

Psychosocial impact of malocclusion in the school performance. A Hierarchical Analysis.

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Objective: To identify any association between the psychosocial impact of malocclusion and academic performance in adolescents. **Methods:** Cross-sectional study in a sample of 297 adolescents aged 10 to 14 years old enrolled in public schools. A self-complete questionnaire enquiring about socioeconomic, demographic, and psychological characteristics and the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) was administered in classrooms. The school provided documents related to School Performance (average grade in the Portuguese subject and absences). A conceptual structure was built, and independent variables were inserted hierarchically into logistic models for school performance (outcome). Independent variables were: Gender, age, caries status (DMFT), orthodontic treatment need (IOTN-DHC), psychological impact (PIDAQ) and school commitment (class absences and missed classes). **Results:** Boys (OR = 3.56; 95% CI: 1.54-8.21) with caries experience (OR = 2.77; 95% CI: 1.23-6.23), need for orthodontic treatment (OR = 0.40; 95% CI: 0.18-0.91) and adolescents who reported a psychological impact (OR = 2.70; 95% CI: 1.16-6.30) had worse school performance. **Conclusion:** Boys with caries and malocclusion experience who reported the psychological impact of the need for orthodontic treatment are more likely to have worse school performance.

Keywords: Malocclusion, Psychosocial impact, Academic performance

Introduction

Oral health conditions can negatively impact school performance, as individuals with poor oral health are more likely to have worse academic performance. (De Paula *et al.*, 2015; Maharani *et al.*, 2017; Gopalan *et al.*, 2018; Naavaal and Kelekar, 2018; Rebelo *et al.*, 2018; Ruff *et al.*, 2018; Karki *et al.*, 2019; Lehtinen *et al.*, 2020). Dental caries is a risk factor for poor school performance (Piosevan *et al.*, 2012; Gopalan *et al.*, 2018; Ribeiro *et al.*, 2018) since it may cause pain and discomfort, influencing sleep, reducing the ability to learn and, consequently, affecting performance in the school environment (Naavaal and Kelekar, 2018; Ribeiro *et al.*, 2018). Dental trauma and periodontal problems also negatively influence the school context (Piovesan *et al.*, 2012; Kaewkamnerdpong and Krisdapong, 2018).

Malocclusion is a prevalent condition among adolescents (Marques *et al.*, 2005; Freitas *et al.*, 2015; Martins *et al.*, 2019) with a direct influence on health-related quality of life (OHRQoL) and family life (Sun *et al.*, 2017; Sun *et al.*, 2018; Alrashed and Alqerban, 2021). However, the literature is inconclusive about its impact on the academic performance of adolescents (Basha *et al.*, 2016; Rebelo *et al.*, 2019; Ribeiro *et al.*, 2018).

Nor does the literature provide information on how Gender can modulate the impact of malocclusion on school performance. Girls report greater impact of dental esthetics (Iranzo-Cortés *et al.*, 2020; Ilijazi-Shahigi *et al.*, 2021). Thus, social activities may be affected in this context, negatively reflecting on school performance (Basha *et al.*, 2016).

The impact of malocclusion on quality of life is related to the intensity and complexity of the social, emotional, and behavioral relationships experienced in adolescence (Almeida *et al.*, 2019) and, therefore, its consideration in health care is important. This study aimed to identify any association between the psychosocial impact of malocclusion and academic performance in adolescents. We hypothesized that the psychosocial impact of poor dental aesthetics is associated with poor academic performance.

Methods

A cross-sectional study was conducted with 297 adolescents between 10 and 14 years of age enrolled in 4 public schools in Araras (São Paulo, Brazil). The municipality has an estimated population of 118,843 inhabitants at data collection, with a Human Development Index (HDI) of 0.78 (Atlas of Human Development in Brazil). The study was approved by the Human Research Ethics Committee (No.14414519.1.00000.5385) and carried out following the STROBE guidelines. Adolescents and their legal guardians were informed that participation in the study was entirely voluntary, the study's objectives were clarified, and the confidentiality of the collected data was guaranteed. After agreeing to participate, the guardians signed the free and informed consent terms, and the adolescents signed the assent term.

