Oral Health Knowledge and Oral Hygiene Habits in a Sample of 12-Year-Old Hispanics: A Cross-sectional Study

Milagros J. Toro, DDS, MSD, PhD; Sona Rivas-Tumanyan, DMD, DrPh; Margarita Murillo, DDS, MSc*; Luis Orraca, DDS*; Bayardo Garcia-Godoy, DDS, MSc; Ana K. Bencosme, DDS; Augusto R. Elias-Boneta, DMD, MSD, DHC

Objective: To explore the association between hygiene knowledge and habits and gingivitis in Puerto Rican schoolchildren.

Methods: Questionnaires on oral health knowledge and hygiene habits were provided to almost half of the 12-year-olds who participated in an island-wide cross-sectional oral health study. The evaluations included gingival examinations in 2 quadrants. Odds ratios (ORs) (with 95% CIs) were computed using logistic regression models and oral health-related knowledge and hygiene habits to gingivitis.

Results: Of the 823 participants who completed the questionnaire 53.43% were female, and 81% had gingivitis. Most reported having received instructions on brushing (98%), flossing (89.5%), and using mouthwash (90%). The majority (75%) rated their gums as healthy, and 44.68% agreed that oral health affects general health. Nearly half (44%) reported brushing their teeth at least 2 times a day, and 80.25%,flossing daily. In multivariate analysis, not having been instructed on how to brush was related to greater odds of having gingivitis (OR: 7.32; 95% CI: 1.5-35.67). Flossing more than once a day was associated with half the odds of gingivitis (OR: 0.50; 95% CI: 0.29-0.88).

Conclusions: The children had knowledge of oral hygiene methods but were mostly unaware that gingival health could affect systemic health. Fewer than half reported brushing 2 or more times a day. Not having been instructed on how to brush was associated with higher odds of gingivitis.

[P R Health Sci J 2024;43(2):61-67]

Key words: Bleeding on probing, Gingivitis, Oral health knowledge, Oral hygiene

Gingivitis, a mild form of periodontal disease (PD), is a common oral health problem (1). The most common type of gingivitis, plaque-induced gingivitis, is caused by microbial biofilms (2). During puberty, periodontal tissues have a steroid hormone–related augmented response to dental plaque and other soft/hard dental deposits (2–5). Untreated gingivitis has the potential to progress to periodontitis, a more severe condition, one that contributes to tooth loss in adults (6). Therefore, gingivitis management is a primary strategy to prevent the development of periodontitis (7). The basis for gingivitis prevention/control is appropriate dental plaque removal (8–10). Having knowledge about oral health and disease risk factors improves oral care practices and contributes to healthy behaviors (11,12). It has been reported that tooth brushing and oral health knowledge are inversely associated with dental gingival bleeding (13). In addition, reductions of gingival scores have been reported in adolescents after an oral health educational intervention (14).

Differences in oral health knowledge, views, and behaviors have been identified in adolescents from different countries (15). The association between knowledge about both gingivitis and oral health and hygiene habits in schoolchildren in Puerto Rico (PR) is unexplored. Still, this information would be valuable to accurately evaluating the oral health needs of Puerto Ricans and to planning strategies for gingivitis management and the prevention of more advanced PD. This population-based, cross-sectional study aimed to explore the association between the knowledge of both gingivitis and oral health and hygiene habits.

Methods

Study Design

The present island-wide study was part of a more extensive comprehensive study that assessed the oral health status of 12-year-olds attending public and private schools in PR. The study design has been described previously (16,17). Specifically, this cross-sectional, island-wide representative study used a multi-stage sampling methodology.

Setting and Sample Selection

As has been previously described, the study was conducted at several private and public (urban and rural) schools on the island (16). The sampling frame consisted of the totality of private and public (urban and rural). Schools were stratified according to government health region, the determination of which had occurred in 1997.

School of Dental Medicine, University of Puerto Rico Medical Sciences Campus, San Juan, Puerto Rico

*The authors have no conflict of interest to disclose.*These authors contributed equally to this work.*

Address correspondence to: Milagros J. Toro, DDS, MSD, PhD, School of Dental Medicine, University of Puerto Rico Medical Sciences Campus, San Juan, Puerto Rico. Email: milagros.toro@upr.edu

Recruitment

In November 2010, after the main study was authorized by the Department of Education and the University of PR Medical Sciences Campus Institutional Review Board, the clinical procedures were begun, continuing until May 2011. A letter of invitation, an informed consent form, a medical history questionnaire, and a demographic information form were sent to the potential participants' parents. Using a computer-generated random number, 20 12-year-olds, were selected in each school to participate in the main study. A questionnaire about oral health knowledge/education and oral hygiene habits was administered to approximately half of the participants of the main study (10 children per school) (16).

