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Association between malocclusion and bullying related to dental appearance among adolescents: a population-based study

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Abstract

Background

Malocclusion may negatively affect adolescents' psychosocial well-being, particularly when dentofacial characteristics are perceived as unattractive. This study assessed the association between malocclusion and bullying related to dental appearance among adolescents.

Methods

A cross-sectional study was conducted with a representative sample of 1,015 adolescents aged 12–15 years enrolled in public and private schools. Malocclusion was assessed using Angle's classification, the Dental Aesthetic Index (DAI), and additional occlusal characteristics. Bullying related to dental appearance was assessed through a structured questionnaire. Associations were evaluated using hierarchical logistic regression models, and results were expressed as odds ratios (OR) and 95% confidence intervals (95% CI).

Results

The prevalence of bullying related to dental appearance was 10.2%. After adjustment, adolescents from lower socioeconomic groups and those attending public schools were more likely to report bullying. Among the occlusal characteristics evaluated, disabling malocclusion (OR = 1.86; 95%CI: 1.10–3.15), anterior crowding (OR = 2.47; 95%CI: 1.47–4.14), maxillary anterior misalignment (OR = 2.70; 95%CI: 1.43–5.10), mandibular anterior misalignment (OR = 2.52; 95%CI: 1.09–5.80), very severe maxillary overjet (OR = 2.58; 95%CI: 1.49–4.47), and deep overbite (OR = 1.76; 95%CI: 1.10–2.81) were associated with bullying related to dental appearance.

Conclusions

Bullying related to dental appearance affected approximately one in ten adolescents and was associated with socioeconomic factors, school context, and malocclusions characterized by greater aesthetic impairment. These findings highlight the psychosocial impact of visible occlusal traits during adolescence.

Background

Bullying is a widespread phenomenon among children and adolescents and has become an important public health concern worldwide [1, 2]. It is characterized as intentional and repeated aggressive behavior perpetrated by one or more individuals against another person over time, causing physical, emotional, or social harm[1]. Different forms of bullying have been described, including physical

aggression, verbal abuse, social exclusion, humiliation, threats, and cyberbullying [2, 3]. Regardless of the form in which it occurs, bullying can negatively affect psychological well-being, academic performance, and social relationships during a critical stage of development [3–5].

Physical appearance is among the most common reasons for victimization among children and adolescents [4, 5], and dentofacial characteristics have been identified as frequent targets of teasing and social exclusion [6]. Dentofacial appearance plays an important role in facial attractiveness and social interactions and is therefore one of the main motivations for seeking orthodontic treatment during childhood and adolescence [7–9]. Previous studies have reported associations between dentofacial appearance, bullying experiences, and adverse psychosocial outcomes among children and adolescents [6, 10].

Malocclusion is one of the most prevalent oral health conditions affecting children and adolescents worldwide [11]. Due to its high prevalence and potential impact on oral function, psychosocial well-being, and quality of life, malocclusion is recognized as an important oral health condition [11, 12]. Previous studies have shown that adolescents with malocclusion may experience poorer oral health-related quality of life, particularly when esthetic concerns are present [13]. Furthermore, bullying related to dentofacial appearance has been associated with negative emotional and social outcomes, including reduced self-esteem, anxiety, loneliness, and impaired school performance [6].

Recent systematic reviews have reported associations between dentofacial characteristics, malocclusion, and bullying experiences among children and adolescents, but the available evidence remains heterogeneous and of limited certainty [8, 10]. Differences in the assessment of bullying, malocclusion, and dentofacial characteristics limit direct comparisons across studies and hinder the interpretation of findings [10]. In addition, many studies have focused on selected dentofacial features or clinical orthodontic populations, while population-based investigations simultaneously evaluating malocclusion severity, specific occlusal traits, and bullying related to dental appearance remain relatively uncommon [8, 10].

Therefore, this population-based study aimed to assess the association between malocclusion and bullying related to dental appearance among adolescent students from a Brazilian city.

