



Prevalence of malocclusion in adolescents according to sex, caries experience, gingival bleeding and smile dissatisfaction

Prevalência de má oclusão em adolescentes de acordo com sexo, experiência com cáries, sangramento gengival e insatisfação com o sorriso.

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ABSTRACT

Objective: The propose of this study was to estimate the prevalence of malocclusion among adolescents and to assess the differences of this prevalence according to sex, experience of caries, gingival bleeding, and smile dissatisfaction. **Methods:** A cross-sectional study was conducted with 600 adolescents from 10 to 16 years old, who were identified and selected from public schools' records. Intraoral and extraoral examinations were performed following World Health Organization recommendations and included: number of decayed, missing and filled teeth, presence of gingival bleeding, and occlusal condition. The latter was assessed based on information of Dental Aesthetic Index, and Foster and Hamilton Index, in addition to the evaluation of dental midline, facial and smile pleasantness according to Capelozza Filho classification. Smile dissatisfaction was also evaluated. Bivariate Poisson regression with

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robust variance was used to compare prevalence rates. **Results:** The prevalence of malocclusion, caries experience, gingival bleeding and smile dissatisfaction were 96.0%, 52.3%, 55.8%, and 49.4%, respectively. The prevalence of malocclusion was higher among adolescents with gingival bleeding. Statistically significant associations were noticed between crowding of the upper and lower anterior teeth and gingival bleeding, as well as among Class III molar relationship, deviation of the dental midline, anterior open bite, anterior crossbite, and caries experience. Smiles classified as acceptable or unpleasant were associated with dissatisfaction. **Conclusion:** These findings have evidenced a higher prevalence of malocclusion among adolescents and its association with caries experience, gingival bleeding, and smile dissatisfaction.

Keywords: Adolescents; Bleeding; Malocclusion; Dental caries

RESUMO

Objetivo: O objetivo deste estudo foi estimar a prevalência de má oclusão em adolescentes e avaliar as diferenças dessa prevalência segundo sexo, experiência de cárie, sangramento gengival e insatisfação com o sorriso. **Métodos:** Foi realizado um estudo transversal com 600 adolescentes de 10 a 16 anos, identificados e selecionados em prontuários de escolas públicas. Os exames intraorais e extraorais foram realizados seguindo as recomendações da Organização Mundial de Saúde e incluíram: número de dentes cariados, perdidos e obturados, presença de sangramento gengival e condição oclusal. Este último foi avaliado com base nas informações do Índice de Estética Dentária e do Índice de Foster e Hamilton, além da avaliação da linha média dentária, da agradabilidade facial e do sorriso segundo a classificação de Capelozza Filho. A insatisfação com o sorriso também foi avaliada. A regressão de Poisson bivariada com variância robusta foi utilizada para comparar as taxas de prevalência. **Resultados:** As prevalências de má oclusão, experiência de cárie, sangramento gengival e insatisfação com o sorriso foram 96,0%, 52,3%, 55,8% e 49,4%, respectivamente. A prevalência de má oclusão foi maior entre adolescentes com sangramento gengival. Foram observadas associações estatisticamente significativas entre apinhamento dos dentes anteriores

superiores e inferiores e sangramento gengival, bem como entre relação molar de Classe III, desvio da linha média dentária, mordida aberta anterior, mordida cruzada anterior e experiência de cárie. Sorrisos classificados como aceitáveis ou desagradáveis foram associados à insatisfação. **Conclusão:** Esses achados evidenciaram maior prevalência de má oclusão entre adolescentes e sua associação com experiência de cárie, sangramento gengival e insatisfação com o sorriso.

Palavras-chave: Adolescentes; Sangramento; Má oclusão; Cáries dentárias.

INTRODUCTION

Malocclusion is a term used to designate abnormalities in the positioning of the teeth, bite and/or jaws. It is not a single entity, but rather a group of conditions, and it is therefore divided into different classes. Additionally, it is the third most prevalent oral health problem around the world¹⁻⁴.

Given its serious nature, epidemiological surveys on occlusion are important and necessary^{3,5}. These surveys apply occlusal indexes, such as Dental Aesthetic Index (DAI), to assess malocclusion and to determine the need for referral to orthodontic treatment⁶.

It is worthy to assess malocclusion during adolescence because it is described as the “orthodontic age”⁷. Furthermore, malocclusion is related to facial appearance and smile satisfaction, thus it can affect self-esteem and quality of life^{7,8}.

Notwithstanding, scientific evidence on the impacts of malocclusion on health is controversial and unclear⁹. There is no consensus whether misalignment of the teeth is a hindering factor for brushing and flossing, or whether malocclusion increases the risk of caries and periodontal disease¹⁰.

