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Prevalence and factors associated with gingivitis among secondary school adolescents in Acapulco, Mexico

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ABSTRACT

Objective: To estimate the prevalence of gingivitis and its associated factors among students at a public secondary school in Acapulco, Mexico. **Materials and methods:** A cross-sectional epidemiological study was conducted in February 2024 among 105 third-grade students from a public secondary school in Acapulco, Mexico. A self-administered questionnaire was applied, and a periodontal clinical examination was performed based on the classification of biofilm-induced gingival diseases. Crude and adjusted prevalence ratios were calculated using bivariate and multivariate analyses with the Mantel-Haenszel method. **Results:** The prevalence of gingivitis was 35.2% (n = 37/105), and all cases were localized. Two factors were associated with gingivitis: female sex (aPR = 2.19; 95% CI: 1.06-3.16) and toothbrushing fewer than three times per day (aPR = 2.32; 95% CI: 1.11-4.83). **Conclusion:** Gingivitis prevalence was moderate and exclusively localized. Female sex and toothbrushing fewer than three times per day were the main associated factors. These findings highlight the need to implement school-based strategies to prevent gingivitis and promote oral health among adolescents.

Keywords: prevalence; gingivitis; adolescent; schools; Mexico.

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INTRODUCTION

Gingivitis is the mildest and most reversible form of periodontal disease. It is characterized by a localized inflammatory response of the gingival tissues, typically induced by the accumulation of oral biofilm. From a clinical point of view, gingivitis manifests with erythema, edema, bleeding on probing, and, in some cases, halitosis. Unlike periodontitis, gingivitis does not involve clinical attachment loss or destruction of the alveolar bone, as the junctional epithelium remains in its original position (1–3).

Worldwide, the prevalence of periodontal diseases among young adults ranges from 4% to 76% in developed countries and from 50% to 90% in developing countries (4). In Mexico, a growing trend of poor oral hygiene has been documented as school age advances. According to data from the Epidemiological Surveillance System for Oral Pathologies (SIVEPAB), 58% of adolescents between 15 and 19 years old presented a Simplified Oral Hygiene Index (OHI-S) greater than zero, indicating the presence of dental biofilm or calculus. Although this value does not necessarily imply periodontal disease, it reflects inadequate oral hygiene and a high population-level biofilm burden, which is considered a major predisposing factor for gingivitis (5).

Adolescence represents a critical period for the establishment and consolidation of oral health habits. Several factors inherent to this stage—such as sex, area of residence, poor oral hygiene, initiation of tobacco use, frequent intake of fermentable carbohydrates, hormonal changes associated with puberty, and family socioeconomic and educational status—may negatively affect periodontal health (6–8). In this context, oral health education within the school setting is essential, as it enables early detection of gingivitis and timely intervention before irreversible damage to the periodontal supporting tissues occurs (9,10).

Although studies on gingivitis have been conducted in various demographic groups in Acapulco, such as university students and pregnant women (11–13), there are no published data specifically addressing its prevalence among adolescents enrolled in secondary education. This gap is particularly relevant in the Mexican context, where national-level information on adolescent periodontal health is limited and regional data from the state of Guerrero are virtually nonexistent. Given that adolescence is a key stage for the adoption of long-term health behaviors and that the school environment constitutes an optimal setting for population-based preventive interventions, the objective of this study was to estimate the prevalence of gingivitis and identify associated factors among adolescents attending a public secondary school in Acapulco, Mexico.

MATERIALS AND METHODS

A cross-sectional epidemiological study was conducted among adolescents from the Technical Secondary School No. 68 in Acapulco, Mexico, in February 2024. The target population included all third-grade students attending the afternoon shift, who constituted the accessible universe. Although the entire group was invited to participate, the minimum required sample size was previously estimated using the Epi InfoTM tool, assuming an expected proportion of 58% based on SIVEPAB data (5), a 95% confidence level, and a 5% margin of error. The calculation confirmed the adequacy of the selected group, chosen for its larger enrollment and logistical feasibility.

Students whose parents or legal guardians provided written informed consent were included. Exclusion criteria comprised students who lacked consent, reported systemic diseases (according to self-report in the questionnaire), were undergoing orthodontic treatment, presented morphological or positional dental anomalies that could favor biofilm retention (such as marked rotations, severe crowding hindering clinical assessment, or structural defects), were receiving periodontal treatment, or participated only partially (questionnaire only or clinical examination only). Of the 121 eligible students, 116 agreed to participate. Subsequently, 11 students were excluded according to the predefined criteria, resulting in a final analytical sample of 105 participants (response rate: 95.8%).