Methods

Study design and sample

This cross-sectional study was conducted among 12- to 15-year-old adolescents enrolled in public and private schools in São Luís, Maranhão, Brazil. The study used data from a population-based survey designed to investigate malocclusion, orthodontic treatment needs, functional alterations, and oral health-related quality of life. The sample size calculation and sampling procedures have been described previously [13].

A total of 1,050 adolescents were assessed for eligibility. Seventeen undergoing orthodontic treatment were excluded. Of the remaining 1,033 eligible participants, seven declined participation and 11 were absent during data collection. The final sample comprised 1,015 adolescents.

Examiner training, calibration, and pilot study

Data collection was conducted by two trained and calibrated teams, each consisting of one interviewer/recorder and one orthodontist examiner. Diagnostic reproducibility was assessed before the main study using Kappa statistics and intraclass correlation coefficient, adopting a minimum acceptable value of 0.70. Intra-examiner reproducibility ranged from 0.88 to 0.91, while inter-examiner reproducibility ranged from 0.79 to 0.81. A pilot study involving 32 adolescents was conducted to evaluate questionnaire administration procedures and clinical examination protocols under field conditions. The pilot study participants were not included in the final analytical sample.

Data collection

Data collection followed World Health Organization recommendations for oral health surveys and was performed under natural light conditions [14]. Data was collected by two trained and calibrated teams, each composed of an interviewer/recorder and an orthodontist examiner. All questionnaires were administered by trained interviewers using a structured questionnaire.

Sociodemographic and socioeconomic information, including school type, household income, educational level of the head of household, socioeconomic status, history of grade repetition, and self-reported race/skin color, was obtained from parents or legal guardians. Behavioral information, including bullying related to dental appearance, was obtained directly from the adolescents. Clinical data were collected through orthodontic examinations. Data was collected between March/2012 and October/2013.

Socioeconomic status was classified according to the criteria established by the Brazilian Association of Research Companies (ABEP) [15], which categorizes households into classes A–B (higher socioeconomic status), C (intermediate socioeconomic status), and D–E (lower socioeconomic status) based on household assets and living conditions.

Assessment of malocclusion

Malocclusion was assessed using Angle's classification [16], the Dental Aesthetic Index (DAI) [17], and additional occlusal traits not included in the DAI. Participants were classified according to Angle's classification as having normal occlusion, Class I, Class II, or Class III malocclusion [16].

The DAI was used to assess malocclusion severity and normative orthodontic treatment need [17]. Based on DAI scores, participants were categorized as having normal or minor malocclusion (DAI ≤25), definite malocclusion (DAI 26–30), severe malocclusion (DAI 31–35), or disabling malocclusion (DAI ≥36).

In addition to the DAI components, posterior crossbite, posterior open bite, and deep overbite were evaluated separately. The occlusal characteristics analyzed included missing anterior teeth, anterior crowding, anterior spacing, incisal diastema, maxillary and mandibular anterior misalignment, maxillary overjet, anterior crossbite, anterior openbite, posterior crossbite, posterior open bite, and deep overbite.

Clinical examinations were performed using an orthodontic wire, an adapted silicone stop, and a millimeter endodontic ruler [13,18].

Assessment of bullying related to dental appearance

The outcome of interest was self-reported bullying related to dental appearance. This variable was assessed using a single item from the dentofacial appearance satisfaction section of the study questionnaire [13,18], which asked: “Do you think people are teasing you or making fun of you because of the appearance of your teeth?” Responses were recorded on an 11-point scale ranging from 0 (“never”) to 10 (“always”). For analytical purposes, responses were dichotomized as follows: no bullying (scores 0–5) and bullying (scores 6–10), representing frequent perception of teasing related to dental appearance.

Statistical analysis

Data were analyzed using Stata for Windows, version 14.0 (StataCorp, College Station, TX, USA). Descriptive analyses were performed using absolute and relative frequencies and their corresponding 95% confidence intervals (95% CI). Differences in the distribution of categorical variables were assessed using Pearson’s chi-square test, adopting a significance level of 5%.