According to the Brazilian educational system, the adolescents included in the study were enrolled in public school and attended elementary school (between the 5th and 9th grades). Classrooms and participants were randomly selected

using a computer program. Adolescents who had undergone previous orthodontic treatment or were in the mixed dentition stage were excluded from the sample. The sample size was calculated considering a confidence interval of 95% and a test power of 80%, an exposed/unexposed ratio of 1:1, a 50% response of the unexposed group (malocclusion), and an odds ratio of 2.0. Assuming these parameters, a total of 296 adolescents would be necessary.

The average grade in Portuguese school subjects (official Brazilian language) in the last semester of 2019 was used to determine School performance. Data were collected from the school records (Gopalan *et al.*, 2018) and dichotomized into below/above average school performance ($< 5 \geq 5$ respectively). Absences and missed classes were based on the attendance record of each adolescent during the same period in 2019 (Gopalan *et al.*, 2018; Kaewkamnerdpong and Krisdapong, 2018). One hundred school days were observed during the semester, with the number of missed classes determining the frequency of absence.

Adolescents completed the Brazilian version of the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) (Klages *et al.*, 2006; Sardenberg *et al.*, 2011). The PIDAQ measures OHRQoL impacts specific to orthodontics, especially the impacts and perceptions of dental appearance. The scale consists of 23 items, in four domains: Dental self-confidence (6 items), Aesthetic concern (3), Psychological impact (6), and Social impact (8). Each item is scored on a five-point scale, ranging from 0 (no impact) to 4 (maximum impact). Total PIDAQ and domain scores were obtained by summing the item codes (Klages *et al.*, 2006; Sardenberg *et al.*, 2011; Prado *et al.*, 2016; Santos *et al.*, 2016; Raghavan *et al.*, 2019). For data analysis, this variable was dichotomized by the median of the total score and each domain (Santos *et al.*, 2016).

The Oral Health Component (DHC) of the Orthodontic Treatment Need Index (IOTN) was used to record dental aspects of malocclusion and normative need for orthodontic treatment (Brook and Shaw, 1989). IOTN-DHC considers the absence of teeth (including congenital absence and impacted teeth); overjet (positive or negative); anterior or posterior crossbite; crowding; overbite; and an anterior or posterior open bite, using a scale of 5 grades, in ascending order (IOTN-DHC 1 to 5). The most severe score from any of these parameters was assigned to each participant. For data analysis the IOTN-DHC was dichotomized into = 1 (No need for orthodontic treatment) or IOTN-DHC > 1 (needs orthodontic treatment) (Lima *et al.*, 2010; Dallé *et al.*, 2019).

Caries experience was diagnosed based on the World Health Organization (1997) and dichotomized as DMFT = 0 (no caries experience) or DMFT > 1 (with caries experience).

Clinical examinations were performed by a single calibrated examiner, who participated in theoretical and clinical training and calibration. Kappa coefficients exceeded 0.92 and 0.98 for diagnosing malocclusion and dental caries, respectively for inter-rater reliability with the trainer.

The outcome variable was school performance in Portuguese (grammar and texts in the national language of Brazil), dichotomized into below (< 5) and above-average (≥ 5). After descriptive analysis, simple logistic regression models between each independent variable and the outcome were performed. Raw odds ratios with 95% confidence intervals were calculated from these models. Variables with $p < 0.20$ in simple analyses were studied in hierarchical multiple logistic regression models.