Data were collected by two trained dental interns. Examiner calibration included a theoretical session delivered by a periodontology specialist and a supervised clinical practice session at a university clinic. A pilot study was then conducted with approximately 10% of the projected sample, consisting of adolescents with characteristics similar to those of the target population. The pilot study was carried out under the same methodological conditions planned for the fieldwork, including the teeth and clinical sites defined for the main evaluation. During this process, inter-examiner reliability was assessed, yielding a Cohen's kappa coefficient of 0.84, indicating substantial agreement (14). Intra-examiner reliability was also evaluated through repeated measurements in the pilot subgroup, achieving values considered acceptable. Additionally, examiners were standardized in the application of the simplified O'Leary Plaque Index to ensure consistency in scoring stained sites.

Parents or guardians were informed about the clinical examinations, which were conducted in the morning, even though the students were enrolled in the afternoon shift, and they were asked to ensure that the students fasted on the assigned day. Examinations were organized by classroom blocks, with approximately 10 students

evaluated per day. A designated area within the classroom was used, with adequate lighting and headlamps as visual support. Standardized biosafety protocols were followed, and students were seated on conventional school desks to maintain uniform evaluation conditions.

Sociodemographic and behavioral data were collected using a 13-item self-administered questionnaire. Variables included sex, age, oral hygiene habits (toothbrushing frequency, toothbrush replacement, use of dental floss and mouthwash), self-reported systemic diseases, self-perceived gingival bleeding, and access to dental services (dental visit within the past year, reason for the last visit, and receipt of oral health education). Clinical data were recorded on a technical form using a dental chart based on the nomenclature of the World Dental Federation (FDI) (15).

The outcome variable was the presence of gingivitis, defined as probing depth ≤3 mm with bleeding on probing at ≥10% of the evaluated sites, according to the classification of biofilm-induced gingival diseases (16). Six representative teeth (12, 16, 24, 32, 36, and 44) were examined using a calibrated North Carolina periodontal probe (Hu-Friedy®). To reduce the risk of gingival sulcus trauma, a methodological adjustment recommended by the periodontology specialist was implemented. The evaluation included four surfaces per tooth (mesial, buccal, distal, and lingual or palatal), resulting in a total of 24 examined sites.

Gingival health status was categorized as follows: healthy periodontium when the probing depth was ≤3 mm with bleeding in <10% of sites (Figure 1A); localized gingivitis when bleeding was present in three to seven sites (≥10%), affecting at least three teeth (Figure 1B); and generalized gingivitis when bleeding was present in eight or more sites (≥30%), affecting at least four teeth. However, no cases of generalized gingivitis were identified. It is important to mention that the percentage cut-off points were interpreted in accordance with international classification criteria.