Variables with p-values <0.20 in the univariate analyses were considered eligible for inclusion in the multivariable analysis. A hierarchical conceptual framework was adopted (Figure 1). The hierarchical modeling strategy was based on a conceptual framework in which distal determinants may influence the outcome directly or through variables located at more proximal levels [19]. Demographic (sex and age) and socioeconomic variables (skin color and socioeconomic status) were considered distal determinants of bullying related to dental appearance. School-related variables (type of school administration and history of grade repetition) were included at the intermediate level, whereas clinical variables related to malocclusion were considered proximal determinants.

Multivariable logistic regression models were fitted according to the hierarchical framework. Variables from each level associated with the outcome at $p<0.10$ were retained and entered as adjustment factors for variables at subsequent levels. Intermediate-level variables were adjusted for retained distal-level variables, and proximal malocclusion variables were adjusted for variables retained from both distal and intermediate levels. Adjusted odds ratios (ORs) and corresponding 95% confidence intervals (95% CI) were estimated. Statistical significance was set at $p<0.05$.

Results

The final sample comprised 1,015 adolescents aged 12–15 years. Females accounted for 50.4% of the participants, 61.4% reported brown skin color, and 75.5% attended public schools. Class I malocclusion was the most prevalent occlusal pattern (56.3%), and 44.7% of the adolescents presented a normative need for orthodontic treatment. Overall, 10.2% reported bullying related to dental appearance (Table 1).

Table 1
Association between socioeconomic/demographic variables and bullying related to dental appearance in adolescents.

	Bullying				
	No		**Yes**		p-value
	N	%	n	%	
Gender					0.36
Male	464	90.6	48	9.4	
Female	447	88.9	56	11.13	
Age (years)					0.35
12	402	88.2	54	11.8	
13	173	90.1	19	9.9	
14	210	93.3	15	6.7	
15	126	88.7	16	11.3	
Socioeconomic class (ABEP)					**0.02**
A-B	303	93.5	21	6.5	
C	512	87.8	71	12.2	
D-E	96	88.9	12	11.1	
Skin color					0.26
White	229	91.9	20	8.1	
Brown	556	89.2	67	10.8	
Black	126	88.1	17	11.9	
Type of school administration					**< 0.001**
Private	238	95.6	11	4.4	
Public	673	87.9	93	12.1	
Grade repetition					**0.006**
No	677	90.9	67	9.1	
Yes	233	86.6	36	13.4	

In the adjusted analysis, socioeconomic status and school administration were associated with bullying. Adolescents from socioeconomic classes C (OR = 2.18; 95% CI: 1.31–3.64) and D-E (OR = 2.00; 95% CI:

1.01–4.82) had higher odds of reporting bullying than those from classes A-B. Adolescents attending public schools had higher odds of reporting bullying related to dental appearance than those attending private schools (OR = 2.77; 95% CI: 1.74–4.43) (Table 2).

Table 2
Univariate logistic regression analysis between socioeconomic/demographic variables and bullying related to dental appearance in adolescents

	Bullying					
	Crude			Adjusted[1]		
	OR	95% CI	p-value	OR[1]	95% CI	p-value[1]
Gender						
Male	Ref.					
Female	1.21	0.80–1.84	0.36			
Age (years)						
12	Ref.			Ref.		
13	0.82	0.44–1.52	0.51	0.73	0.37–1.43	0.35
14	0.53	0.23–1.24	0.14	0.47	0.20–1.11	0.08
15	0.95	0.45–1.99	0.88	0.84	0.41–1.74	0.63
Socioeconomic class (ABEP)						
A-B	Ref.			Ref.		
C	2.00	1.25–3.20	0.005	2.18	**1.31–3.64**	**0.004**
D-E	1.80	0.79–4.12	0.15	2.00	**1.01–4.82**	**0.04**
Skin color						
White	Ref.					
Brown	1.38	0.85–2.24	0.18			
Black	1.54	0.91–2.62	0.10			
Type of school administration						
Private	Ref.			Ref.		
Public	2.99	1.89–4.74	< 0.001	**2.77**	**1.74–4.43**	**< 0.001**
Grade repetition						
No	Ref.					
Yes	1.56	**1.15–2.12**	**0.006**			

[1] Only variables with a p-value less than 10% were kept in the multivariate regression model.