Therefore, it is necessary to face this gap in the scientific literature and to better understand malocclusion, its prevalence, traits and health impacts. The purpose of this study was to estimate the prevalence of malocclusions in a sample of adolescents registered at public schools of a city in the north of the State of Minas Gerais, Brazil. Additionally, it was evaluated the associations of malocclusion with sex, caries experience, gingival bleeding and smile dissatisfaction.

METHODS

Study population

This is a cross-sectional inquiry. The study population consisted of adolescents aged 10 to 16 years old registered at public schools at Montes Claros, Minas Gerais, Brazil. All the public schools in the city were listed, and all the students were identified per region. There were 63 schools and 77.833 students. A random sample was selected using two-stage cluster sampling. In the first stage, population was selected from schools in the North, South, East and West regions of Montes Claros using probability proportional to size. In the second stage, adolescents were randomly selected from each school based on their registration number, sex and age, using simple random sampling.

The minimum sample size was calculated adopting an estimated prevalence rate of 50%, 95% confidence interval and 5% margin of error. Finite-population and design-effect corrections were performed by adopting deff equal 1.5. A sample size of at least 577 adolescents was determined.

Data collection procedures

Intraoral and extraoral examinations were performed at schools. During the extraoral evaluation, the face was observed at rest and upon smiling. The intraoral exam consisted of visual inspection using a mouth mirror and World Health Organization (WHO) Community Periodontal Index (CPI) probe. All biosafety standards were strictly followed. Three researchers conducted data collection after undergoing training and having achieved a satisfactory level of intra and inter-examiner agreement (*Kappa* coefficient or Intraclass Correlation Index above 0.77).

Malocclusion was assessed considering the occlusal parameters presented in Dental Aesthetic Index (DAI) and Foster and Hamilton Index (adapted), following WHO recommendations¹¹. Other aspects related to malocclusion but not included in these indexes¹ were also evaluated: dental midline, facial and smile pleasantness. Facial pleasantness was assessed based on an analysis proposed by Capelozza Filho¹², considering the following

classification: pleasant, acceptable or unpleasant¹³. The spontaneous smile of each participant was assessed based on the same categories. Deviation of the dental midline was recorded positive when upper and lower dental midlines were not coincident with each other.

Caries experience and gingival bleeding were evaluated according to criteria established by WHO¹¹.

To determine caries experience, the number of decayed, missing, and filled teeth (DMFT) was registered. If at least one tooth was decayed, missing, or filled ($DMFT \geq 1$), then caries experience was recorded as positive.

Gingival bleeding was recorded by sextants using WHO CPI probe. If there is gingival bleeding in at least one sextant, then a positive code was recorded.

Smile dissatisfaction was self-reported and assessed using a question adopted in a Brazilian national inquiry on oral health, known as *SB Brasil*¹⁴: “With regard to your teeth/mouth, are you?”, considering the following response options: very satisfied; satisfied; neither satisfied nor dissatisfied; dissatisfied; and very dissatisfied. For comparison, data were dichotomized between satisfied (including very satisfied and satisfied) and dissatisfied (including the other situations).

In summary, assessment of occlusal conditions included the following: crowding of the upper anterior teeth (normal/mild, moderate/severe); crowding of the lower anterior teeth (normal/mild, moderate/severe); diastema (absent, present); canine keys (Class I, Class II, Class III); molar relationship (Class I, Class II, Class III); posterior crossbite (absent, unilateral, bilateral); overjet (normal, increased, top-to-top, anterior crossbite); overbite (normal, reduced, open, deep); dental midline (normal, deviated); facial pleasantness (pleasant, acceptable, or unpleasant); and smile pleasantness (pleasant, acceptable, or unpleasant).

The prevalence of each occlusal condition was estimated. The overall prevalence of malocclusion was then calculated, defined as “the presence of at least one occlusal abnormality”^{1,3,4}. Two prevalence rates were calculated: one including only the aspects presented at DAI and Foster and Hamilton Index and another including all the occlusal conditions examined.

Statistical Analysis

Statistical analysis was conducted considering correction for clustering to compensate for unequal selection probabilities. A weight equal to the inverse of the probability of inclusion was assigned to each participant, considering the non-response rate for each school. The analyses were performed using the Complex Sample Module of the Statistical Package for Social Sciences 20.0 (SPSS Inc., Chicago, IL, USA).

The prevalence of each occlusal condition was calculated according to sex (male/female), caries experience (DMFT = 0/DMFT \geq 1), gingival bleeding (present/absent) and smile satisfaction (satisfied/dissatisfied). Bivariate Poisson regression with robust variance was utilized to estimate prevalence ratios (PR) adopting a 95% confidence interval (CI_{95%}).