Inclusion and Exclusion Criteria

Inclusion criteria

Being a healthy child (physical status classified as American Society of Anesthesiologists [ASA] I) or one with mild systemic disease (ASA II) (18), and being 12 years of age at the time of recruitment. Exclusion criteria: Being a child with a condition requiring antibiotic prophylaxis or who was unable to comply with the study procedures.

Study Procedures

All the clinical procedures were conducted in a single visit and comprised a medical history review; height and weight measurements, soft tissue examinations, cumulative caries experience (decayed, missing, and filled surfaces [DMFS] scores), pit and fissure sealant inspection, a dental fluorosis assessment, gingival evaluations (bleeding on probing), and a dental calculus assessment. All the fully erupted teeth in 2 randomly selected quadrants were assessed.

Details of the examination procedures have been previously described (17,19). The study outcome of gingivitis was defined as an individual's having at least 2 (that is, 25%) of his or her examined teeth showing gingival bleeding on probing (17).

Oral Health Knowledge and Oral Hygiene Habits Questionnaire

Trained study personnel administered a multiple-choice questionnaire to the children that explored their oral health knowledge and hygiene habits and answered the questions—if any—that the participating children had about the questionnaire and clarified any questions to the participants. The items on the instrument gathered information about the participants' knowledge of oral hygiene practices, dental plaque, gum disease, and PD, as well as examining the respondents' understanding of how the previous elements can affect an individual's general health.

Study Size

The objective of the main study was to estimate the prevalence and distribution of dental/gingival conditions in this population; therefore, our sample size calculations were based on the expected DMFS score values (19). To achieve the required sample size of 1500 participants, 133 schools were selected based on our assumption that 75% of the overall student population would meet the inclusion criteria and that, of those who did, 75% would complete the study. Due to time and budget constraints, administering the questionnaire to all the qualified individuals was not feasible; therefore, it was decided to survey 50% of the eligible children.

Statistical Methods

All the dental/gingival evaluation data were entered into Microsoft Excel spreadsheets and imported into the SAS statistical software, version 9.3 (SAS Statistical Institute, Cary, NC), and the files verified, managed, and analyzed. All the analyses accounted for clustering in the design and used inverse probability weighting. The distribution of the questionnaire responses was summarized using weighted frequencies and percentages, both in all the participants and by gingivitis status. To study the associations between gingivitis (yes/no) outcome and oral health knowledge, education, and oral hygiene habits, we used logistic regression models. Odds ratios (95% CIs) for gingivitis were calculated using unadjusted, as well as sex- and school-type-adjusted models, for several combinations of questionnaire response variables (knowledge, education, habits). Model 1 included oral health–knowledge questions on dental plaque, gum (periodontal) disease, and flossing. Model 2 comprised questions on oral health education (that is, whether the participant had been taught how to brush, floss, and use mouthwash). Additionally, in those who were taught how to brush/use mouthwash/floss), we studied whether the place where they were taught (home, school, or dentist's office vs. none of the above) was associated with gingivitis (models 3a, 3b, and 3c). Model 4 included the frequency of tooth brushing, mouthwash use, and flossing.

Results

A total of 823 children (weighted N = 886) completed the questionnaire on knowledge and oral hygiene habits; 53% of them were females, and 84.59% were from public schools. The majority of the questionnaire respondents (81.37%) had gingivitis, similar to the 80.41% reported in the overall study (17). Table 1 shows the oral health knowledge possessed by all the children, those with gingivitis, and by those who were gingivitis-free. Fewer than half of the children could correctly identify what dental plaque and gum (periodontal) disease were, with slightly better knowledge of the reasons for using dental floss (61% correctly identified "to clean dental plaque" as being one such reason). Nearly three-quarters of the participating children thought their gums were healthy, with only 44.68% of them agreeing that oral health may affect general health. Gingivitis-free children had somewhat better knowledge about dental plaque and oral health implications on general health than did children with gingivitis. Table 2 depicts oral hygiene instruction and sources for said instruction in the children. Most of the children reported having been taught how to brush (nearly 98%), floss (89.53%), and use mouthwash (90.08%). Most of them had learned how to brush and floss at home, the dentist's office, and/or school. Oral hygiene methods and their frequencies are displayed in Table 3. Fewer than half of the children reported brushing their teeth twice or more times a day (43.47%). The reported uses of mouthwash and dental floss at least once a day (each) were 73.2% and 80.21%, respectively.