The hierarchy of variables was performed according to the conceptual model (Figure 1). School performance was considered an outcome variable. The independent

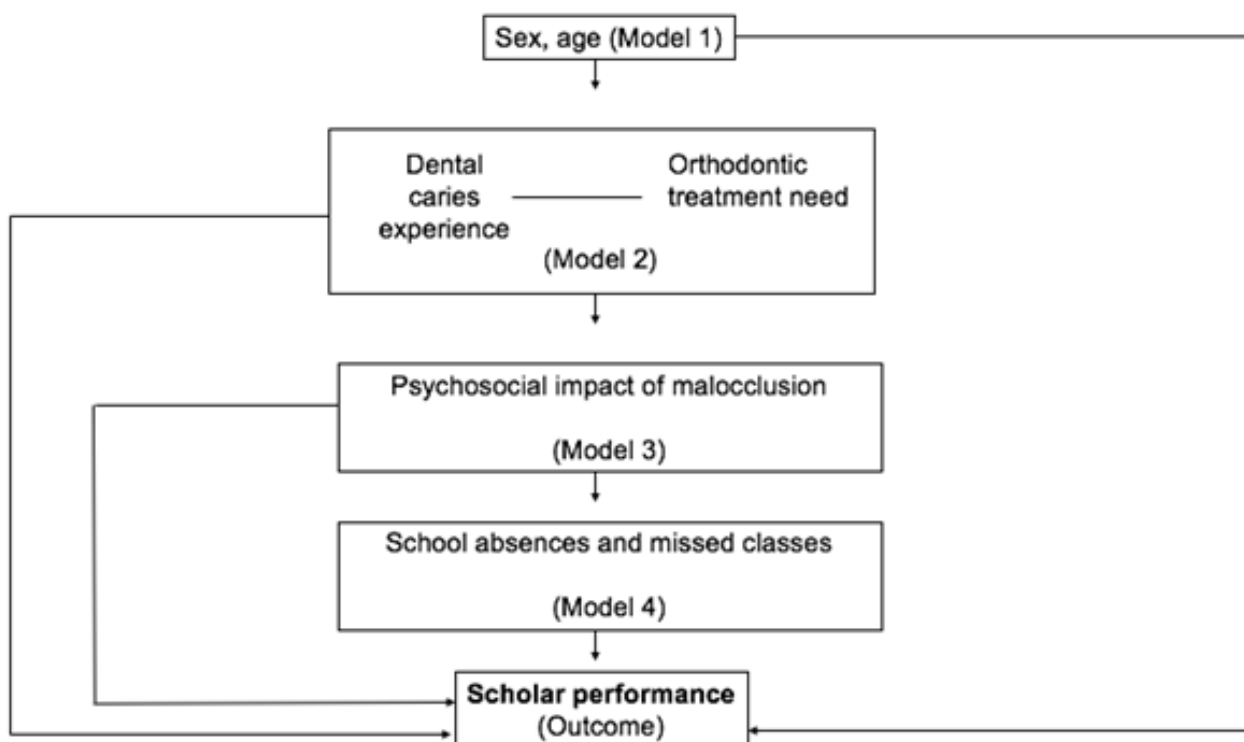


Figure 1. Conceptual hierarchical framework of relationships between school performance, demographic backgrounds, clinical conditions, school absences and missed classes and psychosocial impact of malocclusion.

variables were: Gender, age, caries experience (DMFT), orthodontic treatment need (IOTN-DHC), psychological traits (PIDAQ), and school commitment (class absences and missed classes). As some independent variables are related, independent models were built for these variables. These models calculated adjusted odds ratios with 95% confidence intervals. The fit of the models was evaluated by the Akaike Information Criterion (AIC) and -2 Log L (log-likelihood). Analyzes were performed using the R program (R Foundation for Statistical Computing, Vienna, Austria).

Results

A total of 354 adolescents were approached, of whom 58 did not meet the eligibility criteria. Table 1 summarises key characteristics of the 297 participants. Slightly more were male (55.6%), 72.1% had experience of caries and 72.7% needed orthodontic treatment. According to the PIDAQ, 51.5% of adolescents reported psychosocial impact of malocclusion. For each of the PIDAQ domains, 50.8% reported impacts on self-confidence, 64.6% on aesthetic concern, 50.8% on the psychological domain and 51.9% on the social domain.