Ethical Aspects

This study was approved by the research Ethics Committee (CEP) of Universidade Estadual de Montes Claros (No. 1.876.375/2016). A written authorization form was signed by the school principals, the adolescents, and their legal guardians. If an adolescent needed dental treatment, then he or she was referred for a dental clinic of a public university.

RESULTS

Six hundred adolescents agreed to participate in this study: 83.5% declared themselves as black or brown, 61.5% were female, and 54.0% aged 14 years old or less. The prevalence of caries experience (DMFT \geq 1), gingival bleeding, and smile dissatisfaction were 52.3%, 55.8%, and 49.4%, respectively.

The most prevalent occlusal abnormality was crowding of the lower anterior teeth (58.5%), followed by deviation of the dental midline (54.9%), crowding of the upper anterior teeth (51.5%), deep overbite (47.7%), and accentuated overjet (46.5%). Prevalence of Class I was 51.3%, Class II was 40.9% and Class III was 7.8%. Global prevalence of malocclusion, considering the aspects presented in the standardized indexes, was 89.2%, while prevalence considering all the occlusal conditions examined in this study was 96.0% (Table 1).

No statistically significant differences in the prevalence of the occlusal conditions were observed between males and females (Table 1).

Table 1 – Prevalence of occlusal conditions according to sex among adolescents registered at public schools, city of Montes Claros, Minas Gerais, Brazil (n = 600)

VARIABLE	TOTAL (n = 600)		MALE (n = 231)		FEMALE (n = 369)		PR ^a	CI (95%) ^b
	%	CI (95%)	%	CI (95%)	%	CI (95%)		
Crowding of the upper anterior teeth								
Normal/Mild	86.8	80.3 – 91.3	84.1	74.0 – 90.8	88.5	83.3 – 92.2	1	–
Moderate/severe	13.2	8.7 – 19.7	15.9	9.2 – 26.0	11.5	7.8 – 16.7	0.81	0.65– 1.00
Crowding of the lower anterior teeth								
Normal/Mild	86.2	80.5 – 90.5	84.5	75.0 – 90.8	87.4	82.0 – 91.3	1	–
Moderate/severe	13.8	9.5 – 19.5	15.5	9.2 – 25.0	12.6	8.7 – 18.0	0.87	0.65– 1.17
Diastema								
Absent	76.0	73.7 – 78.2	77.7	75.5 – 79.7	75.0	71.6 – 78.1	1	–
Present	24.0	21.8 – 26.3	22.3	20.3 – 24.5	25.0	21.9 – 28.4	1.01	0.98– 1.23
Canine keys								
Class I	51.3	37.4 – 65.0	57.5	41.8 – 71.8	47.4	35.3 – 59.8	1	–
Class II	40.9	28.6 – 54.4	35.4	22.8 – 50.5	44.3	32.7 – 56.5	1.06	0.97– 1.16
Class III	7.8	4.9 – 12.2	7.1	4.1 – 11.9	8.3	5.2 – 13.1	1.05	1.00– 1.11
Molar relationship								
Class I	61.6	48.0 – 73.6	61.3	44.3 – 76.0	61.8	48.0 – 73.9	1	–
Class II	27.3	16.2 – 42.2	26.2	12.3 – 47.4	28.0	17.5 – 41.5	0.99	0.95– 1.05
Class III	11.1	8.4 – 14.6	12.5	8.3 – 18.3	10.2	8.2 – 12.7	0.97	0.89– 1.06
Posterior crossbite								
Absent	90.1	88.8 – 91.2	89.1	85.8 – 91.7	90.7	86.8 – 93.5	1	–
Unilateral	7.6	6.1 – 9.5	7.6	5.7 – 10.1	7.6	4.5 – 12.6	0.99	0.91– 1.09
Bilateral	2.3	1.3 – 4.0	3.3	1.7 – 6.3	1.7	0.9 – 3.2	0.90	0.75– 1.08
Overjet								
Normal	46.1	43.1 – 49.2	47.7	39.6 – 56.0	45.1	40.4 – 49.9	1	–