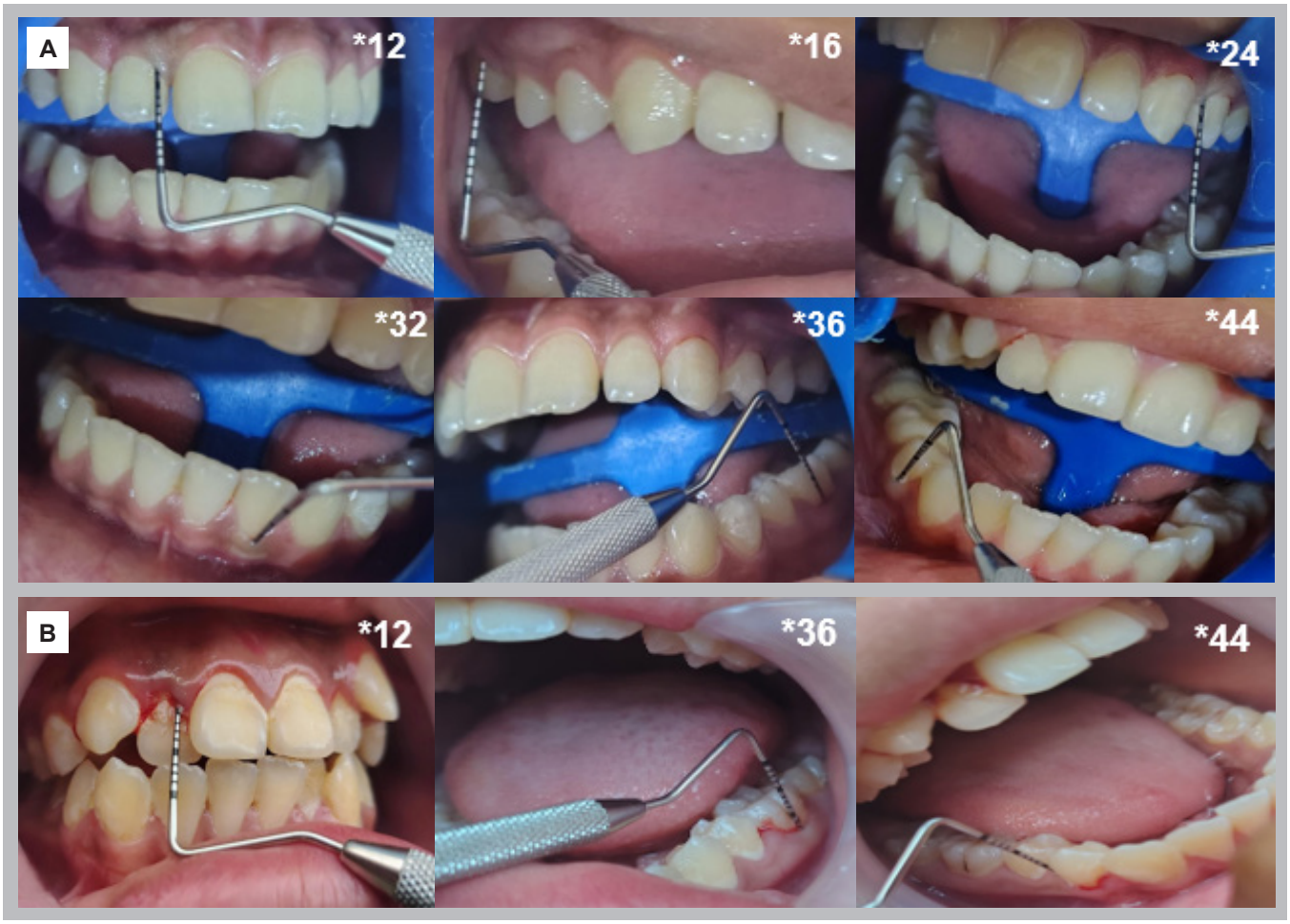

Figure 1. Clinical criteria for the classification of biofilm-induced gingivitis in adolescent students from a public secondary school in Acapulco, Mexico. A) Healthy periodontium: probing depth ≤3 mm with bleeding in less than 10% of sites or no bleeding; B) Localized gingivitis: probing depth ≤3 mm with bleeding in ≥10% of the evaluated sites, distributed across three to seven surfaces in at least three teeth. For the definition of generalized gingivitis, bleeding in eight or more surfaces affecting four or more teeth was considered. *Operational thresholds established by the research team in accordance with the updated classification of biofilm-induced gingival health.

Independent variables were dichotomized based on clinical and biological criteria. Sex was classified as male or female, and age was grouped into defined ranges. A reported toothbrushing frequency of three times per day was considered adequate, whereas lower frequencies were classified as inadequate. Other variables, such as dental floss use, mouthwash use, self-perceived gingival bleeding, dental visits, and receipt of oral health education, were categorized as positive or negative responses.

Oral hygiene was assessed using the simplified O'Leary Plaque Index. Disclosing tablets were applied to four surfaces of six representative teeth (42, 46, 34, 22, 26, and 14). The percentage was calculated by dividing the number of stained sites by the total number of examined sites and multiplying the result by 100%. Oral hygiene was classified as acceptable (≤29%) or poor (≥30%) (13).

Data were entered into Microsoft Excel and analyzed using CIETmap® software (17). A univariate analysis was performed to obtain absolute frequencies and measures of central tendency and dispersion. Bivariate analysis assessed the association between gingivitis and independent variables using the chi-square test, and prevalence ratios (PRs) with 95% confidence intervals (CIs) were estimated. Variables with p values <0.05 were included in an explanatory multivariate model using the Mantel–Haenszel method, with backward stepwise elimination of variables showing weaker associations. The model was adjusted for variables considered biologically plausible, even if they did not reach statistical significance in the bivariate analysis.