Table 1. Oral health knowledge distribution[1] in 12-year-old Puerto Ricans: all respondents and by gingivitis status

Oral Health Knowledge	Response	All (WtN[2] = 886)	Participants with Gingivitis (WtN = 721)	Gingivitis-Free Participants (WtN = 165)
What is dental plaque? Identified correct answer (bacterial layer and food attached to the teeth)	yes no do not know no answer	346 (39.05) 391 (44.13) 146 (16.47) 3 (0.30)	268 (37.25) 329 (45.64) 122 (16.89) 2 (0.22)	78 (46.93) 62 (37.67) 24 (14.76) 1 (0.64)
What is gum/periodontal disease? Identified correct answer (a disease that affects the supporting tissues	yes no do not know	439 (49.60) 270 (30.47) 177 (19.93)	361 (50.08) 214 (29.69) 146 (20.23)	78 (47.48) 56 (33.86) 31 (18.66)
Why should one floss? Identified correct answer (to remove dental plaque)	yes no do not know	542 (61.21) 338 (38.16) 6 (0.63)	436 (60.54) 280 (38.89) 5 (0.57)	106 (64.11) 58 (34.99) 1 (0.90)
Self-rated periodontal status: Do you think your gums are healthy?	yes no do not know	659 (74.38) 98 (11.06) 129 (14.56)	540 (74.93) 81 (11.26) 100 (13.81)	119 (71.96) 17 (10.20) 29 (17.84)
General health implications: Do you think your oral health can affect your general health?	yes no do not know no answer	396 (44.68) 422 (47.63) 67 (7.53) 1 (0.16)	311 (43.16) 363 (50.34) 46 (6.31) 1 (0.20)	85 (51.30) 59 (35.82) 21 (12.87) 0 (0)

[1] Weighted frequencies (percentages) are presented. [2] WtN: weighted N

In the multivariate analysis (Table 4), not being taught to brush one's teeth was associated with having higher odds of gingivitis (OR: 7.32; 95% CI: 1.50-35.67). In the children who were taught to floss, those taught at home had a 56% reduction in the odds of gingivitis (OR: 0.44; 95% CI: 0.21-0.91) compared to those in the reference group. Compared to children that reported flossing once a day, those who flossed more frequently (more than once a day) had half the odds of gingivitis (OR: 0.50; 95% CI: 0.29-0.88).

Discussion

This population-based, cross-sectional study was—and remains—the first island-wide study to explore the association between gingivitis and oral health knowledge/hygiene habits in 12-year-old Puerto Ricans.

Concerning oral health knowledge, most of the participating children had been instructed on how to brush their teeth and how to use mouthwash, primarily at home, and nearly half of them were aware of PD's etiology and significance. A previous study on 12-year-old Puerto Ricans found that parents, mostly, had provided oral hygiene instructions and that 60% of the children who participated in the study were uninformed about PD prevention, particularly those attending public schools (20). Other studies worldwide have reported similar findings regarding the source of dental-care information (21).

Tooth brushing and dental flossing are essential oral hygiene behaviors to preserve gingival health. A high proportion (nearly 80%) of the children in our study claimed to brush at least once a day, and a little more than 40% of them reported toothbrushing twice or more a day. The frequency of tooth brushing among children and adolescents varies worldwide. From 34% to 83% of the 11-year-olds in 22 European countries and Canada brushed more than once a day (22). In the U.S., 72% of 11- to 13-year-olds brush with the same frequency (23). In our study, children not instructed on how to brush their teeth had significantly higher odds of gingivitis. In agreement with our findings, reports on gingival bleeding in Chinese adolescents have been associated with a low frequency of tooth brushing (24).

