Artículos Originales de Investigación
https://doi.org/10.47990/9dvwdc18

Temporomandibular disorders and associated risk factors in children and adolescents in Cartagena, Colombia.

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Abstract: Objectives: To determine the risk factors associated with temporomandibular disorders (TMD) in children and adolescents attending the pediatric dentistry service of the University of Cartagena - Colombia. **Methodology:** The sample consisted of 105 participants. Prior to the signing of informed consent by the legal representatives, a survey was applied to measure the sociodemographic variables. The diagnosis of TMD was obtained with axis I of the RDC/TTM, and the oral habits and behaviors questionnaire was also applied. The radiographic analysis was standardized to evaluate the variables skeletal malocclusions, growth pattern, Baccetti cervical maturation stage, and cervical curvature analysis according to Penning; postural attitude was measured with the photographic model of body posture. The statistical analysis was performed with the STATA program version for Windows 14, using a univariate and multivariate logistic regression analysis, with the chi^2 test, assuming a value of ($p< 0.05$) for significance. **Results:** The model obtained for the explanation of TMD was the crude one showing statistical significance for the variables canine class, oral habits/behaviors, postural attitude and the variable age ($p< 0.004$). The statistical strength was low (R^2=14%). **Conclusion:** The negative impact of class II canine malocclusion in children and adolescents with TMD is highlighted, being considered the variable with the highest weight within the regression coefficient, which was significantly associated with oral behaviors, forward position of the mandible, inadequate postural attitude and the age group ≥ 6 years.

Key words: Malocclusion, temporomandibular disorders, children and adolescents, class II, oral behaviors.

Trastornos temporomandibulares y factores de riesgo asociados en niños y adolescentes de Cartagena, Colombia.

Resumen: Objetivos: Determinar cuáles son los factores de riesgo asociados a los trastornos temporomandibulares (TTM) en niños y adolescentes que acuden al servicio de odontopediatría de la Universidad de Cartagena – Colombia. **Metodología:** La muestra fue de 105 participantes. Previo a la firma de consentimiento informado por los representantes legales se aplicó una encuesta para medir las variables sociodemográficas. el diagnostico de los TTM se obtuvo con el eje I de RDC/TTM, se aplicó igualmente el cuestionario de hábitos y comportamientos orales. El análisis radiográfico se estandarizó para evaluar las variables maloclusiones esquelética, patrón de crecimiento, estadio de maduración cervical de Baccetti, y análisis de curvatura cervical según Penning; la actitud postural se midió con el modelo fotográfico de postura corporal. El análisis estadístico se realizó con el programa STATA versión para Windows 14, se utilizó un análisis de regresión logística univariable y multivariable, con la prueba de chi^2, asumiendo un valor de ($p< 0,05$) para la significancia. **Resultados:** el modelo obtenido para la explicación de los TTM fue el crudo mostrando significancia estadística para las variables clase canina, hábitos/comportamientos orales, actitud postural y la variable edad ($p< 0,004$). La fuerza estadística fue baja (R^2=14%) **Conclusión:** Se resaltar el impacto negativo de la maloclusión clase II canina en los niños y adolescentes con TTM, siendo considerada la variable de mayor peso dentro del coeficiente de regresión, la cual se asoció significativamente en conjunto con el comportamiento oral posición adelantada de la mandíbula, inadecuada actitud postural y el grupo edad ≥ 6 años.

Palabras clave: Maloclusión, Trastornos temporomandibulares, niños y adolescentes, clase II, comportamientos orales.

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Desordens temporomandibulares e factores de risco associados em crianças e adolescentes em Cartagena, Colômbia.