The research protocol was approved by the Research Ethics Committee of the Universidad Autónoma de Guerrero (Folio: 2023–013). Written informed consent was obtained from parents or legal guardians. Participation was voluntary, adolescents provided assent, confidentiality was ensured, and all participants received an individualized clinical diagnosis.

RESULTS

Of the 105 participants, 55.2% (n = 58) were female and the remainder were male, yielding a female-to-male ratio of 1.23:1. Ages ranged from 13 to 15 years, with a mean age of 13.5 years (SD = 0.55). Toothbrushing frequency ranged from once to three times per day, with a mean of 2.77 (SD = 0.54); most participants reported brushing three times per day (82.9%; n = 87). Regarding toothbrush replacement, 40.0% (n = 42) reported changing their toothbrush once a year. Use of dental floss and mouthwash was reported by 67.6% (n = 71) and 39.0% (n = 41) of participants, respectively. With respect to self-perceived oral health, 12.4% (n = 13) reported experiencing gingival bleeding during toothbrushing. Within the past year, 21.9% (n = 23) had attended a dental visit, primarily due to dental caries (n = 12), routine check-ups (n = 7), or dental pain (n = 4). Additionally, 38.1% (n = 40) reported having received oral health education, most commonly provided by dentists (n = 23) or other healthcare personnel (n = 17) (Table 1).

Table 1. Sociodemographic characteristics, oral hygiene, self-examination, and access to dental services among adolescents at a public secondary school in Acapulco, Mexico.

Factors	Variables	Category	n	%
Sociodemographic	Sex	Female	58	55.2
		Male	47	44.8
	Age	13 years	53	50.5
		≥14 years	52	49.5
Oral hygiene	Toothbrushing frequency per day	3 times	87	82.9
		≤2 times	18	17.1
	Toothbrush replacement interval	3 months	28	26.7
		6 months	35	33.3
		Once a year	42	40.0
	Use of dental floss	Yes	71	67.6
		No	34	32.4
	Use of mouthwash	Yes	41	39.0
		No	64	61.0

Table 1. (*Continuation*).

Factors	Variables	Category	n	%
Self-examination	Gingival bleeding during toothbrushing	Yes	13	12.4
		No	92	87.6
Access to dental services	Dental visit within the past year	Yes	23	21.9
		No	82	78.1
	Oral health education	Yes	40	38.1
		No	65	61.9

The simplified O'Leary Plaque Index showed a range of 12–87%, with a mean of 33.8% (SD = 17.1). According to the established cut-off points, 73.3% (n = 77) of the participants demonstrated acceptable oral hygiene. Gingivitis was identified in 35.2% (n = 37), and all cases were localized (Table 2).

Table 2. Distribution of the clinical parameters of the simplified O'Leary Oral Plaque Index and classification of gingivitis in adolescents from a public secondary school in Acapulco, Mexico

Simplified O'Leary Oral Plaque Index	Parameters	n	%
≤29 %	Acceptable	77	73.3
≥30 %	Poor	28	26.7
Gingivitis classification*			
Probing depth ≤3 mm with <10% bleeding or no bleeding	Healthy periodontium	68	64.8
Probing depth ≤3 mm with ≥10% bleeding involving three to seven sites in at least three teeth	Localized gingivitis	37	35.2
Probing depth ≤3 mm with ≥10% of eight or more sites in four or more teeth	Generalized gingivitis	0	0

*Operational thresholds defined by the research team based on the classification of gingival diseases, specifically dental biofilm–induced gingivitis in the context of an intact or reduced periodontium.

In the bivariate analysis, three variables showed statistically significant associations with the presence of gingivitis: sex, frequency of toothbrushing, and use of mouthwash (Table 3). In the final multivariate model, sex and toothbrushing frequency remained statistically significantly associated with gingivitis. Female students and those who brushed their teeth two times per day or less showed a higher probability of developing gingivitis (Table 4).

Table 3. Bivariate analysis of factors associated with gingivitis in adolescents from a public secondary school in Acapulco, Mexico.

Factor	Category	Gingivitis (n = 37)	Healthy (n = 68)	UPR	95% CI
Sex	Female[ref]	27	31	1.60	1.15-2.21*
	Male	10	37		
Age	13 years[ref]	17	36	0.97	0.63-1.50
	≥14 years	20	32		
Toothbrushing frequency	≤2 years[ref]	12	6	3.67	1.50-6.87*
	3 times	25	62		
Toothbrush replacement interval	≥6 months[ref]	23	54	0.78	0.59-1.03
	3 months	14	14		

URP: unadjusted prevalence ratio; Ref: reference category; * significant variables.