Regarding occlusal characteristics, adolescents with disabling malocclusion showed a higher prevalence of bullying (15.3%) than those with normal/mild malocclusion (10.1%). Higher frequencies of bullying were also observed among adolescents with crowding in two anterior segments (16.2%), maxillary misalignment ≥ 3 mm (18.7%), mandibular misalignment ≥ 3 mm (19.1%), and very severe maxillary overjet (16.8%) (Table 3).

Table 3
Association between malocclusion variables and bullying related to dental appearance in adolescents

	Bullying related to dental appearance				
	No		Yes		p-value
	n	%	n	%	
Malocclusions					0.33
Angle's classification					
Normal	49	90.7	5	9.3	
Class I	516	90.4	55	9.6	
Class II	294	87.8	41	12.2	
Class III	52	94.5	3	5.5	
DAI					**0.016**
Normal/mild	312	89.9	35	10.1	
Defined	200	93.5	14	6.5	
Severe	183	91.9	16	8.1	
Disabling	216	84.7	39	15.3	
Loss of anterior teeth					0.49
No	814	89.5	95	10.5	
Yes	96	90.6	10	9.4	
Anterior crowding					**0.025**
No	513	91.0	51	9.0	
1 segment crowded	248	91.2	24	8.8	
2 segments crowded	150	83.8	29	16.2	
Anterior spacing					0.28
No	618	89.0	76	11.0	
1 segment spaced	198	90.4	21	9.6	
2 segments spaced	96	94.1	6	5.9	
Incisal diastema					0.21
No	700	89.4	83	10.6	

	Bullying related to dental appearance				
< 2mm	82	95.3	4	4.7	
≥ 2mm	129	88.4	17	11.6	
Maxillary misalignment					**0.019**
No	587	90.7	60	9.3	
< 3mm	237	90.8	24	9.2	
≥ 3mm	87	81.3	20	18.7	
Mandibular misalignment					**0.042**
No	537	90.4	57	9.6	
< 3mm	319	90.4	34	9.6	
≥ 3mm	55	80.9	13	19.1	
Maxillary overjet					**0.031**
Normal (< 2mm)	302	90.1	33	9.9	
Mild (2–3 mm)	403	91.4	38	8.6	
Severe (> 3mm and <5mm)	112	88.9	14	11.1	
Very severe (≥ 5mm)	94	83.2	19	16.8	
Anterior crossbite					0.92
No	878	89.8	100	10.2	
≤ 2mm	27	90.0	3	10.0	
> 2mm	6	85.7	1	14.3	
Anterior open bite					0.63
No	861	89.8	98	10.2	
≤ 1mm	11	91.7	1	8.3	
> 1mm and ≤5mm	36	90.0	4	10.0	
> 5mm	3	75.0	1	25.0	
Deep overbite (≥ 3mm)					0.26
No	631	90.5	66	9.5	
Yes	280	88.1	38	11.9	
Posterior crossbite					0.97

	Bullying related to dental appearance				
No	805	89.7	92	10.3	
Yes	106	89.8	12	10.2	
Posterior open bite					0.86
No	837	89.7	96	10.3	
Yes	74	90.2	8	9.8	

DAI: Dental Aesthetic Index.

After adjustment for age, socioeconomic status, and school administration (Table 4), adolescents with disabling malocclusion were more likely to report bullying than those with normal or mild malocclusion (OR = 1.86; 95% CI: 1.10–3.15). Deep overbite was also associated with bullying (OR = 1.76; 95% CI: 1.10–2.81). Crowding in two anterior segments (OR = 2.47; 95% CI: 1.47–4.14), maxillary misalignment ≥ 3 mm (OR = 2.70; 95% CI: 1.43–5.10), mandibular misalignment ≥ 3 mm (OR = 2.52; 95% CI: 1.09–5.80), and very severe maxillary overjet (OR = 2.58; 95% CI: 1.49–4.47) were also associated with bullying.