Increased	46.5	43.3 – 49.7	44.7	38.6 – 50.9	47.7	43.3 – 52.1	1.01	0.96–1.07
Top-to-top	5.4	4.1 – 7.0	5.4	2.5 – 11.6	5.3	3.5 – 8.0	0.98	0.87–1.11
Anterior crossbite	2.0	0.9 – 4.6	2.2	0.8 – 5.7	1.9	0.8 – 4.6	1.03	0.86–1.25
Overbite								
Normal	40.8	36.1 – 45.6	38.0	31.7 – 44.7	42.5	37.1 – 48.2	1	–
Reduced	8.0	6.3– 10.1	8.3	4.8 – 13.9	7.8	5.1 – 11.9	0.95	0.86–1.06
Open	3.5	2.2 – 5.6	2.2	0.8 – 5.7	4.3	2.0 – 9.1	1.05	0.94–1.18
Deep	47.7	42.7 – 52.8	51.5	45.2 – 57.6	45.3	40.3 – 50.5	0.96	0.92–1.02
Dental midline								
Normal	45.1	37.4 – 53.0	45.7	33.5 – 58.5	44.7	34.7 – 55.1	1	–
Deviated	54.9	47.0 – 62.6	54.3	41.5 – 66.5	55.3	44.9 – 65.3	1.03	0.68–1.56
Facial pleasantness								
Pleasant	72.3	66.7 – 77.2	66.9	55.7 – 76.4	75.7	70.3 – 80.4	1	–
Acceptable	26.9	22.1 – 32.3	31.9	23.3 – 42.0	23.6	18.6 – 29.5	0.95	0.90–1.00
Unpleasant	0.9	0.2 – 4.6	1.2	0.2 – 7.2	0.7	0.1 – 3.4	0.85	0.63–1.16
Smile pleasantness								
Pleasant	40.8	34.1 – 47.8	39.9	31.7 – 48.7	41.3	33.9 – 49.2	1	–
Acceptable	53.7	48.4 – 58.9	51.3	44.6 – 58.0	55.2	47.3 – 62.9	1.01	0.95–1.05
Unpleasant	5.5	2.6–11.4	8.8	5.3–14.3	3.4	0.8 –13.2	0.89	0.78–1.00
Presence of at least one of the conditions								
No	4.0	1.6 – 6.7	1.8	0.7 – 4.3	1.5	0.8 – 2.9	1	–
Yes	96.0	93.3 – 98.4	95.4	90.2 – 97.9	97.5	94.7 – 98.8	1.40	0.95–2.04
Presence of at least one of the conditions (except midline deviation and facial and smile pleasantness)								
No	10.8	8.3 – 14.0	11.8	8.6 – 16.1	10.2	7.2 – 14.3	1	–

Yes	89.2	86.0 – 91.7	88.2	83.9 – 91.4	89.8	85.7 – 92.8	1.10	0.85–1.43
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^aPR = Prevalence Ratio

^bCI = Confidence Interval

Regarding to caries experience, presence of diastemas was the only protective factor (PR = 0.81, CI_{95%} = 0.66-0.97). Class III molar relationship (PR = 1.16, CI_{95%} = 1.01-1.32), anterior crossbite (PR = 1.39, CI_{95%} = 1.06-1.81), anterior open bite (PR = 1.37, CI_{95%} = 1.14-1.65), deviation of the dental midline (PR = 1.17, CI_{95%} = 1.02-1.35), and an unpleasant smile (PR = 1.25, CI_{95%} = 1.05-1.49) were statistically associated with caries experience (Table 2).

Table 2 – Prevalence of occlusal conditions according to caries experience among adolescents registered at public schools, city of Montes Claros, Minas Gerais, Brazil (n = 600)

VARIABLE	WITHOUT CARIES EXPERIENCE n = 314		WITH CARIES EXPERIENCE n = 286		PR ^a	CI (95%) ^b
	%	CI (95%)	%	CI (95%)		
Crowding of the upper anterior teeth						
Normal/Mild	88.2	78.6 – 93.9	85.4	80.8 – 89.1	1	–
Moderate/severe	11.8	6.1 – 21.4	14.6	10.9 – 19.2	1.14	0.85–1.54
Crowding of the lower anterior teeth						
Normal/Mild	89.2	81.5 – 93.9	83.5	78.7 – 87.4	1	–
Moderate/severe	10.8	6.1 – 18.5	16.5	12.6 – 21.3	1.31	0.96–1.8
Diastema						
Absent	71.8	67.0 – 76.3	79.9	74.8 – 84.1	1	–
Present	28.2	23.7 – 33.0	20.1	15.9 – 25.2	0.81	0.66–0.97*
Canine keys						
Class I	53.3	37.7 – 68.3	49.5	34.2 – 64.9	1	–
Class II	40.6	27.4 – 55.2	41.1	27.5 – 56.3	0.92	0.78–1.08
Class III	6.2	4.0 – 9.3	9.4	5.0 – 17.0	0.91	0.77–1.07
Molar relationship						
Class I	64.4	49.6 – 76.9	58.9	45.9 – 70.8	1	–
Class II	27.6	17.7 – 40.4	27.0	14.4 – 44.8	1.01	0.92–1.11
Class III	8.0	5.2 – 12.1	14.1	9.2 – 21.1	1.16	1.01–1.32*
Posterior crossbite						
Absent	91.6	87.0 – 94.7	88.7	85.8 – 91.0	1	–
Unilateral	6.5	4.8 – 8.7	8.7	6.4 – 11.6	1.08	0.92–1.25
Bilateral	1.9	0.6 – 5.9	2.7	0.9 – 7.7	1.04	0.79–1.37
Overjet						

