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Prevalence of malocclusion and orthodontic treatment need among 12 to 13 year-old in Brazilian schoolchildren

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Abstract

Objective: This study aimed to assess the prevalence of the orthodontic treatment need in Brazilian adolescents by using the Dental Aesthetic Index (DAI), investigate associations between DAI scores and demographic and socioeconomic variables, and identify the components of the DAI that primarily contribute to the severity of malocclusion.

Methods: This cross-sectional study was conducted in the public schools of Balneário Camboriú, Brazil; the study sample comprised 704 adolescents aged 12-13 years without history of orthodontic treatment. Malocclusion was assessed by a trained and calibrated orthodontist using the DAI.

Results: Of the schoolchildren, 58.7% had no malocclusion, 24.0% had definite malocclusion, 10.9% had severe malocclusion, and 6.4% had handicapping malocclusion. Approximately 17% of the sample (95% confidence interval: 14.5-20.1) required orthodontic treatment. Anterior maxillary overjet ($r=0.627$), anteroposterior molar relationship ($r=0.590$), irregularity in the maxilla ($r=0.345$), irregularity in the mandible ($r=0.332$), and crowding in the incisal segments ($r=0.305$) were the DAI components that primarily contributed to the variations in DAI scores.

Conclusion: Almost one-fifth of the sample required orthodontic treatment. Maxillary overjet and molar relationship represent the characteristics that primarily influenced the need for orthodontic treatment in the study population.

Key words: Epidemiology; Malocclusion; Orthodontics.

Prevalência da maloclusão e necessidade de tratamento ortodôntico entre alunos escolares brasileiros de 12 e 13 anos de idade

Resumo

Objetivo: O objetivo deste estudo foi o de avaliar a prevalência da necessidade de tratamento ortodôntico em adolescentes brasileiros, utilizando o Índice de Estética Dental (DAI), investigar as associações entre os escores DAI e variáveis demográficas e socioeconômicas, bem como identificar os componentes do DAI que contribuem principalmente para a gravidade da maloclusão.

Métodos: Este estudo transversal foi realizado em escolas públicas de Balneário Camboriú, Brasil; a amostra foi constituída por 704 adolescentes com idades entre 12-13 anos, sem histórico de tratamento ortodôntico. A má oclusão foi avaliada por um ortodontista treinado e calibrado usando o DAI.

Resultados: Das crianças em idade escolar, 58,7% não tinham má oclusão, 24,0% tinham má oclusão definida, 10,9% tinham má oclusão severa, e 6,4% tinham fragilizando má oclusão. Cerca de 17% da amostra (intervalo de confiança de 95%: 14,5-20,1) necessitaram de tratamento ortodôntico. *Overjet* maxilar ($r=0,627$), relação molar antero-posterior ($r=0,590$), irregularidade na maxila ($r=0,345$), irregularidade na mandíbula ($r=0,332$); apinhamento de incisivos ($r=0,305$) foram os componentes do DAI que contribuíram principalmente para as variações nos escores DAI.

Conclusão: Quase um quinto da amostra necessitava de tratamento ortodôntico. *Overjet* maxilar e relação molar representaram as características que influenciaram principalmente a necessidade de tratamento ortodôntico na população do estudo.

Palavras-chave: Epidemiologia; Maloclusão; Ortodontia.

Introduction

Malocclusion is a global public health problem. Studies in different countries show that orthodontic problems are strongly associated with personal appearance dissatisfaction, which also influences the social and psychological well-being of the affected individuals [1]. However, Brazilian epidemiological data related to the prevalence and treatment need for malocclusion are scarce [2]. Such knowledge is vital for public health because of the following 3 reasons: to determine the priority of access to government services; estimate the treatment needs of a specific population; and plan resources as well as facilitate current and potential demand for a given type of treatment [2-3].

In the last decade, rates of orthodontic treatment need such as the Dental Aesthetic Index (DAI) and Index of Orthodontic Treatment Need (IOTN) have been used to screen patients to determine treatment priority, prevent unnecessary treatment, and provide a basis for discussion among health professionals, parents, and children [4]. The DAI, now recommended by the WHO (World Health Organization) [5], has the advantage of exploring clinical and aesthetic components, which are measured simultaneously and mathematically to produce a final value that accounts for the physical and aesthetic aspects of occlusion, including the patient's perception of appearance [6].

This study aimed to identify the prevalence of the orthodontic treatment need in schoolchildren aged 12 and 13 years using the DAI; assess the associations among demographic variables, socioeconomic status, and orthodontic treatment need; and quantify the correlation between the DAI and its components in this population.