Table 4
Univariate logistic regression analysis between malocclusion variables and bullying related to dental appearance in adolescents

	Bullying related to dental appearance					
	Crude			Adjusted[1]		
	OR	95% CI	p-value	OR[1]	95% CI	p-value[1]
Malocclusions						
Angle						
Normal	Ref.			Ref.		
Class I	1.04	0.45–2.43	0.92	0.70	0.35–1.42	0.31
Class II	1.37	0.50–3.75	0.53	0.45	0.19–1.05	0.06
Class III	0.57	0.14–2.29	0.41	0.78	0.37–1.63	0.49
DAI						
Normal/mild	Ref.			Ref.		
Defined	0.62	0.29–1.35	0.22	0.65	0.29–1.42	0.65
Severe	0.78	0.40–1.51	0.45	0.86	0.44–1.69	0.65
Disabling	1.61	1.00-2.62	0.05	**1.86**	**1.10–3.15**	**0.022**
Loss of anterior teeth						
No	Ref.			Ref.		
Yes	0.80	0.42–1.53	0.45	0.66	0.34–1.26	0.19
Anterior crowding						
No	Ref.			Ref.		
1 segment crowded	0.97	0.53–1.78	0.93	1.09	0.58–2.06	0.78
2 segments crowded	1.94	1.22–3.09	0.007	**2.47**	**1.47–4.14**	**0.001**
Anterior spacing						
No	Ref.			Ref.		
1 segment spaced	0.86	0.48–1.53	0.60	0.91	0.50–1.65	0.75
2 segments spaced	0.51	0.22–1.19	0.11	0.52	0.22–1.22	0.13
Incisal diastema						
No	Ref.			Ref.		

	Bullying related to dental appearance					
	Crude			Adjusted[1]		
< 2mm	0.41	0.12–1.47	0.16	0.41	0.11–1.47	0.16
≥ 2mm	1.11	0.71–1.75	0.64	1.13	0.71–1.81	0.59
Maxillary misalignment						
No	Ref.			Ref.		
< 3mm	0.99	0.56–1.76	0.97	0.97	0.54–1.71	0.90
≥ 3mm	2.25	1.26–4.01	0.008	**2.70**	**1.43–5.10**	**0.003**
Mandibular misalignment						
No	Ref.			Ref.		
< 3mm	1.00	0.75–1.35	0.97	1.16	0.86–1.56	0.31
≥ 3mm	2.23	1.05–4.71	0.04	**2.52**	**1.09–5.80**	**0.03**
Maxillary overjet						
Normal (< 2mm)	Ref.			Ref.		
Mild (2–3 mm)	0.86	0.54–1.39	0.53	0.97	0.60–1.56	0.89
Severe (> 3mm and <5mm)	1.14	0.68–1.93	0.6	1.59	0.90–2.81	0.11
Very severe (≥ 5mm)	1.85	1.11–3.09	0.02	**2.58**	**1.49–4.47**	**0.001**
Anterior crossbite						
No	Ref.			Ref.		
≤ 2mm	0.98	0.32–2.99	0.96	0.84	0.28–2.55	0.75
> 2mm	1.46	0.14–15.86	0.75	1.14	0.10-12.86	0.91
Anterior open bite						
No	Ref.			Ref.		
≤ 1mm	0.80	0.23–2.73	0.71	0.77	0.25–2.34	0.63
> 1mm and ≤5mm	0.98	0.41–2.34	0.95	0.89	0.37–2.17	0.80
> 5mm	2.93	0.25–34.18	0.38	2.37	0.20-27.82	0.48
Deep overbite (≥ 3mm)						
No	Ref.			Ref.		
Yes	1.29	0.82–2.02	0.26	**1.76**	**1.10–2.81**	**0.02**

	Bullying related to dental appearance					
	Crude			Adjusted[1]		
Posterior crossbite						
No	Ref.			Ref.		
Yes	0.99	0.53–1.84	0.97	0.93	0.47–1.85	0.84
Posterior open bite						
No	Ref.			Ref.		
Yes	0.94	0.47–1.89	0.86	0.78	0.38–1.62	0.49

[1] Adjusted for age, ABEP socioeconomic class, and type of school administration.