Resumo: **Objetivos:** Determinar os fatores de risco associados às desordens temporomandibulares (DTM) em crianças e adolescentes atendidos no serviço de odontopediatria da Universidade de Cartagena - Colômbia. **Metodologia:** a amostra foi composta por 105 participantes. Antes da assinatura do consentimento informado pelos representantes legais, foi aplicado um inquérito para medir as variáveis sociodemográficas, o diagnóstico de DTMs foi obtido com o RDC/TTM eixo I, e também foi aplicado o questionário de hábitos e comportamentos orais. A análise radiográfica foi padronizada para avaliar as variáveis más oclusões esqueléticas, padrão de crescimento, estágio de maturação cervical de Baccetti e análise da curvatura cervical de Penning; a atitude postural foi mensurada com o modelo fotográfico de postura corporal. A análise estatística foi realizada com o programa STATA versão para Windows 14, através de análise de regressão logística univariada e multivariada, com o teste chi^2, assumindo um valor de (p<0.05) para significância. **Resultados:** o modelo obtido para a explicação das DTMs foi o bruto, apresentando significância estatística para as variáveis classe canina, hábitos/comportamentos orais, atitude postural e a variável idade (^{p}<0.004). **Conclusão:** Destaca-se o impacto negativo da má oclusão canina de classe II em crianças e adolescentes com DTM, sendo considerada a variável com maior peso dentro do coeficiente de regressão, que se associou significativamente ao comportamento oral, posição anterior da mandíbula, atitude postural inadequada e faixa etária ≥ 6 anos.

Palavras-chave: Má oclusão, desordens temporomandibulares, crianças e adolescentes, classe II, comportamentos orais.

Introduction

Temporomandibular disorders (TMDs) are the most commonly reported group of orofacial disorders in adults between the ages of 20 and 40[1]. However, data on these disorders in the pediatric population is scarce and often diverse[2]. Reaching a consensus on the manifestations of TMD in childhood and adolescence has been difficult, mainly due to methodological differences between recent studies, which consequently show disparate results for the same age group, while others use the stages of dental occlusion development, rather than age, to report on the frequency of TMD[3,4].

At the same time, the signs and symptoms of TMDs in the pediatric population seem complex to establish, due to the difficulty of understanding their expressions of pain, location, intensity, and what causes it. Despite this, many studies manage to identify them[5]. Today, we know that the signs and symptoms of TMD range from spontaneous pain, myofascial pain syndrome, headache, noises, crackling, and joint popping during jaw movements and masticatory function[6]. The effects of these disorders affect the quality of life of children/adolescents in the psychosocial dimension, while physical pain and its intensity are associated with psychological distress, TMJ functioning, and adherence to health-promoting behaviors[5-7].

In 2021, a study was published that validated, using the Delphi method, the adaptation and application of Axis I of the RDC/TMD for clinical diagnosis in children and adolescents[8], an important achievement that provided a physical assessment tool, through a consensus of international experts, with language appropriate for this population.

Even in Colombia, the work carried out by Mora-Zuluaga in 2022[9] stands out, where the Helkimo index (HI) was used to determine the presence and severity of TMD in schoolchildren in the city of Cali, taking malocclusions as the main associated risk factor. However, there are few studies that address this issue in the pediatric population (children and adolescents) that are methodologically comparable to current international research. Therefore, it is necessary to continue with studies such as this one, which aims to determine the risk factors associated with TMD in children and adolescents in Cartagena, Colombia.

Materials and methods

A cross-sectional analytical study was conducted. The population of this research consisted of children and adolescents who were admitted to the pediatric dentistry service of the Faculty of Dentistry at the University of Cartagena, Colombia, during the period 2023-2024. The sample consisted of 105 participants. This was calculated taking into account a finite population and an expected frequency of 11.3% of TMD in individuals with skeletal malocclusion[10]. The individuals were selected through non-probabilistic sampling, taking into account the following inclusion criteria: children and adolescents aged 3 to 16 years, of both sexes, whose parents agreed to their participation in the study, and children born in Cartagena with parents and grandparents of Cartagena descent. Exclusion criteria: children and adolescents with syndromes and/or systemic diseases, arthritis or muscular and ear diseases, any type of motor-sensory disability, and parents who also have a physical or motor disability. Participants with uncooperative behavior, such as disruptive movements and crying, children and adolescents undergoing maxillary orthopedic treatment, orthodontic treatment, and/or with a history of orthognathic surgery[10].

Ethical considerations: In accordance with Resolution 8430 of 1993 of the Colombian Ministry of Social Protection, this research project was endorsed by the internal ethics committee of the Faculty of Dentistry at the University of Cartagena.

Prior to signing the informed consent form, the conditions of the research were explicitly explained to the parents and/or legal guardians of the participants.