Normal	42.9	37.5 – 48.5	49.0	41.3 – 56.7	1	–
Increased	52.4	46.9 – 57.8	41.2	35.6 – 47.0	0.97	0.85–1.01
Top-to-top	4.0	2.7 – 6.1	6.6	4.5 – 9.7	1.07	0.89–1.29
Anterior crossbite	0.7	0.1 – 3.1	3.2	1.4 – 7.3	1.39	1.06–1.81*
Overbite						
Normal	41.0	38.6 – 43.4	40.5	31.0 – 50.8	1	–
Reduced	6.7	4.6 – 9.8	9.2	6.4 – 13.0	1.05	0.88–1.23
Open	1.4	0.6 – 3.4	5.4	2.5 – 11.4	1.37	1.14–1.65*
Deep	50.8	48.8 – 52.8	44.9	36.2 – 53.9	0.94	0.86–1.03
Dental midline						
Normal	49.1	40.3 – 58.0	41.4	34.6 – 48.5	1	–
Deviated	50.9	42.0 – 59.7	58.6	51.5 – 65.4	1.17	1.02–1.35*
Facial pleasantness						
Pleasant	72.4	67.7 – 76.6	72.2	65.3 – 78.1	1	–
Acceptable	27.3	22.8 – 32.3	26.5	20.8 – 33.0	0.98	0.89–1.08
Unpleasant	0.3	0.0 – 4.0	1.4	0.3 – 6.6	1.28	0.83–1.96
Smile pleasantness						
Pleasant	43.3	34.2 – 53.0	38.4	32.1 – 45.1	1	–
Acceptable	53.5	45.0 – 61.7	53.9	45.5 – 62.1	1.02	0.94–1.12
Unpleasant	3.2	1.6 – 6.5	7.7	3.6 – 15.7	1.25	1.05–1.49*
Presence of at least one of the conditions						
No	3.2	1.5 – 6.6	3.5	1.4 – 8.3	1	–
Yes	96.8	93.4 – 98.5	96.5	91.7 – 98.6	0.95	0.58–1.54
Presence of at least one of the conditions (except midline deviation and facial and smile pleasantness)						
No	10.2	8.2 – 12.7	11.4	6.7 – 18.8	1	–
Yes	89.8	87.3 – 91.8	88.6	81.2 – 93.3	0.94	0.63–1.39

^aPR = Prevalence Ratio

^bCI = Confidence Interval

*P <.05

In relation to gingival bleeding, statistically significant associations were observed with moderate/severe crowding of the upper (PR = 1.46, CI_{95%} = 1.03-2.02) and lower (PR = 1.27, CI_{95%} = 1.01-1.54) anterior teeth, an acceptable smile (PR = 1.27, CI_{95%} = 1.08-1.49) and the presence of at least one type of malocclusion (PR = 1.39, CI_{95%} = 1.21-1.59) (Table 3).

Table 3 – Prevalence of occlusal conditions according to gingival bleeding among adolescents registered at public schools, city of Montes Claros, Minas Gerais, Brazil (n = 600)