Ref.: reference category; DAI: Dental Aesth

Discussion

In this population-based study, approximately one in ten adolescents reported bullying related to dental appearance. Socioeconomic status, school administration, disabling malocclusion, deep overbite, anterior crowding, anterior dental misalignment, and very severe maxillary overjet were associated with bullying related to dental appearance. Overall, the findings reinforce the relevance of visible occlusal characteristics in adolescents' social experiences.

The prevalence of bullying related to dental appearance observed in the present study (10.2%) was comparable to that reported among schoolchildren in the United Kingdom (9.7%) [20], suggesting a similar burden of appearance-related peer victimization in school-based populations. This result is supported by previous research indicating that teeth constitute one of the most frequently reported physical features targeted by bullying, ranking among the three most commonly cited characteristics by victims (24.3%) [6].

Similarly, a recent study conducted in Egypt reported a high prevalence of bullying and demonstrated associations with malocclusion traits and orthodontic treatment need [21], reinforcing the role of dentofacial characteristics as relevant factors in peer victimization. However, differences in study design, cultural context, and measurement approaches limit direct comparability across populations. Overall, systematic reviews have highlighted considerable heterogeneity in the prevalence of bullying associated with dentofacial characteristics, likely reflecting methodological and contextual differences across studies [8, 10].

No significant association was observed between bullying and gender, which is consistent with findings from previous studies [6, 22]. Although some investigations have reported gender differences in bullying victimization [23], evidence remains inconsistent, particularly when bullying related to physical

appearance is evaluated. Recent literature suggests that social, environmental, and individual characteristics may play a more important role than gender alone in determining vulnerability to bullying experiences [8].

Socioeconomic status was associated with bullying related to dental appearance, with adolescents from less advantaged socioeconomic groups presenting higher odds of reporting bullying. This finding is consistent with previous studies indicating that social inequalities may influence both oral health conditions and psychosocial experiences during adolescence [21, 24]. Socioeconomic disadvantage has been associated with a higher burden of untreated oral conditions, reduced access to orthodontic treatment, and poorer oral health-related quality of life, factors that may contribute to greater exposure to appearance-related stigma [25, 26].

An association was also observed between school administration and bullying, with higher odds among students enrolled in public schools compared to private schools, suggesting a potential influence of school context on peer victimization. This finding is consistent with previous evidence showing a higher prevalence of bullying in public school settings [6, 23], although heterogeneity in measurement approaches limits direct comparisons across studies. Overall, these findings suggest that school context and socioeconomic conditions are closely interrelated and may jointly influence the occurrence of bullying related to dentofacial appearance. Rather than an individual-level phenomenon, bullying in this context appears to reflect broader social and structural determinants.

Regarding malocclusion, only disabling malocclusion remained associated with bullying after adjustment. This finding suggests that more severe dentofacial alterations may have greater social visibility and consequently a greater impact on peer interactions. Previous studies have similarly reported associations between orthodontic treatment need, severe malocclusion, dissatisfaction with dental appearance, and bullying experiences among adolescents [6, 25, 27]. Furthermore, recent systematic reviews concluded that severe dentofacial characteristics are consistently associated with a higher likelihood of bullying victimization [8, 10, 28].

An important finding of the present study was that specific anterior occlusal traits showed stronger associations with bullying than broader malocclusion classifications. Adolescents presenting anterior crowding, maxillary and mandibular misalignment, and very severe maxillary overjet had significantly higher odds of reporting bullying related to dental appearance. These findings are biologically and socially plausible because anterior dental characteristics are highly visible during speech, smiling, and social interaction. Previous studies have reported that visible dentofacial deviations are among the oral characteristics most frequently associated with teasing, negative social judgments, and dissatisfaction with appearance [10, 21, 22, 27, 28]. Recent evidence also -suggests that conspicuous anterior dental irregularities may be perceived more negatively by peers than less visible occlusal alterations [8, 28].

Deep overbite was also associated with bullying in the adjusted model. Although this characteristic has received less attention in the literature than increased overjet or anterior crowding, a previous systematic review identified extreme deep overbite as one of the malocclusions associated with a higher likelihood

of bullying victimization [10]. Nevertheless, evidence regarding the specific role of deep overbite remains limited compared with other occlusal traits. Therefore, and considering the lower statistical power for this variable in the present study, this finding should be interpreted with caution.