Table 3. (*Continuation*).

Factor	Category	Gingivitis (n = 37)	Healthy (n = 68)	UPR	95% CI
Use of dental floss	No[ref]	11	23	0.87	0.48-1.59
	Yes	26	45		
Use of mouthwash	No[ref]	27	37	1.34	1.01-1.79*
	Yes	10	31		
Self-reported gingival bleeding during toothbrushing	Yes[ref]	5	8	1.14	0.40-3.26
	No	32	60		
Dental visit in the past year	No[ref]	30	52	1.06	0.86-1.30
	Yes	7	16		
Oral health education	No[ref]	19	46	0.75	0.53-1.08
	Yes	18	22		
Simplified O'Leary Oral Plaque Index	Poor[ref]	13	15	1.43	0.76-2.70
	Acceptable	24	53		

URP: unadjusted prevalence ratio; Ref: reference category; * significant variables.

Table 4. Final multivariate model of factors associated with gingivitis in adolescents from a public secondary school in Acapulco, Mexico.

Factor	Category	UPR	APR	95% CI	X^2 het	p
Sex	Female	1.60	2.19	1.06-3.16	4.73	0.494
Toothbrushing frequency per day	≤2 times	3.67	2.32	1.11-4.83	4.76	0561

UPR: unadjusted prevalence ratio; APR: adjusted prevalence ratio; χ^2 het: heterogeneity chi-square to identify effect modifiers; p: significance level for the heterogeneity test.
The initial saturated model included the variables sex, toothbrushing frequency per day, and use of mouthwash, adjusted for the simplified O'Leary Oral Plaque Index.

DISCUSSION

The prevalence of gingivitis among adolescents attending a public secondary school in Acapulco, Mexico, was 35.2%. Clinical examination revealed that all cases corresponded to localized gingivitis. Multivariate analysis identified two associated factors: female sex and a toothbrushing frequency of fewer than three times per day.

This prevalence can be considered moderate and is comparable to the findings of the National Oral Health Survey conducted in mainland China, which reported a prevalence of 47.3% among adolescents aged 12–15, also with a predominance of localized gingivitis (18). In Iraq, epidemiological studies have likewise documented early-stage gingivitis in secondary school students, with a risk of progression despite the use of different diagnostic criteria (19). Contributing factors included infrequent dental visits, low socioeconomic status, tobacco use, inadequate toothbrushing frequency, and dental calculus accumulation (18,20).

In Latin America, these findings are consistent with studies conducted in Cuba and Brazil, where gingivitis has been associated with school type, limited access to dental services, and behaviors such as tobacco and alcohol consumption (21,22). In Ecuador, approximately half of adolescents present signs of mild gingivitis, mainly influenced by socioeconomic conditions and inadequate oral hygiene practices (23).

European data show similar trends. In Greece, a high prevalence has been associated with male sex, low parental education and income levels, poor oral hygiene, lack of regular dental care, and tobacco use (24). In contrast, a study in Romania reported a higher prevalence among females, attributed to incorrect toothbrushing techniques (25).

At the national level, considerable variability has been reported in gingivitis prevalence. Franco-Trejo et al. (26) identified lower rates, ranging from 13% to 26% of periodontal disease in the states of Zacatecas, Sinaloa, and Nuevo León. However, other studies have reported

much higher prevalences, between 70% and 80%, among university students in Acapulco, associated with poor oral hygiene, the presence of diastemas, and tooth wear (11,12). These discrepancies suggest that the absence of adequate hygiene practices during adolescence may favor the persistence of gingivitis and its potential progression to periodontitis.

Female students showed a higher probability of presenting gingivitis. Some studies support the notion that hormonal fluctuations during puberty may intensify the gingival inflammatory response, partially explaining this biological difference between sexes (6,7). Nevertheless, behavioral and social factors related to oral hygiene practices and access to dental care may also play a role. In this regard, differences in oral health perception, self-care habits, or the availability of preventive services could influence the higher prevalence observed among females. In general, the influence of unmeasured variables, such as socioeconomic status or diet, which could affect oral hygiene patterns, cannot be ruled out. These possible explanations, not directly evaluated in this study, should be considered as hypotheses for future research aimed at exploring the social determinants of oral health in adolescents.

