have focused on adult populations, limiting generalizability to adolescents whose developing tissues may respond differently to nicotine and aerosol exposures. Few studies have employed comprehensive clinical oral examinations, instead relying on self-reported outcomes. Additionally, the diversity of e-cigarette products and use patterns necessitates ongoing surveillance to characterize contemporary exposures. The aim of this study was to examine current trends in tobacco and vaping use among adolescents and evaluate associated oral health consequences, including periodontal status, oral mucosal lesions, xerostomia, and salivary function. We hypothesized that both exclusive vaping and dual use would be associated with adverse oral health outcomes compared to non-use.

2 Materials and Methods

1.1 Study Design and Setting

This cross-sectional analytical study was conducted between September 2023 and March 2024 across twelve secondary schools in a large metropolitan area. Schools were selected using stratified random sampling to ensure representation across socioeconomic areas. The study protocol received approval from the Institutional Ethics Review Board (Protocol Reference: ERB-2023-1124) and was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from parents/legal guardians, and written assent was obtained from all participating adolescents. Confidentiality regarding substance use was assured to encourage honest reporting.

1.2 Sample Size Determination

Sample size calculation was based on detecting a 0.4 difference in mean CPI scores between groups, assuming a standard deviation of 0.8, power of 80%, and a significance level of 0.05. With four comparison groups and adjustment for unequal group sizes, a minimum total sample of 560 participants was required. Target enrollment was set at 650 to account for potential incomplete data or examination refusals.

1.3 Participants

Adolescents aged 14–18 years enrolled in participating schools were eligible for inclusion. Specific inclusion criteria comprised: (1) age 14–18 years; (2) ability to complete questionnaires and undergo clinical examination; and (3) a minimum of six months since any orthodontic appliance removal. Exclusion criteria included:

(1) current fixed orthodontic treatment;

(2) diagnosed systemic conditions affecting periodontal tissues, including diabetes and immunodeficiencies

(3) use of medications causing xerostomia or gingival changes.

(4) antibiotic use within the past three months.

(5) professional dental cleaning within the past month.

1.4 Data Collection Instruments

1.4.1. Substance Use Questionnaire. A validated questionnaire assessed tobacco and e-cigarette use patterns based on established surveillance instruments, including components from the National Youth Tobacco Survey and PATH Study. Items addressed:

- Lifetime use of cigarettes, cigars, smokeless tobacco, and e-cigarettes
- Current use, defined as past 30 days, of each product type
- Frequency of use, including days per month and times per day
- Duration of use, including months/years since initiation
- Product characteristics for e-cigarettes, including device type, nicotine concentration, and flavors
- Motivations for use and quit intentions

Based on responses, participants were categorized as:

- Non-users: No tobacco or e-cigarette use in the past 12 months
- Exclusive vapers: E-cigarette use only, with no tobacco use, in the past 30 days
- Exclusive tobacco users: Cigarette/tobacco use only, with no e-cigarette use, in the past 30 days
- Dual users: Both e-cigarette and tobacco use in the past 30 days

1.4.2. Xerostomia Assessment. The Xerostomia Inventory (XI), an 11-item validated scale, assessed subjective dry mouth symptoms. Each item was scored from 1–5, ranging from never to very often, yielding total scores of 11–55. Clinical xerostomia was defined as an XI score ≥25.

1.4.3. Demographic Questionnaire. Information was collected on age, sex, grade level, parental education, oral hygiene practices, dental visit patterns, and dietary habits, including caffeine and alcohol consumption.

1.5 Clinical Oral Examination

All examinations were performed by three calibrated dentists (inter-examiner kappa: 0.83–0.88 for CPI; 0.86–0.91 for mucosal lesions) in school health facilities under standardized conditions using portable dental equipment, adequate lighting, plane mouth mirrors, and WHO periodontal probes.

1.5.1. Periodontal Assessment. The Community Periodontal Index (CPI) was recorded according to WHO criteria for index teeth (17/16, 11, 26/27, 47/46, 31, 36/37). Scoring was as follows: 0=healthy; 1=bleeding on probing; 2=calculus detected; 3=shallow pockets (4–5 mm); and 4=deep pockets (≥6 mm). The highest score per sextant and the overall highest score were recorded.