Methods

This cross-sectional study was conducted in all Municipal Educational Centers (MECs) of Balneário Camboriú, Santa Catarina, city of approximately 100,000 inhabitants. From February to July 2009, students aged between 12 and 13 years, whose parents agreed to their participation, were examined. The exclusion criteria included current or previous experience of orthodontic or orthopedic treatment.

The sample size calculation was based on the following parameters: a target population of 1,500 students, projection of 30% of occlusal problems [7], 95% confidence level, 80% statistical power, and 2.5% margin of error; through this calculation, a minimum sample size of 694 adolescents was determined. Anticipating a non-response rate of approximately 40% and an exclusion of 10% of adolescents due to current or previous orthodontic treatment, questionnaires were delivered to all students in all schools.

This present study was approved by the Ethics Committee of Lutheran University of Brazil (ULBRA, Canoas, RS, Brazil). The parents of students consented to their children's participation in the study by signing a consent form.

All information including the predictor variables and outcomes were collected by a single examiner previously trained and calibrated. For the calibration, 20 patients treated in the School of Dentistry (ULBRA, Brazil) were examined with a 15 day interval, and an adequate reproducibility index was obtained (κ=0.86).

Maternal schooling was obtained at the student's school records in the appropriate MEC, and age, sex, and ethnic group were collected by the examiner during the examination.

DAI [6] was used to evaluate the orthodontic treatment need. Exams were performed using gloves (SATARI, Piracicaba, São Paulo, Brazil), a dental mirror #5 (SSWhite, Rio de Janeiro, Rio de Janeiro, Brazil), gauze (CREMER, Blumenau, Santa Catarina, Brazil), wooden spatula (THEOTO, Jundiaí, São Paulo, Brazil), and the Community Periodontal Index (CPI) periodontal probe [4]. DAI was obtained by collecting data for dentofacial abnormalities, including missing teeth, incisal crowding, incisal spacing, largest irregularity in the maxilla, largest irregularity in the mandible, maxillary overjet, mandibular overjet, anterior open bite, and anteroposterior molar relationship. The results were multiplied by the respective round coefficient (weight), summed, and a constant value of 13 was added to the results. The final result was categorized as "no need for orthodontic treatment" (<25), "elective treatment" (26-30), "treatment highly desirable" (31-35), and "mandatory treatment" (>36) [1].

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) (SPSS Inc., Chicago, Illinois, USA) version 16.0 for Windows. The correlation between DAI components and final DAI scores was determined using the Spearman test according to the asymmetric distribution of the scores of DAI components. The chi-squared test was used to assess the association among age, gender, ethnic group, maternal education, and orthodontic treatment need while considering 3 cutoffs DAI scores as outcomes.

The variables gender and level of education were compared between respondents and non-respondents to investigate the effect of non-response (chi-squared and *t*-test for independent samples, respectively).

Results

Of 1446 students attending the schools, 1370 questionnaires were distributed as 76 had a prior history of orthodontic treatment. A total of 704 properly filled questionnaires were returned, representing the final sample.

The variable gender was distributed similarly: 53.1% (374/704) boys and 46.9% (330/704) girls. Regarding age, 321 (45.6%) were 12 years old and 383 (54.4%) were 13 years old. Regarding ethnicity, 530 (75.3%), 42 (6.0%), and 132 students (18.7%) were white, black, and mestizo, respectively. Maternal schooling ranged from 0-13 years with mean (SD) of 7.5 (3.3) years and median (P25-P75) of 8 (4-11) years.

DAI scores ranged from 13 to 47 with a mean (SD) of 25.3 (5.8) and median (P25-P75) of 24 (21-28). Table 1 shows the cutoff points for levels of malocclusion severity proposed by Jenny and Cons [1].

Table 1. Levels of severity of malocclusion

DAI* scores	Severity levels	n	(%)
≤25	Minor or no anomaly; *No treatment need*	413	(58.7)
26-30	Definite malocclusion; *Treatment elective*	169	(24.0)
31-35	Severe malocclusion; *Treatment highly desirable*	77	(10.9)
≥36	Handicapping malocclusion; *Treatment mandatory*	45	(6.4)

* Dental Aesthetic Index.

Table 2 shows the distribution of components of the DAI in each quartile of the DAI scores. The components of the DAI that primarily contributed to the variation in

scores in this population were maxillary overjet ($r=0.627$), anteroposterior molar relationship ($r=0.590$), largest irregularity in the maxilla ($r=0.345$), largest irregularity in the mandible ($r=0.332$), and incisal crowding ($r=0.305$). Moreover, neither mandibular overjet nor incisal spacing contributed to the variation in DAI scores.

By dichotomizing the variable DAI scores according to different cutoff points proposed in the literature to determine the orthodontic treatment need, 41.3% (291/704) had at least an elective indication (DAI>26), 17.3% (122/704) would be indicated as at least highly desirable (DAI>31), and 6.4% (45/704) had a mandatory indication (DAI>36). Table 3 shows no association observed between socioeconomic and demographic variables, and treatment need among individuals in this sample.