VARIABLE	WITHOUT BLEEDING n = 335		WITH BLEEDING n = 265		PR ^a	CI (95%) ^b
	%	CI (95%)	%	CI (95%)		
Crowding of the upper anterior teeth						
Normal/Mild	90.6	83.7 – 94.7	83.8	76.6 – 89.1	1	–
Moderate/severe	9.4	5.3 – 16.3	16.2	10.9 – 23.4	1.46	1.03–2.08*
Crowding of the lower anterior teeth						
Normal/Mild	88.8	81.7 – 93.4	84.2	79.0 – 88.3	1	–
Moderate/severe	11.2	6.6 – 18.3	15.8	11.7 – 21.0	1.27	1.01–1.54*
Diastema						
Absent	78.3	74.6 – 81.6	74.2	68.2 – 79.4	1	–
Present	21.7	18.4 – 25.4	25.8	20.6 – 31.8	1.14	0.87–1.48
Canine keys						
Class I	52.5	34.5 – 70.0	50.3	39.0 – 61.6	1	–
Class II	38.3	22.3 – 57.3	42.9	33.4 – 52.8	1.03	0.88–1.20
Class III	9.1	5.7 – 14.3	6.8	3.8 – 12.1	0.85	0.60–1.20
Molar relationship						
Class I	62.0	47.2 – 74.9	61.3	46.1 – 74.5	1	–
Class II	26.9	16.1 – 41.4	27.6	14.8 – 45.5	1.05	0.88–1.24
Class III	11.0	7.8 – 15.3	11.2	8.0 – 15.4	1.04	0.81–1.33
Posterior crossbite						
Absent	92.0	88.0 – 94.8	88.5	83.4 – 92.2	1	–
Unilateral	6.2	3.4 – 10.8	8.8	5.0 – 14.8	1.23	0.98–1.54
Bilateral	1.8	1.0 – 3.2	2.7	1.4 – 5.1	1.15	0.74–1.78
Overjet						
Normal	46.1	42.5 – 49.8	46.1	40.4 – 51.8	1	–
Increased	46.6	43.9 – 49.2	46.5	39.7 – 53.4	0.96	0.82–1.12
Top-to-top	5.6	2.9 – 10.8	5.2	4.5 – 6.0	0.89	0.61–1.29
Anterior crossbite	1.7	0.7 – 4.1	2.3	0.9 – 5.7	1.02	0.53–1.95
Overbite						
Normal	43.6	37.4 – 50.0	38.5	32.2 – 45.2	1	–
Reduced	7.6	5.8 – 9.8	8.4	6.2 – 11.2	1.01	0.74–1.37
Open	3.0	1.8 – 5.0	3.9	1.5 – 9.9	1.25	0.88–1.77
Deep	45.8	39.1 – 52.6	49.2	44.7 – 53.8	1.04	0.88–1.22
Dental midline						
Normal	47.3	33.6 – 61.4	43.3	36.6 – 50.3	1	–
Deviated	52.7	38.6 – 66.4	56.7	49.7 – 63.4	1.09	0.78–1.53
Facial pleasantness						
Pleasant	76.4	72.9 – 79.5	69.0	59.8 – 77.0	1	–
Acceptable	23.2	19.3 – 27.7	29.7	22.7 – 37.9	1.11	0.94–1.30
Unpleasant	0.4	0.0 – 4.7	1.3	0.2 – 6.8	1.41	0.79–2.5

Smile pleasantness						
Pleasant	49.0	42.5 – 55.6	34.2	27.7 – 41.4	1	–
Acceptable	46.4	40.0 – 52.9	59.5	54.2 – 64.6	1.27	1.08–1.49*
Unpleasant	4.6	1.3 – 15.2	6.3	4.0 – 9.8	1.27	0.92–1.75
Presence of at least one of the conditions						
No	3.6	1.2 – 10.0	3.1	1.0 – 9.3	1	–
Yes	94.4	90.0 – 98.8	96.9	90.7 – 99.0	1.09	0.45–2.68
Presence of at least one of the conditions (except midline deviation and facial and smile pleasantness)						
No	14.5	11.4 – 18.3	8.0	5.3 – 11.8	1	–
Yes	85.5	81.7 – 88.6	92.0	88.2 – 94.7	1.39	1.21–1.59*

^aPR = Prevalence Ratio

^bCI = Confidence Interval

*P<.05

Finally, acceptable (PR = 2.19, CI_{95%} = 1.44-3.35) and unpleasant (PR = 2.85, CI_{95%} = 1.48-5.50) smiles were statistically associated with smile dissatisfaction (Table 4).

Table 4 – Prevalence of occlusal conditions according to smile dissatisfaction among adolescents registered at public schools, city of Montes Claros, Minas Gerais, Brazil (n = 600)

VARIABLE	SATISFIED n = 304		DISSATISFIED n = 296		PR ^a	CI (95%) ^b
	%	CI (95%)	%	CI (95%)		
Crowding of the upper anterior teeth						
Normal/Mild	89.3	79.2 – 94.8	76.1	64.7 – 84.7	1	–
Moderate/severe	10.7	5.2 – 20.8	23.9	15.3 – 35.3	1.28	0.93–1.76
Crowding of the lower anterior teeth						
Normal/Mild	88.8	80.3 – 93.9	75.4	64.9 – 83.6	1	–
Moderate/severe	11.2	6.1 – 19.7	24.6	16.4 – 35.1	1.27	0.97–1.66
Diastema						
Absent	76.8	74.3 – 79.1	74.9	61.2 – 85.0	1	–
Present	23.2	20.9 – 25.7	25.1	15.0 – 38.8	1.02	0.88–1.18
Canine keys						
Class I	51.5	36.2 – 66.6	48.7	38.2 – 59.2	1	–
Class II	40.5	27.4 – 55.1	44.5	34.7 – 54.8	1.08	0.76–1.55
Class III	8.0	5.1 – 12.3	6.8	2.7 – 16.1	0.95	0.47–1.97