Table 2 summarises the bivariate analyzes between the independent variables and the outcome, and Table 3 presents the hierarchical multiple logistic regression models for predictors of school performance. In the first model, demographic variables were studied (Table 3). Male adolescents (OR=2.84; 95% CI: 1.27-6.34) ≥ 12 years old (OR=2.88; 95% CI: 1.13-7.34) are more likely to have worse school performance ($p < 0.05$). Then, the oral health variables were included, and then the variables related to the psychosocial aesthetic impact. In model 3, male adolescents (OR = 3.56; 95% CI: 1.54-8.21), with caries experience (OR=2.77; 95% CI: 1.23-6.23), with orthodontic treatment need (OR=0.40, 95% CI: 0.18-0.91) and who reported an impact on the psychological domain of the PIDAQ (OR=2.70; 95% CI: 1.16-6.30) were more likely to have worse school performance ($p < 0.05$).

Discussion

School performance is an essential aspect of adolescents' routine and can influence their well-being. It is therefore valuable to investigate the relationship between oral health and educational practices in this stage of life (Ribeiro *et al.*, 2018; Ruff *et al.*, 2018; Lawder *et al.*, 2019). Our

Table 1. Oral health status, school performance and psychological impacts of malocclusion in 297 adolescents.

Variable	Category	%
Demographic		
Gender	Female	55.6
	Male	44.4
Age	<12 years ^{&}	39.1
	≥ 12 years	60.9
Oral health		
Dental caries (DMFT)	>0	72.1
	0	27.9
Orthodontic treatment need (IOTN-DHC)	Orthodontic treatment need (IONT-DHC = 1)	72.7
	No orthodontic treatment need (IOTN-DHC >1)	27.3
Psychological trait		
PIDAQ - Dental self-confidence	<13 ^{&}	49.2
	≥ 13	50.8
PIDAQ - Aesthetic concern	<7 ^{&}	35.4
	≥ 7	64.6
PIDAQ - Psychosocial impact	<13 ^{&}	49.2
	≥ 13	50.8
PIDAQ - Social impact	<22 ^{&}	48.1
	≥ 22	51.9
PIDAQ – Total score	<55 ^{&}	48.5
	≥ 55	51.5
School commitment		
Class absences (%)	<5.0%*	48.8
	$\geq 5.0\%$	51.2
Missed classes (%)	<5.0%*	48.8
	$\geq 5.0\%$	51.2

*Average.

Table 2. Logistic regression analyses between independent variables and school performance (n = 297).

		School performance		OR crude (95% CI)
		<5.0* (%)	≥5.0 (%)	
Gender	Female	6.1	93.9	Ref
	Male	15.2	84.8	2.77 (1.25-6.14)
Age	<12 years	5.2	94.8	Ref
	≥12 years	13.3	86.7	2.80 (1.11-7.08)
Dental caries (DMFT)	>0	7.5	92.5	Ref
	0	16.9	83.1	2.51 (1.16-5.41)
Orthodontic treatment need (IOTN-DHC)	Orthodontic treatment need	16.0	84.0	Ref
	No orthodontic treatment need	7.9	92.1	0.45 (0.21-0.97)
PIDAQ - Dental self-confidence	<13	8.2	91.8	Ref
	≥13	11.9	88.1	1.51 (0.70-3.26)
PIDAQ - Aesthetic concern	<7&	9.5	90.5	Ref
	≥7	10.4	89.6	1.10 (0.50-2.46)
PIDAQ - Psychosocial impact	<13&	6.2	93.8	Ref
	≥13	13.9	86.1	2.46 (1.09-5.56)
PIDAQ - Social impact	<22&	9.1	90.9	Ref
	≥22	11.0	89.0	1.24 (0.58-2.66)
PIDAQ – Total score	<55&	7.6	92.4	Ref
	≥55	12.4	87.6	1.71 (0.78-3.74)
Class absences (%)	<5.0%	10.3	89.7	Ref
	≥5.0%	9.9	90.1	0.95 (0.45-2.02)
Missed classes (%)	<5.0%&	9.7	90.3	Ref
	≥5.0%	10.5	89.5	1.10 (0.52-2.34)

Table 3. Hierarchical multiple logistic regression models for predictors of school performance in 297 adolescents.