The observation that specific anterior dental characteristics were associated with bullying is consistent with the concept that psychosocial impacts of malocclusion are not exclusively determined by orthodontic treatment need indices. While indices such as the DAI provide important information regarding treatment priority, they may not fully capture subjective social experiences related to facial and dental appearance. Consequently, adolescents with visible anterior dental irregularities may experience psychosocial impacts even when overall malocclusion severity is not classified as extreme [8, 25].

From a clinical perspective, the findings highlight the importance of considering psychosocial aspects during orthodontic assessment [30]. The potential consequences of bullying extend beyond oral conditions and may affect emotional well-being, self-esteem, social participation, and quality of life [6]. Therefore, clinicians should be attentive not only to functional and morphological aspects of malocclusion but also to the psychosocial concerns reported by adolescents and their families.

The present study has several strengths. It included a large population-based sample obtained through a two-stage cluster sampling design and included adolescents from both public and private schools. In addition, examiner calibration demonstrated satisfactory reproducibility, and multivariable analyses were performed to reduce potential confounding. The use of the DAI, an index recommended by the World Health Organization for epidemiological investigations of malocclusion, also strengthens the methodological consistency of the study [14].

Some limitations should be considered when interpreting the findings. First, bullying related to dental appearance was assessed using a single self-reported item from the dentofacial appearance satisfaction section of the study questionnaire. Although this item directly addresses perceived teasing or social exclusion due to dental appearance, it does not capture the multidimensional nature of bullying, including its frequency, duration, context, or severity beyond the predefined response scale. Second, the study did not investigate whether adolescents explicitly attributed bullying experiences to the specific occlusal characteristics identified during the clinical examination. Therefore, the observed associations reflect perceived teasing related to dental appearance in general, rather than condition-specific victimization. Third, the cross-sectional design does not allow causal inferences. Thus, it is not possible to determine whether malocclusion contributed to bullying experiences or whether other unmeasured factors influenced this relationship. Longitudinal studies are needed to further explore these pathways.

Conclusion

Bullying related to dental appearance affected approximately one in ten adolescents. Disabling malocclusion and specific visible occlusal traits, particularly anterior crowding, severe maxillary overjet, anterior tooth misalignment, and deep overbite, were associated with higher odds of bullying related to dental appearance. These findings highlight the psychosocial burden of malocclusion and reinforce the

importance of considering social and emotional outcomes when planning orthodontic care for adolescents.

Abbreviations

ABEP: Brazilian Association of Research Companies

DAI Dental Aesthetic Index

OR Odds ratio

95%CI 95% confidential interval

Declarations

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Authors' contributions

MLRC: writing – review and editing. **EBFT**: Conceptualization, Formal analysis, Funding acquisition, Methodology, Writing – Original draft, Writing – Critical review and editing. **LSGS**: Conceptualization, Formal analysis, Data collection, Methodology, Validation, Writing – Original draft, Writing – Review and editing. **MMPF:** Writing – Critical review and editing. **MAB**: Writing – Critical review and editing. **CCCR:** Writing – Critical review and editing. **CMCA:** Conceptualization, Methodology, Supervision, Writing – Original draft, Writing – Critical review and editing.

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Data availability

The datasets generated and analyzed during the current study are not publicly available due to potential privacy concerns but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The design and implementation of the present study were conducted in accordance with the Declaration of Helsinki. This study was approved by the Research Ethics Committee of the University Hospital of the Federal University of Maranhão (protocol no. 2429/2010-10). Written informed consent was obtained from the parents or legal guardians of all participants, and written assent was obtained from the adolescents after they received information regarding the objectives and procedures of the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Clinical trial number

Not applicable.