Toothbrushing frequency was associated with the presence of gingivitis. Inadequate brushing often precedes the onset of gingivitis and has been associated in other adolescent populations with higher intake of fermentable carbohydrates and increased oral biofilm accumulation (27). In this study, brushing fewer than three times per day was linked to a higher prevalence of gingivitis; however, most international guidelines consider brushing at least twice a day to be sufficient as a standard practice. Therefore, this finding should be interpreted considering the local habits and conditions of the study population. Moreover, brushing efficacy depends not only on frequency but also on the technique used, which was not evaluated in this study. In addition, due to the cross-sectional design, causal relationships cannot be established.

Certain clinical conditions may also favor biofilm retention and subsequent gingival inflammation. Although participants with orthodontic appliances, prostheses, or dental anomalies were excluded, other factors such as dental crowding, retainers, or poorly adapted restorations are relevant and should be considered in preventing disease progression.

From a public health perspective, the promotion of oral health within the school setting is essential. Effective educational programs should emphasize proper brushing techniques, a minimum frequency of three times per day, and the use of dental floss (28,29). Educational interventions should be age-appropriate, culturally adapted, and gender-sensitive, using interactive materials. Regular dental screenings in schools are recommended to facilitate early detection and individualized follow-up. Active participation by teachers, families, and health professionals is crucial to ensure the sustained success of these programs (30).

Among the strengths of this study is the use of a clinical index aligned with current diagnostic standards, which allowed for accurate classification. In addition, restricting the sample to students from the same school grade enhanced comparability by reducing variability in development and behavior, while capturing a critical period of susceptibility. This strategy minimized potential confounding effects commonly observed in heterogeneous samples with mixed age groups.

Among the limitations, the cross-sectional design precludes causal inference and raises the possibility of reverse causality, particularly regarding toothbrushing frequency. Although examiners were calibrated, certain school-based conditions—such as natural lighting, participant posture, and the absence of full clinical equipment—may have introduced variability in probing pressure and technique. Inadequate probe insertion due to crown angulation could have led to an overestimation of bleeding. Student behavior may also have been influenced by prior awareness of the study's objective, potentially motivating temporary improvements in oral hygiene and partially explaining the high proportion of acceptable biofilm scores. Furthermore, the O'Leary Index has limitations in detecting interproximal biofilm, and the inflammatory response may vary depending on biofilm maturity and individual susceptibility. Additionally, self-reported data may be subject to courtesy bias, and the absence of key variables—such as socioeconomic status, dietary habits, and parental education—limited the depth of explanatory analysis.

Finally, the study focused on students from a single urban public secondary school; therefore, the results are not generalizable to private or rural institutions. Nevertheless, the findings provide valuable information for similar urban school contexts and contribute to the limited epidemiological database on periodontal health among Mexican adolescents.

CONCLUSIONS

The prevalence of gingivitis among the adolescents evaluated was moderate (35.2%), and all cases corresponded to localized gingivitis. Female sex and a toothbrushing frequency of fewer than three times per day were identified as the main associated factors. These results highlight the importance of strengthening school-based oral health promotion programs, with an emphasis on teaching proper oral hygiene techniques and raising awareness among both students and parents, to reduce the burden of periodontal disease at early stages of life.

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Authorship contribution:
ABC, JLLC: conceptualization, research, project administration.
JTO: conceptualization, methodology, supervision, validation.
CAJM: formal analysis, methodology, software, writing of original draft, writing - review & editing.
LSSF: formal analysis, validation, visualization, writing - review & editing.
AUHS: visualization, writing - review & editing.
EGV: supervision.