In the present study, children who received home instruction on dental flossing had nearly half the odds of getting gingivitis as did those who received such instruction somewhere else. Moreover, flossing was found to be a significant protective factor: Children who reported flossing more than once a day had a 50% reduction in the odds of gingivitis compared those who flossed only once in that same span of time. Interestingly, 80% of the children in our study claimed to use dental floss at least once a day; however, dental flossing has been reported as an infrequent oral hygiene method in adolescents from nations other than the US (which includes PR) (21,22). The gingival health status of children in our study was somewhat inconsistent with the responses to the administered questionnaire. This discrepancy was also perceived among Swedish adolescents. Although 76% of them reported brushing twice daily, 75% had gingival scores of >41% (25). As previously suggested in a study of oral health in 12-year-olds, over-reporting brushing frequency and using incorrect brushing techniques are possible explanations for our findings (26). The primary source of information on oral hygiene for children at home

Table 2. Oral hygiene instruction[1] in 12-year-old Puerto Ricans: all respondents and by gingivitis status

Oral Hygiene Instruction	Response Categories	All (WtN[2] = 886)	Participants with Gingivitis (WtN = 721)	Gingivitis-Free Participants (WtN = 165)
Brushing				
Were you taught how to brush your teeth?	yes	867 (97.84)2	702 (97.42)	165 (100)
	no	15 (1.69)	14 (2.01)	0 (0)
	do not know	2 (0.23)	2 (0.28)	0 (0)
	no answer	2 (0.24)	2 (0.29)	0 (0)
Where did you learn how to brush your teeth?	home	715 (80.71)	577 (80.09)	138 (83.41)
	school	472 (53.24)	378 (52.51)	93 (56.44)
	dentist's office	555 (62.63)	448 (62.10)	107 (64.94)
	TV	108 (12.21)	90 (12.44)	19 (11.21)
	other	65 (7.33)	55 (7.69)	10 (5.76)
	nowhere	6 (0.69)	5 (0.66)	1 (0.81)
	do not know	5 (0.51)	5 (0.63)	0 (0)
Flossing				
Were you taught how to floss?	yes	793 (89.53)	645 (89.49)	148 (89.73)
	no	89 (10.06)	73 (10.14)	16 (9.73)
	no answer	4 (0.40)	3 (0.37)	1 (0.54)
Where did you learn how to floss?	home	694 (78.31)	555 (77.04)	139 (83.87)
	school	234 (26.41)	192 (26.63)	42 (25.44)
	dentist's office	415 (46.84)	331 (45.96)	84 (50.68)
	TV	66 (7.49)	54 (7.51)	12 (7.39)
	other	29 (3.26)	24 (3.38)	5 (2.73)
	nowhere	32 (3.56)	27 (3.71)	5 (2.89)
	do not know	1 (0.08)	0 (0)	1 (0.41)
Mouthwash				
Were you taught how to use mouthwash?	yes	798 (90.08)	649 (90.02)	149 (90.35)
	no	83 (9.37)	67 (9.31)	16 (9.64)
	do not know	5 (0.50)	5 (0.61)	0 (0)
Where did you learn how to use mouthwash?	home	728 (82.17)	591 (82.01)	137 (82.87)
	school	211 (23.76)	162 (22.49)	48 (29.27)
	dentist's office	440 (49.64)	351 (48.71)	89 (53.69)
	TV	119 (13.48)	95 (13.17)	25 (14.83)
	other	45 (5.13)	32 (4.38)	14 (8.39)
	nowhere	42 (4.69)	32 (4.39)	10 (5.99)
	do not know	0 (0)	0 (0)	0 (0)

[1] Weighted frequencies (percentages) are presented. [2] WtN: weighted N

is their parents; therefore, emphasis should be placed on parents' accurate oral care knowledge and identifying motivating factors (27) for Puerto Rican children to practice better oral hygiene.

The scientific evidence supporting the benefit of dental flossing is weak; however, our findings suggest that it is a valuable adjunct to the oral hygiene method that consists of brushing, only. Children who reported flossing more than once a day had half the odds of gingivitis than did those flossing only once in that time period. This finding concurs with that of a previous study made in Tehran of 9- to 13-year-olds, which study reported that those unaware of dental flossing were over 3 times more likely to experience gingivitis than dental-floss users were and suggested that flossing at least twice a day had an independent effect on gingivitis prevention (28). Long-term, randomized clinical trials to determine the effectiveness of dental flossing in reducing clinical gingivitis are required to strengthen the evidence.