Data collection: Parents and participants were given a survey to measure sociodemographic variables. Two examiners calibrated by a specialist in the field were available. Before collecting the sample, the reproducibility and comprehension of each instrument were tested. Training on the appropriate palpation force was provided, and the results of each diagnostic test were then discussed by the standard reference calibrator[11].

A routine dental examination was performed to detect local occlusion characteristics such as Angle canine and molar class, interferences, premature contacts, posterior-anterior crossbite, functional and skeletal mandibular deviations. In addition, the clinical diagnosis of other habits such as mouth breathing, atypical swallowing, and unilateral chewing in children and adolescents was included[10].

For the diagnosis of TMD, participants were evaluated using axis I of the RCD/TMD[12]. The analysis of parafunctions, habits, and/or oral behaviors was performed using the validated Oral Behavior Checklist (OBC) list of oral habits[13]. The presence of self-reported sleep bruxism (SB) and awake bruxism (AW) confirmed by a third party was also investigated[12,13].

Radiographic-cephalometric analysis: Teleradiography was standardized for use in cephalometric analysis of skeletal malocclusions, growth pattern, Baccetti cervical maturation stage, and cervical curvature analysis according to Penning[14,15]. X-rays were taken of all participants with their heads in a natural position, looking at the horizon, barefoot, with their jaws closed, without a cephalostat (Figure 1A). The SNA, ANB, SNB, S-N/Go-Gn, and FH/Go-Me angles were evaluated, obtaining the skeletal diagnosis of malocclusions.

The analysis of static posture was performed through visual assessment by a physical therapist with certified experience in the field of biomechanics and posture analysis. Participants were examined in a relaxed standing posture: subjects were asked to stand upright, barefoot, without moving, facing forward, with relaxed shoulders and arms at their sides for a natural head and body position (Figure 1B). A frontal, posterior, and lateral record was obtained, and an assessment of the absence of abnormal muscle tension and normal mobility was performed (16); each participant's postural attitude (PA) was described.

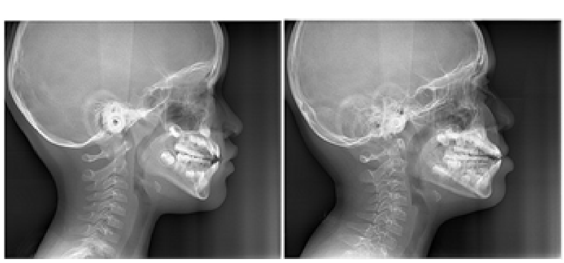

Figure 1 A. *Illustration of teleradiography taken for analysis (without anterior stabilization).*

Statistical analysis: The statistical analysis was performed with STATA version 14 for Windows. Categorical variables were described using relative frequencies and proportions. For quantitative variables, measures of central tendency and dispersion were used. To determine the association between malocclusions, TMD, and the clinical characteristics of the participants, univariate and multivariate logistic regression analysis were used, with the chi-square test, assuming a value of p <0.05 for significance. In addition, the Bonferroni test was applied to correct the statistical model.

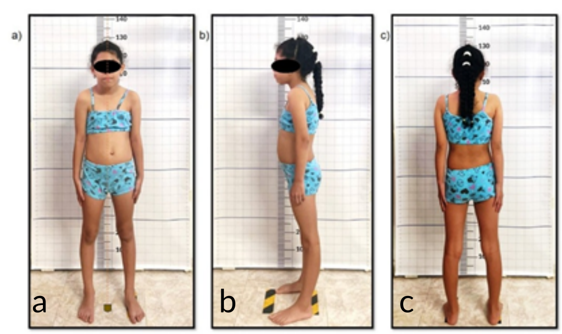

Figure 1 B. *Visual assessment of static posture. a) front view; b) sagittal view; c) rear view.*

Results

The prevalence of TMDs in children and adolescents was 54.2%. Regarding the location of TMDs, unilateral TMDs accounted for 56.8%. The most common group of TMDs among participants was intra-articular TMDs, at 46.6%, and within this group, disc displacement with reduction was the most prevalent disorder, at 85.7%. The next most common group of disorders in this population was painful TMDs, with arthralgia being the most prevalent condition, at 68.0%. Among the clinical characteristics of dental occlusion, one of the most marked in the population was Angle Class II molar malocclusion, with 37.1%, while skeletal Class II malocclusion in participants was 64.7% (Table 1).