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REFERENCES

1. World Health Organization. Oral health [Internet]. OMS; March 17, 2025. Available from: https://www.who.int/news-room/fact-sheets/detail/oral-health
2. Rathee M, Jain P. Gingivitis. In: StatPearls [Internet]. Treasure Island: StatPearls; 2023. Available from: https://www.ncbi.nlm.nih.gov/books/NBK557422/
3. Kinane DF, Stathopoulou PG, Papapanou PN. Periodontal diseases. Nat Rev Dis Primers [Internet]. 2017; 3: 17038. Available from: https://doi.org/10.1038/nrdp.2017.38
4. Wang Y, Zhuo L, Yang S, Dong C, Shu P. Burden of periodontal diseases in young adults. Sci Rep [Internet]. 2025; 15: 6653. Available from: https://doi.org/10.1038/s41598-025-88249-0
5. Secretaría de Salud (MX). Resultados del Sistema de Vigilancia Epidemiológica de Patologías Bucales (SIVEPAB) 2023 [Internet]. Ciudad de México: Secretaría de Salud; 2024. Available from: https://www.gob.mx/cms/uploads/attachment/file/971603/Docto-SIVEPAB-23-29Enero_FINAL.pdf
6. Xiao L, Karapen K, Dong S, Yang H, Zhang X. Epidemiology of periodontal disease in adolescents in mainland China, 1983-2020: a systematic review and meta-analysis. Ann Palliat Med [Internet]. 2021; 10(1): 45-60. Available from: https://doi.org/10.21037/apm-20-1919
7. Alwithanani N. Periodontal disease and smoking: systematic review. J Pharm Bioallied Sci [Internet]. 2023; 15(suppl 1): S64-S71. Available from: https://doi.org/10.4103/jpbs.jpbs_516_22
8. Chimbinha ÍG, Ferreira BN, Miranda G, Guedes R. Oral-health-related quality of life in adolescents: umbrella review. BMC Public Health [Internet]. 2023; 23(1): 1603. Available from: https://doi.org/10.1186/s12889-023-16241-2
9. Gurav KM, Shetty V, Vinay V, Bhor K, Jain C, Divekar P. Effectiveness of oral health educational methods among school children aged 5-16 years in improving their oral health status: a meta-analysis. Int J Clin Pediatr Dent [Internet]. 2022; 15(3): 338-349. Available from: https://doi.org/10.5005/jp-journals-10005-2395
10. Shirahmadi S, Bashirian S, Soltanian AR, Karimi-Shahanjarini A, Vahdatinia F. Effectiveness of theory-based educational interventions of promoting oral health among elementary school students. BMC Public Health [Internet]. 2024; 24(1): 130. Available from: https://doi.org/10.1186/s12889-023-17528-0
11. Romero-Castro NS, Paredes-Solís S, Legorreta-Soberanis J, Reyes-Fernández S, Flores-Moreno M, Andersson N. Prevalence of gingivitis and associated factors among students from the Autonomous