1.5.2. Gingival Assessment. The Gingival Index (GI) of Löe and Silness was recorded on index teeth, scoring 0–3 per surface. The mean GI was calculated.

1.5.3. Oral Mucosal Examination. A systematic examination of all mucosal surfaces, including the lips, buccal mucosa, tongue, floor of the mouth, palate, and gingiva, identified lesions including:

- Nicotinic stomatitis
- Leukoplakia/hyperkeratosis
- Erythematous lesions

- Ulcerations
- Hairy tongue
- Angular cheilitis

1.5.4. Halitosis Assessment. Organoleptic assessment was performed by a calibrated examiner using a 0–5 scale, namely the Rosenberg scale, with scores ≥2 indicating the presence of halitosis.

1.5.5. Salivary Flow Measurement. Unstimulated whole saliva was collected using the spitting method over five minutes into pre-weighed graduated tubes. Participants refrained from eating, drinking, or oral hygiene for one hour prior. Salivary flow rate was calculated as mL/min, with hyposalivation defined as <0.1 mL/min.

1.6 Statistical Analysis

Statistical analyses were performed using SPSS version 28.0 (IBM Corporation) and R version 4.3.1. Descriptive statistics included means with standard deviations for continuous variables and frequencies with percentages for categorical variables. Normality was assessed using Shapiro–Wilk tests. Group comparisons employed one-way ANOVA with Tukey post-hoc tests for continuous variables and chi-square tests for categorical variables. Non-parametric alternatives, namely Kruskal–Wallis tests, were used where assumptions were violated. Multivariate logistic regression identified independent associations between substance use and oral health outcomes, adjusting for confounders. Odds ratios with 95% confidence intervals were calculated. Statistical significance was defined as $p<0.05$.

2 Results

2.1 Participant Characteristics and Substance Use Patterns

Of 650 adolescents approached, 612 completed all study components, giving a 94.2% participation rate. The mean age was 16.1 ± 1.2 years, with 48.5% male and 51.5% female participants. Demographic characteristics and substance use prevalence are presented in Table 1.

Table 1: Demographic Characteristics and Substance Use Patterns (N=612)

Variable	Total (N=612)	Non-Users (n=298)	Exclusive Vapers (n=156)	Tobacco Users (n=72)	Dual Users (n=86)	p-value
Age (years), mean ± SD	16.1 ± 1.2	15.8 ± 1.2	16.3 ± 1.1	16.4 ± 1.1	16.6 ± 1.0	<0.001*
Sex, n (%)						0.042*
Male	297 (48.5%)	132 (44.3%)	78 (50.0%)	42 (58.3%)	45 (52.3%)	
Female	315 (51.5%)	166 (55.7%)	78 (50.0%)	30 (41.7%)	41 (47.7%)	
Grade Level, n (%)						0.003*
9th–10th grade	286 (46.7%)	158 (53.0%)	68 (43.6%)	28 (38.9%)	32 (37.2%)	
11th–12th grade	326 (53.3%)	140 (47.0%)	88 (56.4%)	44 (61.1%)	54 (62.8%)	
Parental Education, n (%)						0.124
High school or below	184 (30.1%)	82 (27.5%)	48 (30.8%)	26 (36.1%)	28 (32.6%)	
University or higher	428 (69.9%)	216 (72.5%)	108 (69.2%)	46 (63.9%)	58 (67.4%)	
Brushing ≥2x/day, n (%)	468 (76.5%)	248 (83.2%)	116 (74.4%)	48 (66.7%)	56 (65.1%)	<0.001*
Dental visit in the past year, n (%)	384 (62.7%)	204 (68.5%)	96 (61.5%)	38 (52.8%)	46 (53.5%)	0.012*
Substance Use Characteristics						
Duration of use (months)	—	—	14.2 ± 8.6	18.4 ± 10.2	22.6 ± 11.8	0.001*
Frequency of use (days/past 30)	—	—	18.4 ± 8.2	16.2 ± 7.8	21.8 ± 6.4	0.002*