Molar relationship						
Class I	62.9	48.5 – 75.4	54.5	38.0 – 70.1	1	–
Class II	25.9	14.5 – 42.0	33.6	24.8 – 43.7	1.45	1.00–2.11
Class III	11.2	9.4 – 13.2	11.9	4.9 – 26.2	1.25	0.71–2.18
Posterior crossbite						
Absent	91.0	89.0 – 92.7	85.4	75.8 – 91.6	1	–
Unilateral	7.0	5.4 – 9.0	10.8	5.9 – 18.9	1.28	0.72–2.76
Bilateral	2.0	1.1 – 3.6	3.8	1.5 – 8.9	1.70	0.73–3.91
Overjet						
Normal	45.7	40.8 – 50.7	48.1	38.0 – 58.3	1	–
Increased	46.5	41.3 – 51.8	58.3	45.6 – 53.7	0.98	0.69–1.40
Top-to-top	6.2	4.0 – 9.4	2.6	0.6 – 10.2	0.35	0.91–1.38
Anterior crossbite	1.6	0.6 – 4.6	3.8	1.9 – 7.5	2.21	0.91–5.40
Overbite						
Normal	41.8	37.4 – 46.3	34.8	25.0 – 46.1	1	–
Reduced	8.0	6.6 – 9.7	5.0	14.4 – 50.1	1.28	0.61–2.42
Open	2.9	1.5 – 5.5	6.5	3.9 – 10.5	1.73	0.78–3.86
Deep	47.4	42.0 – 52.8	50.1	43.3 – 56.9	1.29	0.88–1.88
Dental midline						
Normal	45.5	35.9 – 55.5	40.7	27.4 – 55.5	1	–
Deviated	54.5	44.5 – 64.1	59.3	44.5 – 72.6	1.04	0.89–1.21
Facial pleasantness						
Pleasant	72.5	65.1 – 78.8	71.2	62.0 – 78.9	1	–
Acceptable	26.7	21.4 – 32.9	27.4	18.6 – 38.3	1.11	0.75–1.63
Unpleasant	0.7	0.1 – 5.4	1.5	0.1 – 14.7	1.37	0.25–7.57
Smile pleasantness						
Pleasant	44.9	36.4 – 53.7	24.0	12.7 – 40.6	1	–
Acceptable	50.4	44.8 – 56.0	67.5	50.5 – 80.9	2.19	1.44–3.35*
Unpleasant	4.7	1.5 – 13.8	8.5	4.1 – 16.9	2.85	1.48–5.50*
Presence of at least one of the conditions						
No	3.7	1.5 – 8.8	1.0	0.1 – 9.9	1	–
Yes	96.3	91.2 – 98.5	99.0	90.1 – 99.9	1.17	0.98–1.40
Presence of at least one of the conditions (except midline deviation and facial and smile pleasantness)						
No	11.2	7.4 – 16.7	8.3	3.6 – 18.3	1	–
Yes	88.8	83.3 – 92.6	91.7	81.7 – 96.4	1.06	0.87–1.29

^aPR = Prevalence Ratio

^bCI = Confidence Interval

*P<.05

DISCUSSION

Approximately 90.0% adolescents were found to have malocclusion. The global prevalence of malocclusion observed in this study is higher than national (38.8%)¹⁴, regional (62%)⁵ and local (30.4%) estimates¹⁵. A classic epidemiological survey undertaken in Bauru (a city of the State of São Paulo, Brazil) found that the prevalence of malocclusion was 90.0%¹⁶, while according to *SB Brasil*¹⁴, the prevalence of malocclusion in Brazil has wide variations per regions, ranging from 28.7% to 71.6%.

The divergence in results between studies may be partially explained by methodological differences. One of the reasons for the high prevalence rate found in this study is the fact that some morphological deviations, such as deviation of the dental midline and diastemas, were recorded as malocclusions, regardless of their magnitude.

The present study opted for a global assessment of malocclusion, including important information from DAI, Foster and Hamilton Index and Capellozza Filho classification of facial pleasantness¹². DAI alone can underestimate the prevalence of malocclusion^{4,17,18}. This index was recommended by WHO in 1997¹¹ and it has been widely used around the world. However, it has some drawbacks that limit its comprehensiveness as an assessment tool. Different malocclusion aspects are measured using different criteria and, therefore, the overall score does not necessarily provide a true representation of malocclusion prevalence or severity. Furthermore, it focuses on aesthetics and omits some malocclusions that affect oral health. Another limitation is that it does not specify if crowding is in the upper or lower arch and the classification of molar relationship does not differentiate between Class II and Class III^{1,4,6}. Moreover, DAI score does not indicate which occlusal conditions are most prevalent or the proportions of these abnormalities; DAI score was not calculated here.