The present study has notable strengths. To our knowledge, this was—and remains—the first island-wide survey to investigate the association between gingivitis and oral health knowledge/hygiene habits in Puerto Rican school children. Another strength of our study was that the study personnel administered the questionnaire to the children instead of its being self-administered. Past findings on self-reported health-related behaviors in adolescents reveal that these individuals may be influenced by cognitive and situational factors that could result in respondent bias (29). Our study population was narrowed to 12-year-olds, the global monitoring age recommended for global oral health data comparisons (30); this is a limitation of our study. In addition, although the association between our subjects' not being taught to brush their teeth and the outcome of gingivitis in those subjects appeared to be strong (OR: 7.32; 95% CI: 1.50-35.67), the wide confidence interval for this OR suggests that these results should be interpreted with caution.

In older children, declines in gingivitis have been reported, which declines are presumably due to improvements in oral hygiene habits, response to social pressures (31), and/or stabilizing steroid hormone levels. Further studies assessing oral hygiene status using an oral plaque index could be helpful in the exploration of the association between dental plaque and gingivitis in this population. Further studies in older Puerto Rican adolescents are recommended to evaluate gingival status after the steadying of hormone levels in those individuals.

Since gingivitis is a reversible disease, prevention and early treatment will improve the level of gingival health and prevent the development and progression of PD and potential systemic associations. Oral hygiene behaviors acquired during pre-adolescence are often maintained throughout life (32); thus, early oral health education is an important public health strategy in the prevention and control of gingivitis. Investigating oral hygiene barriers in children, such as boredom, low oral health literacy, and forgetfulness, is required to develop approaches for the behavior modification of oral self-care.

In conclusion, 12-year-old Puerto Ricans were knowledgeable of oral hygiene methods; however, they were unaware of the gingival health/systemic implications of practicing (or not) these methods. Fewer than half of the children reported brushing 2 or more times/day. Not being taught how to brush was associated with significantly higher odds of gingivitis. Children who reported flossing more than once a day had half the odds of gingivitis compared to those who flossed only once a day.

Resumen

Objetivos: Explorar la asociación entre conocimientos y hábitos de higiene y gingivitis en escolares puertorriqueños. Métodos: Se proporcionaron cuestionarios sobre conocimientos de salud bucal y hábitos de higiene a casi la mitad de los niños de 12 años participantes de un estudio transversal de salud bucal en toda la isla. Las evaluaciones incluyeron exámenes gingivales en dos cuadrantes. Se calculó la razón de posibilidades (RP) (IC del 95%) mediante modelos de regresión logística, relacionando el conocimiento y los hábitos de higiene bucal con la gingivitis. Resultados: De los 823 participantes que completaron el cuestionario, 53.43% eran mujeres y 81% tenían gingivitis. La mayoría informó haber recibido instrucciones sobre cepillado (98%), uso del hilo dental (89.5%) y enjuague bucal (90%). La mayoría (75%) calificó sus encías como saludables y el 44.68% coincidió en que la salud bucal afecta la salud general. Casi la mitad (44%) informó cepillarse los dientes ≥ dos veces al día y el 80.25% usar hilo dental diariamente. En el análisis multivariado, no haber recibido instrucciones sobre cómo cepillarse se relacionó con mayores probabilidades de tener gingivitis (RP:7.32; IC 95%: 1.5-35.67). Usar hilo dental más de una vez diariamente se asoció con la mitad de las probabilidades de gingivitis (RP:0.50; IC del 95%: 0.29-0.88). Conclusiones: Los niños tenían conocimiento de métodos de higiene bucal, pero la mayoría desconocían que la salud gingival podría afectar la salud general. Casi la mitad informó cepillarse ≥ 2 veces al día. No haber recibido instrucciones sobre cepillado se asoció con mayores probabilidades de gingivitis.