University of Guerrero, Rev Cubana Estomatol [Internet]. 2016; 53(2): 9-16. Available from: https://revestomatologia.sld.cu/index.php/est/article/view/435/286
12. Romero-Castro NS, Castro-Alarcón N, Reyes-Fernández S, Flores-Alfaro E, Serna-Radilla VO, Parra-Rojas I. Periodontal disease distribution, risk factors, and importance of primary healthcare in the clinical parameters improvement. Int J Odontostomat [Internet]. 2020; 14(2): 183-190. Available from: http://doi.org/10.4067/S0718-381X2020000200183
13. Gallardo LM, Rodríguez JM, Juárez CA, Hernández J, Herrera AU. Prevalence of gingivitis and risk factors among pregnant women from Acapulco, Guerrero: a cross-sectional study. Rev Cient Odontol [Internet]. 2022; 10(1): e094. Available from: https://doi.org/10.21142/2523-2754-1001-2022-094
14. Madadizadeh F, Ghafari H, Bahariniya S. Kappa statistics: a method of measuring agreement in dental examinations. Open Public Health J [Internet]. 2023; 16: e18749445259818. Available from: https://openpublichealthjournal.com/VOLUME/16/ELOCATOR/e18749445259818/FULLTEXT/
15. Rajendra AB, Jones T. Enhancing precision: proposed revision of fdi's 2-digit dental numbering system. Int Dent J [Internet]. 2024; 74(2): 359-360. Available from: https://doi.org/10.1016/j.identj.2023.12.001
16. Chapple IL, Mealey BL, van Dyke TE, Bartold PM, Dommisch H, Eickholz P, et al. Periodontal health and gingival diseases and conditions on an intact and a reduced periodontium: consensus report of workgroup 1 of the 2017 world workshop on the classification of periodontal and peri-implant diseases and conditions. J Clin Periodontol [Internet]. 2018; 45(S1): S74-S84. Available from: https://doi.org/10.1002/jper.17-0719
17. Andersson N, Mitchell S. CIETmap: Free GIS and epidemiology software from the CIETgroup, helping to build the community voice into planning. Montreal: World Congress of Epidemiology; 2002.
18. Wang W, Feng X, Tai B, Hu D, Lin H, Wang B, et al. Epidemiology of plaque-induced gingivitis among 12-15-year-old Chinese schoolchildren: a study based on the 2018 case definition. J Clin Periodontol [Internet]. 2024; 51(3): 299-308. Available from: https://doi.org/10.1111/jcpe.13904
19. Kareem AR, Alwaheb AM, Abdulhameed NF. Dental caries and gingival health condition among secondary school adolescents in relation to the nutritional status in Kerbala City, Iraq. J Bagh Coll Dent [Internet]. 2024; 36(4): 1-6. Available from: https://doi.org/10.26477/jbcd.v36i4.3817
20. 20. Fan W, Liu C, Zhang Y, Yang Z, Li J, Huang S. Epidemiology and associated factors of gingivitis in adolescents in Guangdong Province, Southern China: a cross-sectional study. BMC Oral Health [Internet]. 2021; 21(1): 311. Available from: https://doi.org/10.1186/s12903-021-01666-1
21. Castro-Yero JL, Torrecilla-Venegas R, Yero-Mier IM, Castro-Gutérrez I, Muro-Rojas L. [Characterization of chronic gingivitis in an adolescent population]. Univ Méd Pinareña [Internet]. 2021; 17(1): e606. Available from: https://www.medigraphic.com/pdfs/revunimedpin/ump-2021/ump211l.pdf Spanish.
22. Silveira MF, Freire RS, Brito MF, Martins AM, Marcopito LF. Periodontal condition of adolescents and associated factors. Rev Gaúch Odontol [Internet]. 2019; 67: e2019004. Available from: https://doi.org/10.1590/1981-86372019000043489
23. Medina-Vega M, Ibarra MC, Quezada-Conde MC, Reis IN, Frias AC, Raggio D, et al. Periodontal status among 12-year-old schoolchildren: a population-based cross-sectional study in Quito, Ecuador. Braz Oral Res [Internet]. 2024; 38: e002. Available from: https://doi.org/10.1590/1807-3107bor-2024.vol38.0002
24. Chrysanthakopoulos NA. Prevalence of gingivitis and associated factors in 13-16-year-old adolescents in Greece. Eur J Gen Dent [Internet]. 2016; 5(2): 58-64. Available from: https://doi.org/10.4103/2278-9626.179536
25. Dicu DR, Lazăr AP, Lazăr L. Incidence of periodontal disease among adolescents. J Interdiscip Med [Internet]. 2020; 5(2): 71-75. Available from: https://doi.org/10.2478/jim-2020-0013
26. Franco-Trejo CC, García-Hernández GA, González-Álvarez AK, Álvarez-Morales GM, Medrano-Cortés E, García-Jau RA et al. Prevalencia de enfermedad periodontal y medidas higiénicas en secundarias públicas de Zacatecas, Sinaloa y Nuevo León. Cienc Frontera [Internet]. 2021; (supl. 1): 31-38. Available from: https://erevistas.uacj.mx/ojs/index.php/cienciafrontera/article/view/3529
27. Folayan MO, El Tantawi M, Chukwumah NM, Alade M, Oginni O, Mapayi B, et al. Individual and familial factors associated with caries and gingivitis among adolescents resident in a semi-urban community in South-Western Nigeria. BMC Oral Health [Internet]. 2021; 21(1): 166. Available from: https://doi.org/10.1186/s12903-021-01527-x
28. Simon F, Szabó G, Orsós M, Mijiritsky E, Németh O. The effectiveness of individualized oral hygiene education in preventing dental diseases: a clinical study. J Clin Med [Internet]. 2024; 13(18): 5481. Available from: https://doi.org/10.3390/jcm13185481
29. Eidenhardt Z, Ritsert A, Shankar-Subramanian S, Ebel S, Margraf-Stiksrud J, Deinzer R. Tooth brushing performance in adolescents as compared to the best-practice demonstrated in group prophylaxis programs: an observational study. BMC Oral Health [Internet]. 2021; 21: 359. Available from: https://doi.org/10.1186/s12903-021-01692-z

30. Saccomanno S, De Luca M, Saran S, Petricca MT, Caramaschi E, Mastrapasqua RF, et al. The importance of promoting oral health in schools: a pilot study. Eur J Transl Myol [Internet]. 2023; 33(1): 11158. Available from: https://doi.org/10.4081/ejtm.2023.11158