Univariate analysis: Regarding the age variable by groups, the age group ≥ 6 years showed a significant association with the presence of TMD ($p < 0.029$), being the only sociodemographic variable that did so. When associating TMD with malocclusions and other skeletal characteristics, using the sagittal classification, it was evident that there was no significant association with the different classes I, II, and III ($p<0.566$), as was the case with the variables: growth pattern or angle of divergence ($p<0.081$),

Table 1. Frequency distribution for TMD and clinical variables.

TMD (Temporomandibular Disorders)	Relative frequency	Absolute frequency %
Absent	47	45.19
Present	58	54.81
TMD Location		
Unilateral	32	56.14
Bilateral	25	43.85
Painful TMD		
Myalgia	7	28.00
Myofascial pain	0	0.00
Arthralgia	17	68.00
Headache attributed to TMD	1	4.00
Intra-articular TMD		
Disc displacement with reduction	42	85.71
With reduction with intermittent blockage	0	0.00
Without reduction with limited opening	3	6.12
Without reduction without limited opening	4	8.16
Degenerative TMD		
Absent	104	99.05
Present	1	0.95
Dental open bite		
Absent	88	83.81
Present	17	16.19
Dental deep bite		
Absent	74	70.48
Present	31	29.52

Table 1. Frequency distribution for TMD and clinical variables. (Cont.)

	Relative frequency	Absolute frequency %
OVERJET ≥ 4 mm		
Absent	67	63.81
Present	38	36.19
Posterior crossbite		
Absent	97	92.38
Present	8	7.61
Anterior crossbite		
Absent	84	80.00
Present	21	20.00
Angle canine class		
Undetermined	20	19.05
Class I	54	51.43
Class II	14	13.33
Class III	17	16.19
Angle molar class		
Undetermined	13	12.38
I	24	22.86
II	39	37.14
III	29	27.62
Skeletal class		
I	15	14.29
II	68	64.76
III	22	20.95
Growth pattern		
Normal	19	18.10
Vertical	73	69.52
Horizontal	13	12.38
Mandibular Skeletal Deviation (Levognathia-Dextrognathia)		
Absent	68	61.90
Present	37	35.24
Cervical Bone Maturation		
CS1	65	61.90
CS2	25	23.81
CS3	15	14.29
Total:	**105**	**100.00**

Note: CS stage of cervical maturation Baccett

mandibular deviations (*p*<0.523), and cervical maturation stage (*p*<0.288). However, the local characteristics of the occlusion that did show significance were: posterior crossbite margin (*p*<0.050), anterior crossbite (*p*<0.006), Angle canine classes II and III with (*p*<0.038) and (*p*<0.011) respectively, Angle molar classes II and III with (*p*<0.036) and (*p*<0.041) individually (Table 2).

Table 2. Association between sociodemographic characteristics, clinical-cephalometric variables, bone maturation, oral habits/parafunctions, body posture, and TMD

Age by group	Absent TMD	Present TMD	Total	*p-value*
Early childhood	1	8	9	0.029*
%	11.11	88.89	100.00	
Childhood	43	47	89	
%	47.73	52.27	100.00	
Adolescence	4	3	7	
%	57.14	42.86	100.00	
Gender				
Female	27	28	55	0.466
%	49.09	50.91	100.00	
Male	21	29	50	
%	42.00	58.00	100.00	
Legal representative age				
Youth	6	9	15	0.349
%	40.00	60.00	100.00	
Adulthood	37	46	83	
%	44.58	55.42	100.00	
Old age	5	2	7	
%	71.43	28.57	100.00	
Education level of legal representative				
Primary	4	3	7	0.375
%	57.14	42.86	100.00	
Middle school	21	21	42	
%	50.00	50.00	100.00	
Technical Technologist	15	27	42	
%	35.71	64.29	100.00	
University	8	6	14	
%	57.14	42.86	100.00	
Monthly household income. (CMMW 2023-2024)				
1 CMMW	19	19	38	0.541
%	50.00	50.00	100.00	
< CMMW	8	7	15	
%	53.33	46.67	100.00	
>LMW	21	31	51	
%	40.38	59.62	100.00	

Table 2. Association between sociodemographic characteristics, clinical-cephalometric variables, bone maturation, oral habits/parafunctions, body posture, and TMD (cont.)