Table 3. Distribution[1] of oral hygiene habits[1] in 12-year-old Puerto Ricans: all respondents and by gingivitis status

Oral Hygiene Habit	All (WtN[2] = 886)	Participants with Gingivitis (WtN = 721)	Gingivitis-Free Participants (WtN = 165)
Tooth brushing frequency			
<1/day or never	179 (20.25)	149 (20.67)	31 (18.42)
1/day	321 (36.20)	270 (37.42)	51 (30.84)
2/day	241 (27.15)	188 (26.13)	52 (31.59)
3+/day	145 (16.32)	113 (15.67)	32 (19.15)
do not know	1 (0.07)	1 (0.11)	0 (0)
Mouthwash-use frequency			
Never	234 (26.46)	194 (26.90)	40 (24.59)
1/day	387 (43.67)	315 (43.68)	72 (43.64)
>1/day	262 (29.53)	209 (29.01)	53 (31.77)
do not know	1 (0.16)	1 (0.20)	0 (0)
no answer	2 (0.18)	2 (0.22)	0 (0)
Flossing frequency			
Never	173 (19.58)	140 (19.37)	34 (20.51)
1/day	388 (43.76)	334 (46.39)	53 (32.31)
>1/day	323 (36.45)	245 (33.98)	78 (47.18)
no answer	2 (0.21)	2 (0.25)	0 (0)

[1] Weighted frequencies (percentages) are presented
[2] WtN: weighted N

Acknowledgments

The study was supported by the National Institutes of Health (S21MD001830) and Colgate-Palmolive (Caribbean) Inc. The funding bodies had no role in the design, collection, analysis, or interpretation of data or in writing the manuscript.

References

1. Albandar JM, Rams TE. Global epidemiology of periodontal diseases: an overview. Periodontol 2000. 2002;29:7-10. doi:10.1034/j.1600-0757.2002.290101.x
2. Murakami S, Mealey BL, Mariotti A, Chapple ILC. Dental plaque-induced gingival conditions. J Periodontol. 2018;89 Suppl 1:S17-S27. doi:10.1002/JPER.17-0095
3. Chaitra TR, Manuja N, Sinha AA, Kulkarni AU. Hormonal effect on gingiva: pubertal gingivitis. BMJ Case Rep. 2012;2012:bcr2012006193. Published 2012 Aug 27. doi:10.1136/bcr.2012.006193
4. Al-Ghutaimel H, Riba H, Al-Kahtani S, Al-Duhaimi S. Common periodontal diseases of children and adolescents. Int J Dent. 2014;2014:850674. doi:10.1155/2014/850674
5. Güncü GN, Tözüm TF, Cağlayan F. Effects of endogenous sex hormones on the periodontium--review of literature. Aust Dent J. 2005;50(3):138-145. doi:10.1111/j.1834-7819.2005.tb00352.x
6. Robinson PJ. Gingivitis: a prelude to periodontitis? J Clin Dent. 1995;6 Spec No:41–45.
7. Chapple IL, Van der Weijden F, Doerfer C, et al. Primary prevention of periodontitis: managing gingivitis. J Clin Periodontol. 2015;42 Suppl 16:S71-S76. doi:10.1111/jcpe.12366
8. Löe H. Oral hygiene in the prevention of caries and periodontal disease. Int Dent J. 2000;50(3):129-139. doi:10.1111/j.1875-595x.2000.tb00553.x
9. Albandar JM. Global risk factors and risk indicators for periodontal diseases. Periodontol 2000. 2002;29:177-206. doi:10.1034/j.1600-0757.2002.290109.x

Table 4. Odds ratio estimates (95% CIs) for gingivitis (yes/no), according to knowledge, oral health education, and hygiene practice category