E-cigarette device type, n (%)						0.724
Disposable	—	—	98 (62.8%)	—	52 (60.5%)	
Pod-based	—	—	42 (26.9%)	—	26 (30.2%)	
Mod/Tank	—	—	16 (10.3%)	—	8 (9.3%)	
Nicotine concentration, n (%)						0.682
Unknown	—	—	44 (28.2%)	—	22 (25.6%)	
≤20 mg/mL	—	—	48 (30.8%)	—	24 (27.9%)	
>20 mg/mL	—	—	64 (41.0%)	—	40 (46.5%)	

*Statistically significant at $p<0.05$

Overall, 51.3% of participants reported current use of any nicotine product. E-cigarette use, either exclusive or dual use, was 39.5%, exceeding traditional tobacco use, either exclusive or dual use, which was 25.8%. Among vapers, disposable devices were most common (62.2%), and fruit flavors were preferred (68.4%).

2.2 Periodontal and Gingival Health Outcomes

Significant differences in periodontal and gingival status were observed across the groups. Dual users demonstrated the poorest periodontal health, followed by exclusive tobacco users, exclusive vapers, and non-users. Detailed findings are presented in Table 2.

2.3 Oral Mucosal Lesions, Xerostomia, and Salivary Function

Significant differences were observed in mucosal findings, xerostomia prevalence, and salivary flow rates across the groups, as shown in Table 3.

2.4 Multivariate Analysis

Multivariate logistic regression, adjusting for age, sex, oral hygiene practices, and dental visits, confirmed independent associations between substance use and oral health outcomes. Exclusive vaping was associated with increased odds of moderate-to-severe gingivitis (OR=2.84; 95% CI: 1.82–4.43; $p<0.001$), xerostomia 28 (OR=3.68; 95% CI: 2.28–5.94; $p<0.001$), and mucosal lesions (OR=2.92; 95% CI: 1.56–5.47; p=0.001). Dual
use demonstrated the strongest associations across all outcomes.

Table 2: Periodontal and Gingival Health Outcomes by Substance Use Group

Variable	Non-Users (n=298)	Exclusive Vapers (n=156)	Tobacco Users (n=72)	Dual Users (n=86)	F/X^2	p-value
CPI Score, mean ± SD	0.86 ± 0.54	1.42 ± 0.68a	1.56 ± 0.71a	1.89 ± 0.72a,b,c	68.42	<0.001*
CPI Category, n (%)					86.24	<0.001*
Healthy (0)	124 (41.6%)	32 (20.5%)	10 (13.9%)	6 (7.0%)		
Bleeding (1)	112 (37.6%)	54 (34.6%)	22 (30.6%)	18 (20.9%)		
Calculus (2)	52 (17.4%)	52 (33.3%)	28 (38.9%)	38 (44.2%)		
Pockets (3–4)	10 (3.4%)	18 (11.6%)	12 (16.6%)	24 (27.9%)		
Gingival Index, mean ± SD	0.72 ± 0.38	1.14 ± 0.46a	1.28 ± 0.52a	1.52 ± 0.54a,b	82.16	<0.001*
GI ≥1.0 (moderate inflammation), n (%)	86 (28.9%)	92 (59.0%)	48 (66.7%)	68 (79.1%)	94.68	<0.001*
Bleeding on Probing (% sites)	18.4 ± 12.6	32.8 ± 16.4a	38.2 ± 18.2a	46.4 ± 19.8a,b	78.94	<0.001*
Calculus Present, n (%)	62 (20.8%)	70 (44.9%)	40 (55.6%)	62 (72.1%)	92.36	<0.001*
Visible Plaque Index, mean ± SD	1.24 ± 0.48	1.52 ± 0.56a	1.68 ± 0.62a	1.78 ± 0.58a	32.84	<0.001*

*Statistically significant at $p<0.001$

Post-hoc: a=significantly different from non-users; b=significantly different from exclusive vapers; c=significantly different from tobacco users

Table 3: Oral Mucosal Lesions, Xerostomia, and Salivary Function by Substance Use Group