Participant's education level.	Absent TMD	Present TMD	Total	*p-value*
None	2	2	4	0.782
%	50.00	50.00	100.00	
Preschool/Elementary school	34	42	76	
%	44.74	55.26	100.00	
Middle school	12	12	24	
%	50.00	50.00	100.00	
Technical Technologist	0	1	1	
%	0.00	100.00	100.00	
OPEN BITE				
No	38	50	88	0.236
%	43.18	56.82	100.00	
Yes	10	7	17	
%	58.82	41.18	100.00	
DEEP BITE				
No	35	39	74	0.615
%	47.30	52.70	100.00	
Yes	13	18	31	
%	41.94	58.06	100.00	
OVERJET ≥4MM				
No	31	36	67	0.880
%	46.27	53.73	100.00	
Yes	17	21	38	
%	44.74	55.26	100.00	
POSTERIOR CROSSBITE				
No	47	50	97	0.050*
%	48.45	51.55	100.00	
Yes	1	7	8	
%	12.50	87.50	100.00	
POSTERIOR CROSSBITE				
No	44	40	84	0.006*
%	52.38	47.62	100.00	
Yes	4	17	21	
%	19.05	80.95	100.00	
CLASS I CANINE ANGLE				
Absent	20	31	51	0.194
%	39.22	60.78	100.00	
Present	28	26	54	
%	51.85	48.15	100.00	

Table 2. Association between sociodemographic characteristics, clinical-cephalometric variables, bone maturation, oral habits/parafunctions, body posture, and TMD (cont.)

CLASS II ANGLE CANINE	Absent TMD	Present TMD	Total	*p-value*
Absent	38	53	91	0.038*
%	41.76	58.24	100.00	
Present	10	4	14	
%	71.43	28.57	100.00	
CLASS III ANGLE CANINE				
Absent	45	43	88	0.011*
%	51.14	48.86	100.00	
Present	3	14	17	
%	17.65	82.35	100.00	
ANGLE CLASS I MOLAR.				
Absent	35	46	81	0.344
%	43.21	56.79	100.00	
Present	13	11	24	
%	54.17	45.83	100.00	
ANGLE CLASS II MOLAR				
Absent	25	41	66	0.036*
%	37.88	62.12	100.00	
Present	23	16	39	
%	58.97	41.03	100.00	
ANGLE CLASS III MOLAR				
Absent	39	36	75	0.041*
%	52.00	48.00	100.00	
Present	9	21	30	
%	30.00	70.00	100.00	
SAGITTAL SKELETAL MALOCCLUSION				
Class I	5	10	15	0.566
%	33.33	66.67	100.00	
Class II	32	36	68	
%	47.06	52.94	100.00	
Class III	11	11	22	
%	50.00	50.00	100.00	
MAXILLARY GROWTH PATTERN				
Normal	12	7	19	0.092
%	63.16	36.84	100.00	
Vertical	33	40	73	0.874
%	45.21	54.79	100.00	
Horizontal	3	10	13	0.080
%	23.08	76.92	100.00	

Table 2. Association between sociodemographic characteristics, clinical-cephalometric variables, bone maturation, oral habits/parafunctions, body posture, and TMD (cont.)

MANDIBULAR SKELETAL DEVIATION	Absent TMD	Present TMD	Total	*p-value*
No	33	35	68	0.523
%	48.53	51.47	100.00	
Yes	15	22	37	
%	41.67	58.33	100.00	
CERVICAL BONE MATURATION				
CS1	26	39	65	0.288
%	40.00	60.00	100.00	
CS2	13	12	25	
%	52.00	48.00	100.00	
CS3	9	6	15	
%	60.00	40.00	100.00	
Oral habits and parafunctions				
No	4	1	5	0.115
%	80.00	20.00	100.00	
Yes	44	56	100	
%	44.00	56.00	100.00	
Sleep bruxism				
No	37	37	74	0.173
%	50.00	50.00	100.00	
Yes	11	20	31	
%	35.48	64.52	100.00	
Awake bruxism				
No	43	36	79	0.002*
%	54.43	45.57	100.00	
Yes	5	21	26	
%	19.23	80.77	100.00	
Awake and sleep bruxism				
No	47	54	101	0.396
%	46.53	53.47	100.00	
Yes	1	3	4	
%	25.00	75.00	100.00	
Tongue thrusting				
No	12	12	24	0.631
%	50.00	50.00	100.00	
Yes	36	45	81	
%	44.44	55.56	100.00	

Table 2. Association between sociodemographic characteristics, clinical-cephalometric variables, bone maturation, oral habits/parafunctions, body posture, and TMD (cont.)