Table 2. Degree of correlation between Dental Aesthetic Index (DAI) scores and its components

DAI components	DAI				Correlation	
	1st Q ≤20	2nd Q 21–24	3rd Q 25–28	4th Q ≥29	p	r
No. of missing teeth: mean (SD)	0.00 (0.0)	0.00 (0.0)	0.01 (0.11)	0.11 (0.41)	<0.001	0.197
Crowding in incisal segment						
No	96 (38.2%)	59 (23.5%)	47 (18.7%)	49 (19.5%)	<0.001	0.305
One segment	44 (20.6%)	79 (36.9%)	47 (22.0%)	44 (20.6%)		
Two segments	12 (5.0%)	70 (29.3%)	76 (31.8%)	81 (33.9%)		
Spacing in incisal segment						
No	106 (21.4%)	153 (30.8%)	121 (24.4%)	116 (23.4%)	0.199	0.048
One segment	35 (25.9%)	33 (24.4%)	29 (21.5%)	38 (28.1%)		
Two segments	11 (15.1%)	22 (30.1%)	20 (27.4%)	20 (27.4%)		
Diastema in anterior segment: mean (SD)	0.03 (0.18)	0.09 (0.31)	0.18 (0.54)	0.37 (0.75)	<0.001	0.221
Largest irregularity in the maxilla: mean (SD)	0.30 (0.60)	0.60 (0.65)	0.91 (1.02)	1.21 (1.26)	<0.001	0.345
Largest irregularity in the mandible: mean (SD)	0.27 (0.50)	0.78 (0.69)	0.94 (0.90)	1.07 (1.04)	<0.001	0.332
Maxillary overjet: mean (SD)	1.55 (0.82)	2.37 (1.04)	2.89 (1.34)	4.80 (2.12)	<0.001	0.627
Mandibular overjet: mean (SD)	0.01 (0.08)	0.01 (0.12)	0.01 (0.08)	0.04 (0.29)	0.216	0.047
Anterior open bite: mean (SD)	0.01 (0.08)	0.00 (0.07)	0.04 (0.24)	0.07 (0.33)	<0.001	0.133
Molar relationship: n (%)						
Normal	110 (37.9%)	115 (39.7%)	45 (15.5%)	20 (6.9%)	<0.001	0.590
Half-cusp displacement	39 (18.6%)	72 (34.3%)	62 (29.5%)	37 (17.6%)		
Displacement ≥ 1 full cusp	3 (1.5%)	21 (10.3%)	63 (30.9%)	117 (57.4%)		

Table 3. Sample distribution of students according to different cutoff points for the levels of severity of malocclusion

Variable	N	DAI* Mean (SD)	Presence of malocclusion (DAI ≥ 26) n (%)	p	Treatment highly desirable (DAI ≥ 31) n (%)	p	Treatment mandatory (DAI ≥ 36) n (%)	p
Total	704	25.3 (5.8)	291 (41.3)		122 (17.3)		45 (6.4)	
Sex								
Male	374	25.3 (5.9)	155 (41.4)	0.950	67 (17.9)	0.662	29 (7.8)	0.116
Female	330	25.2 (5.7)	136 (41.2)		55 (16.7)		16 (4.8)	
Age								
12 years	321	25.1 (5.5)	139 (43.3)	0.332	50 (15.6)	0.261	19 (5.9)	0.639
13 years	383	25.4 (6.1)	152 (39.7)		72 (18.8)		26 (6.8)	
Ethnic group								
White	530	25.2 (5.8)	214 (40.4)	0.659	92 (17.4)	0.993	34 (6.4)	0.968
Black	42	25.5 (6.5)	19 (45.2)		7 (16.7)		3 (7.1)	
Mestizo	132	25.4 (5.8)	58 (43.9)		23 (17.4)		8 (6.1)	
Maternal education								
≤4 years	176	25.2 (5.9)	77 (43.8)	0.516	30 (17.0)	0.990	11 (6.3)	0.913
5-7 years	291	25.4 (5.9)	123 (42.3)		51 (17.5)		20 (6.9)	
≥8 years	234	25.2 (5.7)	90 (38.5)		41 (17.5)		14 (6.0)	

* Dental Aesthetic Index.

No difference was found between respondents and non-respondents regarding the variables gender (male respondents: 53.1% vs. male non-respondents 51.8%; P=0.665) and level of education [respondents: 6.6 (1.0) years vs. non-respondents: 6.5 (0.9) years; P=0.083].

Discussion

The present study primarily indicated a reasonable prevalence of malocclusion in the evaluated adolescents, which should be interpreted while considering the population investigated and method of assessment of orthodontic conditions. Moreover, the determined need for orthodontic treatment was moderate.