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Figures

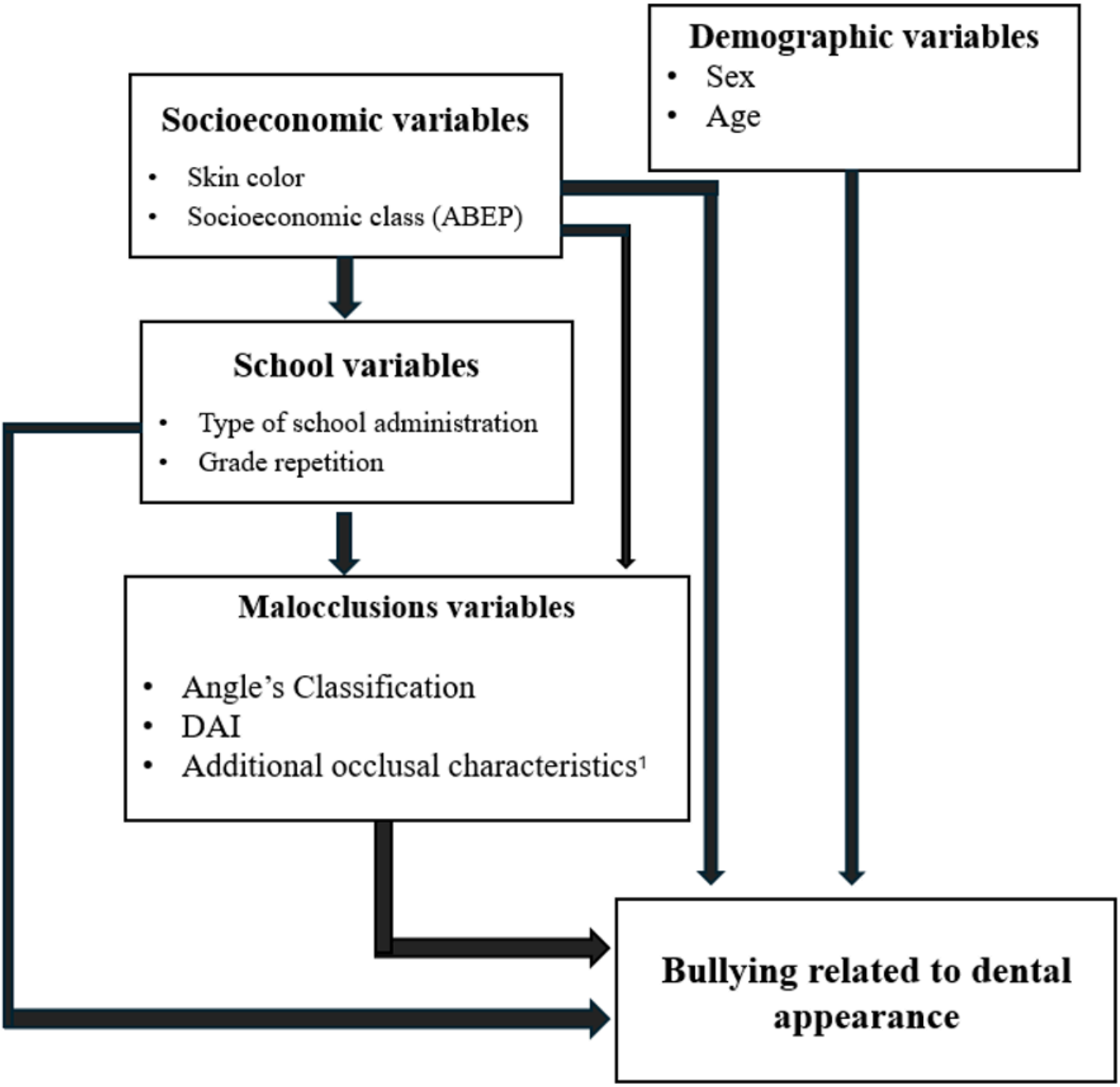


Figure 1

Hierarchical conceptual framework of factors associated with bullying related to dental appearance.

DAI: Dental Aesthetic Index

[1] Loss of anterior teeth, Anterior crowding, Anterior spacing, Incisal diastema, Maxillary misalignment, Mandibular misalignment, Maxillary overjet, Anterior crossbite, Anterior open bite, Deep overbite, Posterior crossbite, Posterior open bite