Unilateral chewing	Absent TMD	Present TMD	Total	*p-value*
No	38	39	77	0.215
%	49.35	50.65	100.00	
Yes	10	18	28	
%	35.71	64.29	100.00	
ADVANCED POSITION OF THE JAW				
No	43	37	80	0.003*
%	53.75	46.25	100.00	
Yes	5	20	25	
%	20.00	80.00	100.00	
BITING FOREIGN OBJECTS				
No	47	56	103	0.902
%	45.63	54.37	100.00	
Yes	1	1	2	
%	50.00	50.00	100.00	
FINGER SUCCION				
No	43	46	89	0.207
%	48.31	51.69	100.00	
Yes	5	11	16	
%	31.25	68.75	100.00	
LIP SUCCION				
No	43	46	89	0.207
%	48.31	51.69	100.00	
Yes	5	11	16	
%	31.25	68.75	100.00	
TONGUE SUCCION				
No	47	54	101	0.396
%	46.53	53.47	100.00	
Yes	1	3	4	
%	25.00	75.00	100.00	
MOUTH BREATHING				
No	8	12	20	0.569
%	40.00	60.00	100.00	
Yes	40	45	85	
%	47.06	52.94	100.00	
BODY POSTURE				
Adequate	26	21	47	0.045*
%	55.32	44.68	100.00	
Inadequate	22	36	58	
%	37.93	62.07	100.00	

Table 2. Association between sociodemographic characteristics, clinical-cephalometric variables, bone maturation, oral habits/parafunctions, body posture, and TMD (cont.)

CERVICAL SPINE CORRECTION	Absent TMD	Present TMD	Total	*p-value*
No	30	36	66	0.945
%	45.45	54.55	100.00	
Yes	18	21	39	
%	46.15	53.85	100.00	
DORSAL KYPHOSIS				
No	39	41	80	0.264
%	48.75	51.25	100.00	
Yes	9	16	25	
%	36.00	64.00	100.00	
HYPERLORDOSIS				
No	43	46	89	0.207
%	48.31	51.69	100.00	
Yes	5	11	16	
%	31.25	68.75	100.00	
SCOLIOSIS				
No	44	53	97	0.800
%	45.36	54.64	100.00	
Yes	4	4	8	
%	50.00	50.00	100.00	
Total: 105 participants.				

Note: (%) percentage, CMMW current minimum monthly wage in Colombia, CS Baccetti cervical maturity stage,
* *p*-value < 0.050

Among the habits and parafunctions that showed a statistically significant association was AB ($p<0.002$), recording the behavior or habit of anterior jaw positioning with ($p<0.003$) and a frequency of 23.8% as the most frequent action associated with AB. In terms of body posture variables, the PA variable stands out, showing a statistically significant association ($p< 0.045$). The other variables in this group did not show an association with TMD in this study; however, dorsal kyphosis or "hunchback" was the most prevalent postural attitude among participants, at 23.8% (Table 2).

For the multiple analyses, the explanatory model for TMD was the crude model with no interaction adjustment. This model was statistically significant for canine class, oral habits and behaviors, postural attitude, and group age ($p<0.004$). However, the explanatory power was low (R^2=14%), so these results cannot yet be generalized to the target population. Still, the negative impact of canine class II on TMD stands out as the most significant variable in the regression coefficient (Table 3).