	Model 1	Model 2	Model 3
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Gender	*2.84 (1.27-6.34)	**3.35 (1.46-7.66)	**3.56 (1.54-8.21)
Age [#]	*2.88 (1.13-7.34)	-	-
Caries experience [#]		*2.78 (1.25-6.18)	*2.77 (1.23-6.23)
Orthodontic treatment need [#]		*0.40 (0.18-0.91)	*0.40 (0.18-0.91)
Psychosocial impact [#]			*2.70 (1.16-6.30)
-2 Log L	182.00	176.56	170.85
AIC	188.00	184.56	180.85

[#]Ref.: age (<12 years); caries experience (without); orthodontic treatment need (without); psychosocial impact (<22&); OR: Odds ratio; CI: Confidence interval; & Median of the sample; -2 Log L (empty model) = 194.41; AIC (empty model) = 196.41.

data support the hypothesis that students with malocclusion have lower academic performance. Age did not influence school performance, corroborating data from another study (Kaewkamnerdpong and Krisdapong, 2018). On the other hand, boys were more likely to perform worse than girls (Piosevan *et al.*, 2012; Basha *et al.*, 2016; Gopalan *et al.*, 2018).

Oral health plays a fundamental role in general health status and, consequently, in determining the quality of life of individuals and their ability to develop social and physical functions (Jurgensen and Petersen, 2009). Although previous studies cannot be generalized to other populations and our outcome has not yet been studied in

the literature, it is possible to see correlations between oral health and school performance (Seirawan *et al.*, 2012; Gopalan *et al.*, 2018). In addition, the number of oral health problems and, consequently, poorer performance has been observed in boys (Gopalan *et al.*, 2018).

Another important finding was that adolescents with dental caries experience had worse school performance, corroborating other studies (Kaewkamnerdpong and Krisdapong, 2018; Gopalan *et al.*, 2018; Ruff *et al.*, 2018). Caries can cause pain, which might decrease school attendance or reduce students' attention to classes, again affecting their school performance (Naavaal and Kelekar, 2018; Ruff *et al.*, 2018).

Normative need for orthodontic treatment negatively impacted the academic performance of adolescents. Untreated malocclusion can affect school absenteeism (Basha *et al.*, 2016) and non-active participation in classes and school activities due to altered aesthetics and phonetics, impacting communication (Basha *et al.*, 2016). Furthermore, poor school performance is negatively influenced by absence from classes due to dental problems (Maharani *et al.*, 2017; Gopalan *et al.*, 2018; Kaewkamnerdpong and Krisdapong, 2018; Ruff *et al.*, 2018). Psychological aspects of malocclusion (as indicated by the PIDAQ domains) was related to adolescents' school performance. This is an important finding since the psychological stress resulting from malocclusion, and the psychological and social impacts of bullying can impact behavior and psychosocial well-being, reflecting in poorer school performance (DiBiase and Sandler, 2001; Basha *et al.*, 2016; Tristão *et al.*, 2020).

Although cross-sectional, our data support the relationship between oral health problems, emphasizing malocclusion with absenteeism and school performance in adolescents, as we seek objective measures for such assessments. Conversely, a recent systematic review (Ribeiro *et al.*, 2018) did not support the influence of oral health on school practice, as the studies analyzed used subjective tools to assess clinical conditions.

The high level of orthodontic treatment need observed in this sample was related to the sensitive threshold used for IOTN-DHC (> 1 in any component) (Lima *et al.*, 2010; Dallé *et al.*, 2019).

Given current knowledge about the relationship between occlusal problems and school performance, this is the first Brazilian study on the association of the psychosocial impact of malocclusion on school performance and school absenteeism. Further research is needed, as in addition to encouraging the prevention of oral diseases, favor the planning of future school oral health programs.

In conclusion, with dental caries and malocclusion experience who reported psychological impact of the need for orthodontic treatment are more likely to have worse school performance.

Conflict of interest

The authors declare no conflicts of interest.

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