Variable	Non-Users (n=298)	Exclusive Vapers (n=156)	Tobacco Users (n=72)	Dual Users (n=86)	X^2/ F	p-value
Any Oral Mucosal Lesion, n (%)	19 (6.4%)	29 (18.6%)	16 (22.2%)	27 (31.4%)	42.86	<0.001*
Lesion Types, n (%)						
Nicotinic stomatitis	0 (0%)	6 (3.8%)	8 (11.1%)	10 (11.6%)	28.94	<0.001*
Leukoplakia/hyperkeratosis	2 (0.7%)	8 (5.1%)	4 (5.6%)	8 (9.3%)	18.62	<0.001*
Erythematous lesions	4 (1.3%)	10 (6.4%)	4 (5.6%)	6 (7.0%)	12.48	0.006*
Hairy tongue	8 (2.7%)	12 (7.7%)	6 (8.3%)	10 (11.6%)	14.26	0.003*
Angular cheilitis	5 (1.7%)	6 (3.8%)	3 (4.2%)	5 (5.8%)	5.42	0.144
Xerostomia (XI ≥25), n (%)	44 (14.8%)	66 (42.3%)	26 (36.1%)	50 (58.1%)	78.64	<0.001*
XI Score, mean ± SD	18.2 ± 5.4	26.8 ± 7.2a	24.6 ± 6.8a	29.4 ± 7.8a, b	86.92	<0.001*
Salivary Flow Rate (mL/min)	0.38 ± 0.14	0.28 ± 0.12a	0.26 ± 0.11a	0.22 ± 0.10a, b	52.68	<0.001*
Hyposalivation (<0.1 mL/min), n (%)	12 (4.0%)	22 (14.1%)	12 (16.7%)	20 (23.3%)	32.46	<0.001*
Halitosis (Rosenberg ≥2), n (%)	48 (16.1%)	58 (37.2%)	34 (47.2%)	48 (55.8%)	68.42	<0.001*
Halitosis Score, mean ± SD	1.12 ± 0.84	1.78 ± 1.02a	1.94 ± 1.08a	2.24 ± 1.12a	42.86	<0.001*

*Statistically significant at $p<0.05$

Post-hoc: a=significantly different from non-users; b=significantly different from exclusive vapers

3 Discussion

This study provides comprehensive evidence regarding the prevalence and oral health consequences of tobacco and vaping use among contemporary adolescents. Our findings reveal that e-cigarette use has become the predominant form of nicotine exposure in this population, and both exclusive vaping and dual use are associated with significantly compromised periodontal health, increased xerostomia, and an elevated prevalence of oral mucosal lesions. The observed prevalence of any nicotine product use (51.3%), with e-cigarettes exceeding traditional tobacco, underscores the dramatic shift in adolescent substance use patterns. These findings align with national surveillance data documenting the vaping epidemic among youth. The predominance of disposable devices and fruit flavors reflects marketing strategies specifically targeting younger users, as demonstrated by Jackler and colleagues. The high proportion of users reporting unknown nicotine concentrations (27%) highlights concerning gaps in product awareness that may facilitate inadvertent high-dose exposure. The significantly elevated CPI scores observed in exclusive vapers compared to non-users represent a key finding with clinical implications. The 0.56-unit difference in mean CPI scores indicates meaningfully increased periodontal inflammation and pathology associated with vaping alone, independent of traditional tobacco exposure. While the effect magnitude was smaller than that observed with tobacco smoking, the high prevalence of vaping translates to a substantial population-level burden. Our findings corroborate preliminary evidence from adult studies reporting periodontal changes in e-cigarette users. The mechanisms underlying vaping-related periodontal changes likely involve multiple pathways. E-cigarette aerosol contains reactive oxygen species, carbonyls, and volatile organic compounds capable of inducing oxidative stress and inflammatory responses in periodontal tissues. Nicotine itself produces vasoconstriction, potentially masking clinical signs of inflammation while promoting attachment loss. Additionally, alterations in the oral microbiome following e-cigarette exposure have been documented, favoring periodontal pathogen colonization. The propylene glycol and glycerin vehicle components may also contribute through desiccation effects and alteration of tissue properties. The pronounced xerostomia observed among vapers and dual users carries significant implications beyond patient discomfort. Salivary flow reduction compromises multiple protective functions, including antimicro-bial activity, pH buffering, remineralization, and lubrication.