Table 3. Multivariate analysis between TMD, sociodemographic characteristics, malocclusions, habits, oral parafunctions, and body posture

Present TMD	Coefficient	Standard error	z	*p*< (z)	95% confidence interval	
Age group	1.56	1.16	-1.34	0.180	-3.84	.721
Clase canina	-1. 41	0.68	-2.05	0.040	-2.882	-.152
Awake bruxism	1.18	0.57	2.04	0.041	.215	2.473
Postural attitude	0.86	0.44	1.92	0.050	-.016	1.737
Constant	1.07	1.20	0.90	0.369	-1.273	3.431

Note: Logistic regression: Number of obs= 105, LR chi^2= 20.53, p > chi^2= 0,004, Pseudo R^2= .14

Discussion

Thanks to the crude multivariate analysis model, we can explain the association of TMD in the study population. These results show the negative impact of the following variables: age group ≥6 years, the local characteristic of Angle Class II canine occlusion, AB in one of its forms, represented by the oral behavior or habit of positioning the jaw anteriorly, and inadequate PA as risk factors associated with TMD in children and adolescents ($p <$ 0.004); with a Pseudo R^2 = .14 indicating a model with moderate explanatory power, which is common in health, but clinically useful.

Clearly, these results show how the age variable, evaluated in this study by groups classified by stages of life, makes it easier to identify which groups aged ≥6 years were associated with the presence of TMD, demonstrating similarity with the main studies recently published globally, which show that TMD tends to increase with age, assuming a range of between 25 and 45 years, as the most commonly reported ages[17]. However, it is reported that many of the literature reviews found were conducted in adult populations, with few studies expressing how TMD manifests in populations under 5 years of age. We know that during early childhood, events such as the consolidation of the first dentition or deciduous dentition occur, and also in this same age range, dimensional changes begin to take place for the establishment of mixed dentition[18]. Subsequently, during the following ages, events linked to growth and development increase, making them more susceptible to any type of temporomandibular development disorder[19].

Studies such as that by Bilgiç et al.[20] report that the prevalence of TMD increases during developmental stages. During periods of morphological changes, we may see a greater presence of signs and symptoms of TMD.

In this study, the only local occlusion factor associated with TMD was canine class II, which was relevant because it was the most significant variable in the multivariate analysis. Upon reviewing other studies, we found that class II is also a condition that affects individuals with TMD in various ways. For example, authors such as Šimunović et al. [21] report that Class II increases the probability of presenting some sign and/or symptom of TMD by 2.6 times, while Farronato et al.[22] report that Class II is associated with a higher prevalence of muscle strain problems, not strictly with joint problems.

Another way of interpreting how Angle Class II canine becomes a negative factor associated with TMD in children and adolescents is that this malocclusion exhibits a distal sagittal relationship of the dental arches and the other elements of the occlusion are affected by it. Additionally, this condition affects growth and development because it consolidates the skeletal biotype of Class II in terms of the position of the condyle in the glenoid cavity in affected individuals[23]. On the other hand, canines are dental organs whose functions include guiding the dynamics of mandibular movements, so their altered position could have direct consequences on the functions of the stomatognathic system, reducing masticatory efficiency[24].

Muscle problems related to the presence of dental Class II malocclusion include muscle stress and/or fatigue. Individuals with Class II malocclusion also have unique muscle shapes and diameters and are more likely to have smaller intermaxillary and gonial angles[25]. The condition of molar and/or canine Class II, without intervention, will accompany the individual into adulthood with the consequent consolidation of a skeletal Class II[23,26].

This study also found a significant association between habits and/or parafunctions and the presence of TMD, specifically BV, reported as the oral behavior of anteriorly positioning the mandible or anterior displacement/ sliding of the mandible, a habit described in the Oral Behavior Checklist (OBC)[13]. It is pertinent to note that the variable of anterior jaw position does not represent a Class III and/or pseudo Class III malocclusion, because it reflects a behavior or parafunction that is not part of the diagnostic criteria for this malocclusion[27,28].

Authors such as Nykänen et al.[29] indicate that the most common form of bruxism in children and adolescents is teeth clenching. Yap et al.[30] also state that the frequency of oral behaviors is higher during BS than that reported during BV. Similarly, Keela et al.[31] report that the oral behavior of "clenching or grinding teeth during sleep" is the strongest predictor of pain in TMD. All of the above authors express results contrary to ours, proving a strong association of TMD exclusively with the classic forms of bruxism reported in the literature in the general population.