Variables in the Model	Answer Category	Unadjusted OR (95% CI)	School Type- and Sex-Adjusted OR (95% CI)
1. Oral health knowledge (WtN1 = 884)	Child identified correct answer		
What is dental plaque?	no	1.55 (0.94-2.53)	1.51 (0.94-2.43)
	yes (ref.)	1.0	1.0
What is gum (periodontal) disease?	no	0.83 (0.51-1.36)	0.80 (0.49-1.31)
	yes (ref.)	1.0	1.0
Why should one floss?	no	1.16 (0.75-1.77)	1.19 (0.78-1.83)
	yes (ref.)	1.0	1.0
2. Oral hygiene education (WtN = 884)			
Were you taught how to brush your teeth?	no/don't know	7.38 (1.55-35.10)	7.32 (1.50-35.67)
	yes (ref.)	1.0	1.0
Were you taught how to use mouthwash?	no/don't know	1.02 (0.53-1.96)	1.05 (0.54-2.04)
	yes (ref.)	1.0	1.0
Were you taught how to floss?	no/don't know	0.96 (0.41-2.25)	0.98 (0.40-2.41)
	yes (ref.)	1.0	1.0
3a. In children who were taught how to brush their teeth (WtN = 866) Where did you learn how to brush your teeth?[2]	home	0.78 (0.40-1.52)	0.77 (0.38-1.54)
	home	0.78 (0.40-1.52)	0.77 (0.38-1.54)
	school	0.85 (0.53-1.36)	0.87 (0.55-1.38)
	dentist's office	0.90 (0.53-1.53)	0.95 (0.55-1.64)
	none of the above (ref.)	1.0	1.0
3b. In children who were taught how to use mouthwash (WtN = 796) Where did you learn how to use mouthwash?[2]	home	0.94 (0.31-2.84)	1.00 (0.35-2.91)
	school	0.72 (0.46-1.14)	0.75 (0.49-1.14)
	dentist's office	0.87 (0.52-1.45)	0.91 (0.53-1.56)
	none of the above (ref.)	1.0	1.0
3c. In children who were taught how to floss (WtN = 793) Where did you learn how to floss?[2]	home	0.41 (0.20-0.88)	0.44 (0.21-0.91)
	school	1.15 (0.65-2.02)	1.24 (0.68-2.25)
	dentist's office	0.73 (0.43-1.25)	0.75 (0.44-1.31)
	none of the above (ref.)	1.0	1.0
4. Oral hygiene habits (WtN = 881)			
Frequency of Tooth Brushing	3+/day	0.95 (0.47-1.92)	0.86 (0.45-1.64)
	1/day	1.37 (0.74-2.56)	1.37 (0.74-2.54)
	<1/day or never	1.30 (0.58-2.91)	1.22 (0.57-2.64)
	2/day (ref.)	1.0	1.0
Frequency of Mouthwash Use	>1/day	1.02 (0.54-1.94)	1.06 (0.57-1.99)
	never	1.18 (0.67-2.05)	1.16 (0.67-2.01)
	1/day (ref.)	1.0	1.0
Frequency of Flossing	<1/day or never	0.66 (0.34-1.27)	0.66 (0.35-1.27)
	>1/day	0.51 (0.30-0.89)	0.50 (0.29-0.88)
	1/day (ref.)	1.0	1.0

[1] WtN: weighted N. [2] Children could choose more than one answer. Abbreviations: OR, odds ratio; ref., reference group

10. Wade KJ, Meldrum AM. Gingivitis control. In: Panagakos FS, Davies RM, eds. Gingival Diseases: Their Aetiology, Prevention and Treatment. InTech; 2011:139-154. doi: 10.5772/24813
11. Deinzer R, Micheelis W, Granrath N, Hoffmann T. More to learn about: periodontitis-related knowledge and its relationship with periodontal health behaviour. J Clin Periodontol. 2009;36(9):756-764. doi:10.1111/j.1600-051X.2009.01452.x
12. Al-Darwish MS. Oral health knowledge, behaviour and practices among school children in Qatar. Dent Res J (Isfahan). 2016;13(4):342-353. doi:10.4103/1735-3327.187885
13. Gao J, Ruan J, Zhao L, Zhou H, Huang R, Tian J. Oral health status and oral health knowledge, attitudes and behavior among rural children in Shaanxi, western China: a cross-sectional survey. BMC Oral Health. 2014;14:144. Published 2014 Nov 29. doi:10.1186/1472-6831-14-144
14. Vangipuram S, Jha A, Raju R, Bashyam M. Effectiveness of Peer Group and Conventional Method (Dentist) of Oral Health Education Programme Among 12-15 year Old School Children - A Randomized Controlled Trial. J Clin Diagn Res. 2016;10(5):ZC125-ZC129. doi:10.7860/JCDR/2016/17725.7844
15. Graça SR, Albuquerque TS, Luis HS, et al. Oral Health Knowledge, Perceptions, and Habits of Adolescents from Portugal, Romania, and Sweden: A Comparative Study. J Int Soc Prev Community Dent. 2019;9(5):470-480. doi:10.4103/jispcd.JISPCD_194_19
16. Elias-Boneta AR, Toro MJ, Rivas-Tumanyan S, et al. Persistent oral health disparity in 12-year-old Hispanics: a cross-sectional study. BMC Oral Health. 2016;16:10. Published 2016 Feb 1. doi:10.1186/s12903-016-0162-7
17. Elias-Boneta AR, Ramirez K, Rivas-Tumanyan S, Murillo M, Toro MJ. Prevalence of gingivitis and calculus in 12-year-old Puerto Ricans: a