The findings of this study in relation to each specific occlusal condition are similar to those reported in other studies. The most prevalent malocclusion was crowding of the lower anterior teeth (58.5%), which is higher than diastemas prevalence rate (24.0%). Secondary data from *SB Brasil* showed that prevalence of spacing problems was 71.43%, with higher prevalence of lack of space compared to excess (58.74% and 18.98%, respectively)¹⁹. Prevalence rates of Class I, Class II and Class III reported in other studies ranged from 58.4% to 77.0%, 17.0 to 37.6%, and 2.5% and 7.0%, respectively^{7,14,16,20}.

No statistically significant differences in the prevalence of the occlusal conditions were observed between males and females. This finding is similar to that reported by a systematic literature review and meta-analysis of prevalence of malocclusion³ and corroborates well-established findings that malocclusion is not influenced by sex^{5,9,10,16}.

Prevalence of class III molar relationship, anterior open bite, anterior crossbite, and deviation of the dental midline was higher among participants with caries experience, corroborating the findings of previous studies in which adolescents with DMFT > 0 were twice more likely to have malocclusion compared to those who did not have caries experience^{9,10,21}. One study, specifically, demonstrated that subjects with overjet higher than 3 mm and some molar relationship conditions (Class II or Class III higher or equal 1 cusp) were 30% more likely to have caries²¹. These results suggest that unsatisfactory intercuspation increases the likelihood of dental caries, since the disorganization of the biofilm produced by dental contact during mandibular movements may be reduced. Previous studies also show that the presence of deviation of the dental midline was greater among individuals with caries experience^{9,10}. It is interesting to note that the studies that reported this association were unable to identify the reason for this difference. One possible explanation is that deviation of the dental midline was influenced by confounding factors, such as lack of space between the teeth. So, the true association would be, in fact, between lack of space and caries experience. Further research should be carried out using multiple analysis to better understand this problem.

Prevalence of diastemas was higher among adolescents without caries experience. Maybe, having spaces between the teeth facilitate the removal of biofilm.

The findings of this study showed that there was a positive association between the presence of gingival bleeding and increased prevalence of crowding of both upper and lower anterior teeth. This association was also reported by others epidemiological studies^{9,21,22}. It is scientifically plausible that malocclusion led to higher accumulation of biofilm and hinder hygiene²¹. However, evidence confirming this assertion remains limited, given that longitudinal studies of this association are scarce.

The prevalence of smile dissatisfaction was higher among adolescents with acceptable or unpleasant smiles compared to those with pleasant smiles. It is widely reported in the literature that malocclusions have a negative influence on smile pleasantness, thus affecting quality of life. Improving smile pleasantness is an important psychosocial benefit of orthodontic

treatment; it enhances self-esteem and quality of life and may have indirect influence on adoption of healthy habits^{5,15,22,23}.

Smile pleasantness was the only variable significantly associated with smile satisfaction. This finding suggests that examiners and study participants used some similar criteria for classifying smiles. However, since no occlusal alteration was associated with adolescents' dissatisfaction with their smiles, this self-classification may have been influenced by cultural aspects or other characteristics of the dentition, such as color, shape, presence or absence of fluorosis and caries-related lesions^{24,25}.

There was no association between facial pleasantness and smile satisfaction. Nevertheless, a systematic literature review found that the main motivational factor for seeking orthodontic treatment was facial pleasantness²⁶. Qualitative studies adopting methodologies more suited to understand subjective aspects such as perception and satisfaction are necessary.

This study has some limitations. First, the associations do not indicate cause-effect relationships and should therefore be interpreted with caution. The possibility of reverse causation is also a critical bias in cross-sectional studies. In terms of methodology, the inclusion of different classifications and occlusal aspects to correct the shortfalls of DAI may be considered a limitation because it hinders direct comparison with findings of other studies. Nonetheless, this methodology may be more reliable, robust and increase the validity of our findings. The absence of normal occlusion, which was found in almost all participants, raises the question whether a more flexible concept of malocclusion should be built, as proposed by Capelozza Filho²⁷.

An appropriate standardized classification of malocclusions for epidemiological studies is unavailable⁴. In 2013, WHO stopped recommending the epidemiological assessment of occlusion based on DAI^{1,2,3,5,28}. It is therefore essential to develop indexes or simple and quick malocclusion assessment instruments with adequate reliability and reproducibility.

CONCLUSION

Approximately, 90% of the adolescents was classified as having malocclusion. There were associations among occlusal conditions such as crowding of the anterior teeth, Class III molar relationships, deviation of the dental midline, anterior open bite and anterior crossbite

with caries experience and gingival bleeding, which demonstrates that malocclusions may have a negative impact on adolescent oral health. Smile dissatisfaction was more prevalent among adolescents with acceptable or unpleasant smiles; malocclusions may be related to self-image.

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