In contrast to the above authors, Storari et al.[32] recognize the existence of many other behaviors related to bruxism, without considering their origin, whether physiological or pathological. Therefore, it is appropriate to highlight studies such as those by Sun et al. [33], who emphasize the strong association of oral behaviors with TMD in the pediatric population. They also report that the main behavior associated with TMD is "holding or protruding the jaw forward/to the side."

All of the above suggest that the variable of forward jaw position in our study is well distinguished as a behavior/habit linked to AB, according to the current literature.

Clearly, our results can be related to those of Ángelo et al.[34], who report that the presence of oral behaviors linked to bruxism is significant for TMD in children/adolescents. Furthermore, they associate Class II with an increase in the severity of TMD, noting that it increases levels of myalgia and articular disc displacement. However, it would be necessary to study this population to determine whether anterior jaw positioning acts as a protective factor for individuals with TMD and Class II malocclusion, as explained by Yazıcıoğlu et al.[35] in children aged 7 to 10 years in Turkey. Currently, bruxism is a motor behavior that can be a risk factor, a protective factor, or a neutral factor[36].

The PA variable was also associated with TMD ($p<0.050$), coinciding with the work of Minervini et al.[37], who report this association, stating that the nerve pathways that regulate body posture are the same ones that control mandibular position.

Another study conducted on children and adolescents aged 8 to 14 revealed that Class II causes the center of gravity and postural control in individuals with TMD to be anteriorized[38]. In our study, the postural attitude of dorsal kyphosis ("hunchback") showed the highest frequency among the variables in this group, at 23.8%. This condition causes the head and shoulders to lean forward.

Chaves et al.[39] also explain this relationship between TMD, posture, and malocclusion as follows, stating that postural changes in the head and shoulders of children and adolescents aged 10 to 18 years attending a public school in Brazil were due to biomechanical adaptations of the masticatory muscles and temporomandibular joint. Similarly, Odzimek et al.[40] conclude that neck pain in adolescents and young adults is related to TMD pain.

Despite the results discussed in this paper, which suggest an association between body posture and occlusion, we agree with authors such as Carda-Navarro et al.[41] who consider it necessary to conduct further studies that take a comprehensive approach to the diagnosis of body posture and occlusion.

The main scope of this research is based on consolidating knowledge relevant to dentists, pediatric dentists, maxillofacial orthopedists, and oral rehabilitation specialists who require a solid foundation to support their clinical and therapeutic decisions regarding TMD. These healthcare professionals can use these results to gain an overview of the associations of TMD in this population. In addition, they have a checklist of diagnostic elements to evaluate that will guide them in recognizing TMD and treating it depending on the range of associations.

The limitations of this study include the absence of an assessment of emotional and psychosocial variables or the psychological state of the participant, which are relevant in the genesis or maintenance of disorders and could contribute to a better description. Likewise, not using important imaging diagnostic tools when evaluating the pediatric population, where symptoms can be difficult to communicate or interpret, could have significantly strengthened the interpretation of the results.

However, to give the study more credibility, cross-comparison between subjective data (self-report via survey), clinical diagnoses of axis I of RCD/TMD, and cephalometric and postural findings reinforced the quality of the TMD diagnosis and reduced the impact of individual variability in symptom perception. Combining the RCD/TMD axis I instrument with the OBC oral behavior checklist helped validate reports of habits such as awake bruxism, especially those related to forward jaw position, which showed a statistically significant association with TMD.

Even so, motivated by a desire to conduct an exhaustive control of variables, this study attempted to exhaust all possible associations of this pathology in the group studied. As the results show, this does not mean that the relationship between the variables found is the direct cause of TMD, but rather that they should be considered risk factors, markers, or related through confounding variables not considered. Nevertheless, we emphasize the need to conduct relevant studies whose methodological design aims to reveal the causal relationship of TMD in children and adolescents

Conclusion

The frequency of TMD in children and adolescents was high in this study. Despite showing low statistical strength, we can highlight the association of the following risk factors in this population: presenting canine class II, being ≥ 6 years of age, exhibiting oral behavior of forward jaw position linked to AB, and showing poor posture. Skeletal malocclusions did not show a significant association with TMD.

Funding

The authors deny any source of funding.

Declaration of conflicts of interest: none

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Recibido 27/02/25
Aceptado 25/07/25
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