cross-sectional study. BMC Oral Health. 2018;18(1):13. Published 2018 Jan 19. doi:10.1186/s12903-017-0471-5
18. Daabiss M. American Society of Anaesthesiologists physical status classification. Indian J Anaesth. 2011;55(2):111-115. doi:10.4103/0019-5049.79879
19. Elías-Boneta AR, Crespo Kebler K, Gierbolini CC, Toro Vizcarrondo CE, Psoter WJ. Dental caries prevalence of twelve year olds in Puerto Rico. Community Dent Health. 2003;20(3):171-176.
20. Crespo K, Elías A, Toro C, Giusti J, González C, Rivera R. Oral Health Knowledge and DMFS in 12 Year Olds. (IADR abstract #2384). J Dent Res. 1999;78(Issue 1-Suppl):403. doi: 10.1177/0022034599078S101
21. Azodo CC, Agbor AM. Gingival health and oral hygiene practices of schoolchildren in the North West Region of Cameroon. BMC Res Notes. 2015;8:385. Published 2015 Aug 29. doi:10.1186/s13104-015-1350-2
22. Kuusela S, Honkala E, Kannas L, Tynjälä J, Wold B. Oral hygiene habits of 11-year-old schoolchildren in 22 European countries and Canada in 1993/1994. J Dent Res. 1997;76(9):1602-1609. doi:10.1177/00220345970760091301
23. Maes L, Vereecken C, Vanobbergen J, Honkala S. Tooth brushing and social characteristics of families in 32 countries. Int Dent J. 2006;56(3):159-167. doi:10.1111/j.1875-595x.2006.tb00089.x
24. Gao J, Ruan J, Zhao L, Zhou H, Huang R, Tian J. Oral health status and oral health knowledge, attitudes and behavior among rural children in Shaanxi, western China: a cross-sectional survey. BMC Oral Health. 2014;14:144. Published 2014 Nov 29. doi:10.1186/1472-6831-14-144
25. Ericsson JS, Wennström JL, Lindgren B, Petzold M, Östberg AL, Abrahamsson KH. Health investment behaviours and oral/gingival health condition, a cross-sectional study among Swedish 19-year olds. Acta Odontol Scand. 2016;74(4):265-271. doi:10.3109/00016357.2015.1112424
26. Zhang S, Liu J, Lo EC, Chu CH. Dental and periodontal status of 12-year-old Bulang children in China. BMC Oral Health. 2014;14:32. Published 2014 Apr 5. doi:10.1186/1472-6831-14-32
27. Walker K, Jackson R. The health belief model and determinants of oral hygiene practices and beliefs in preteen children: a pilot study. Pediatr Dent. 2015;37(1):40-45.
28. Jessri M, Jessri M, Rashidkhani B, Kimiagar SM. Oral health behaviours in relation to caries and gingivitis in primary-school children in Tehran, 2008. East Mediterr Health J. 2013;19(6):527-534.
29. Brener ND, Billy JO, Grady WR. Assessment of factors affecting the validity of self-reported health-risk behavior among adolescents: evidence from the scientific literature. J Adolesc Health. 2003;33(6):436-457. doi:10.1016/s1054-139x(03)00052-1
30. World Health Organization. Oral health surveys: basic methods. 4 ed. World Health Organization: ORH/EPID; 1997.
31. Hugoson A, Koch G, Hallonsten AL, Norderyd J, Aberg A. Caries prevalence and distribution in 3-20-year-olds in Jönköping, Sweden, in 1973, 1978, 1983, and 1993. Community Dent Oral Epidemiol. 2000;28(2):83-89. doi:10.1034/j.1600-0528.2000.028002083.x
32. Saied-Moallemi Z, Virtanen JI, Vehkalahti MM, Tehranchi A, Murtomaa H. School-based intervention to promote preadolescents' gingival health: a community trial. Community Dent Oral Epidemiol. 2009;37(6):518-526. doi:10.1111/j.1600-0528.2009.00491.x