Studies from Australia [2], India [8], Malaysia [1,3-7, 9-10], Nigeria [9], Spain [11], and Brazil report similar results in this respect [12]. Moreover, higher prevalence with values above 30% considering DAI scores greater than 31 are reported in Canada [13], New Zealand [14], Nigeria [15], Peru [16], and other regions in Brazil [17].

Among the factors that possibly contribute to the lower prevalence of malocclusion is the low rate of missing teeth in this population, which reflects a lower DMFT (decayed, missing and filled teeth) index than other regions of the country [17]. Decay is the main factor affecting tooth loss, whereas missing teeth in the assessment of the DAI has greater weight on final value of this index. Diastema and open bite in the anterior segment are also weighted heavily in the calculation of the DAI and presented both low prevalence and severity in this population. This may have influenced the lower final DAI values.

Despite recognition of the importance of epidemiological studies of malocclusion, there is no standard index or specific criteria for assessing malocclusion [2,11]; this is often due to the multiple methods used to date [9]. The DAI has many benefits: it is useful, simple, reliable, easy to apply, an impartial indicator of malocclusion, and is independent of other occlusal index [3,6,11,18].

However, DAI has some disadvantages. It does not cover important features such as cross-bite, midline deviation, or overbite and may under-diagnose the need for orthodontic treatment [4,11]. It may underestimate the need for orthodontic treatment in cases where the canine is displaced, when the incisors are rotated or crowded, and cases of increased overbite; however, it may overestimate the need for orthodontic treatment when there is an increase in overjet, even in straight teeth [19]. Moreover DAI was integrated into the International Collaboration Study of Oral Health Outcomes by the World Health Organization [20] and has been used worldwide in epidemiologic studies of orthodontic treatment need in several industrialized and developing countries [3,10].

The components that primarily contributed to the variation in DAI scores in this population were maxillary overjet, anteroposterior molar relationship, incisal crowding, and largest irregularities in the maxilla and mandible, which is similar to those reported in studies from Australia [2], Malaysia [10], New Zealand [14] and Nigeria [15]. Thus, it is believed that certain dentofacial irregularities may be influenced by the chronological order of tooth eruption beyond 12 to 13 years of age. At this age, the deciduous canines are in the process of exfoliation and the space for their permanent successors is often restricted or insufficient for their proper alignment, resulting in increased crowding and irregularities in the anterior maxilla.

The lack of an association between socioeconomic factors and orthodontic treatment need was previously reported in studies in Nigeria [9], Peru [16], and Brazil [21]. Possible explanations for these findings highlight the fact that unlike other diseases affecting the stomatognathic system such as decay and periodontal disease, malocclusion presents a predominantly hereditary causality [22].

No association was observed between gender and the prevalence of malocclusion – the same as in the study populations in Nigeria [9-15], Peru [16], Spain [11], and previous studies in adolescents from other regions of Brazil [21]. A recent study that evaluated American adolescents seeking orthodontic treatment reports lower DAI scores in girls [23]. These results do not differ from our findings, confirming the assumption that the current uptake of services by girls is excellent because of heightened concern for their esthetic occlusal issues.

The findings of the present study can be generalized to populations with cultural and demographic characteristics similar to those of the population living in Southern Brazil: mostly white individuals with heterogeneous socioeconomic status, living in a developing country.

DAI scores were not associated with ethnicity in our study, corroborating the results of a study conducted in Malaysia [10]. This can be explained at least in part by the great racial diversity found in Brazil. However, in a study conducted in Nigeria, adolescents had better dental appearance and less need for orthodontic treatment than Caucasians (i.e., Americans and Australians) and Asians (i.e., Japanese), indicating that malocclusion and need for treatment vary according ethnicity [9].

One limitation of the present study is the reasonable number of non-respondents. However, considering the similarity in baseline characteristics between respondents and non-respondents, selection bias is unlikely to be an issue in this study.

Despite the moderate need for treatment according to the results, a substantial proportion of adolescents showed a severe level of malocclusion, indicating the need for health policies to provide and make preventive, interceptive, and corrective resources available to combat malocclusions even though one of the principal reasons for the non-completion of orthodontic treatment by schoolchildren is its high cost [21]. In these circumstances, it would be desirable to quantify treatment need in order to prioritize the availability of resources at the disposal of public service.

Conclusions

The present findings indicate that almost one-fifth of the sample requires orthodontic treatment. The components of the DAI that primarily contributed to the variation in orthodontic treatment need were maxillary overjet, anteroposterior molar relationship, largest irregularities in the maxilla and mandible, and incisal crowding. Moreover, in the study population, socioeconomic and demographic variables did not influence the need for orthodontic treatment.

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