The observed mean salivary flow rates in vapers (0.28 mL/min) and dual users (0.22 mL/min), while technically above hyposalivation thresholds for most individuals, represent substantial reductions from non-user values that may predispose them to caries, ero-sion, and mucosal pathology over time. The hygroscopic nature of propylene glycol in e-liquids may directly contribute to oral dryness. The increased prevalence of oral mucosal lesions in nicotine users, affecting nearly one-third of dual users, warrants clinical attention. While most observed lesions represented benign inflammatory or reactive changes, the presence of leukoplakia and hyperkeratotic lesions in adolescent vapers is concerning given their potential for malignant transformation. Nicotinic stomatitis, traditionally associated with pipe smoking, was observed in both tobacco and e-cigarette users, suggesting that thermal and chemical irritation from vaping resembles combustible exposure effects. Long-term follow-up studies are essential to characterize the natural history of these lesions.Dual users consistently demonstrated the most severe oral health consequences across all measured out-comes, supporting concerns about additive or synergistic effects from combined exposures. The higher frequency and longer duration of use among dual users may partially explain these findings, though bio-logical interactions between combustible smoke and e-cigarette aerosol components likely contribute. The observation that dual use is common among adolescents, representing over half of all tobacco users in our sample, emphasizes the importance of addressing both product categories in prevention and cessation efforts. The association between nicotine product use and poorer oral hygiene behaviors observed in our study may reflect shared underlying risk factors or bidirectional relationships. Substance-using adolescents demon-strated lower brushing frequency and dental attendance, potentially compounding direct effects on oral tissues. Comprehensive approaches addressing both substance use and oral health behaviors may be neces-sary for optimal outcomes. Integration of tobacco and vaping screening into dental practice, coupled with brief intervention and referral, represents an evidence-based strategy requiring broader implementation.From a clinical perspective, dental professionals should be aware that apparently healthy-appearing gingivae in vapers may mask underlying pathology due to nicotine-induced vasoconstriction. Thorough periodontal assessment and patient education regarding vaping risks are warranted. The elevated xerosto-mia prevalence suggests consideration of salivary substitutes and enhanced caries-prevention measures for adolescent vapers. Recognition and monitoring of mucosal lesions in this population are essential for early detection of potentially concerning changes. Several limitations merit acknowledgment. The cross-sectional design precludes causal inference regard-ing temporal relationships between substance use and oral health outcomes. Self-reported substance use may be subject to underreporting despite confidentiality assurances. The school-based recruitment may under-represent certain populations, including school non-attenders. Additionally, the rapidly evolving e-cigarette marketplace means that product characteristics in our sample may not reflect future patterns. Future research should employ longitudinal designs to establish temporal sequences and dose-response relationships. Investigation of specific e-cigarette constituents, including flavoring chemicals and their ther-mal degradation products, may identify particularly harmful exposures. Biomarker studies could provide objective exposure assessment. Development and evaluation of targeted interventions for adolescent vapers, incorporating oral health consequences messaging, represent a priority for prevention efforts.

4 Conclusion

This study demonstrates that both electronic cigarette use and traditional tobacco use are associated with significant adverse oral health consequences in adolescents. The emergence of vaping as the predominant form of nicotine exposure in this population creates new challenges for oral health promotion, as many adolescents and their parents may perceive vaping as a safer alternative lacking the established risks of combustible tobacco. Exclusive vapers demonstrated significantly compromised periodontal health, increased gingival inflam-mation, elevated xerostomia prevalence, and higher rates of oral mucosal lesions compared to non-users. These findings indicate that e-cigarette use, independent of traditional tobacco exposure, poses meaningful risks to oral health. Dual users combining both product categories exhibited the most severe oral health consequences across all outcomes measured, suggesting additive or synergistic harmful effects. The high prevalence of nicotine product use among adolescents, particularly e-cigarettes, underscores the urgent need for comprehensive prevention strategies. Dental professionals are uniquely positioned to screen for tobacco and vaping use, provide education regarding oral health consequences, and facilitate cessation support. Integration of substance use assessment and intervention into routine adolescent dental care may contribute to

reducing the burden of nicotine-related oral disease. Continued surveillance of evolving product trends and their health effects is essential as the e-cigarette marketplace continues to change. Longitudinal research documenting the long-term trajectory of oral health outcomes in adolescent vapers will inform evidence-based guidance for clinical practice and public health policy. In the interim, a precautionary approach warning adolescents about potential oral health risks of vaping appears warranted based on current evidence

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