Pesquisa Brasileira em Odontopediatria e Clínica Integrada 2022; 22:e210150
https://doi.org/10.1590/pboci.2022.051
ISSN 1519-0501 / eISSN 1983-4632

ORIGINAL ARTICLE

Temporomandibular Disorders are Associated with Sociodemographic Factors, Health-Related and Oral Conditions in Adolescents: A Cross-Sectional Study

Ana Luiza Peres Baldiotti[1], Gabrielle Amaral-Freitas[1], Rafaela Scariot[2], Maria Luísa Leandro de Souza Dias[1], Renata de Castro Martins[3], Saul Martins Paiva[1], Fernanda Morais Ferreira[1]

[1]Department of Child and Adolescent Oral Health, Dental School, Federal University of Minas Gerais, Belo Horizonte, MG, Brazil.
[2]Department of Oral and Maxillofacial Surgery, School of Dentistry, Federal University of Paraná, Curitiba, PR, Brazil.
[3]Department of Social and Preventive Dentistry, Dental School, Federal University of Minas Gerais, Belo Horizonte, MG, Brazil.

Correspondence: Ana Luiza Peres Baldiotti, Department of Child and Adolescent Oral Health, Federal University of Minas Gerais, Av. Antônio Carlos, 6627, Belo Horizonte, MG, Brazil. 31.270-901. **E-mail:** alpbaldiotti@gmail.com

Academic Editor: Alessandro Leite Cavalcanti

Received: 04 August 2021 / **Review:** 20 October 2021 / **Accepted:** 12 December 2021

How to cite: Baldiotti ALP, Amaral-Freitas G, Scariot R, Dias MLLS, Martins RC, Paiva SM, et al. Temporomandibular disorders are associated with sociodemographic factors, health-related and oral conditions in adolescents: a cross-sectional study. Pesqui Bras Odontopediatria Clín Integr. 2022; 22:e210150. https://doi.org/10.1590/pboci.2022.051

ABSTRACT

Objective: To assess the association between temporomandibular disorder (TMD) with sociodemographic factors, health-related factors, and oral conditions in adolescents. **Material and Methods:** This cross-sectional study was developed with 89 adolescents between 13 to 18 years. TMD diagnosis was obtained by the Research Diagnostic Criteria for Temporomandibular Disease (RDC/TMD) Axis I. Diagnoses of chronic pain, depression, presence of non-specific physical symptoms, including pain and anxiety, were obtained by the RDC/TMD Axis II. The feeling of happiness was measured by the Subjective Happiness Scale. Socio-economic and demographic characteristics were collected through self-administered questionnaires. Patients were examined for dental caries, dental trauma, malocclusion, and tooth wear. Parents answered a sociodemographic, economic, and general health questionnaire. Data were submitted to descriptive statistics, and a logistic regression model was used to assess the association between TMD and the socio-economic, demographic, health-related, and clinical variables. **Results:** TMD prevalence was 42%. TMD was associated to skin color (p=0.040), use of medications in the past year (p = 0.020) and previous dental trauma (p=0.030). Also, it tended to be associated with the presence of probable awake bruxism (p=0.053). **Conclusion:** Sociodemographic factors, health-related factors, and oral conditions play a role in TMD, with nonwhite adolescents, those who had used medications in the past year and/or had previous dental trauma having a greater chance of present this disorder.

Keywords: Temporomandibular Joint Disorders; Prevalence; Depression; Adolescent.

Introduction

Temporomandibular disorders (TMDs) are a heterogeneous group of joint and muscle disorders in the craniofacial region [1,2] and are the most common cause of non-dental pain in this area [3]. Pain has several consequences on daily activities and negatively affects the lives of patients [4,5].

TMD has already been extensively studied in the adult population, and most adults affected by TMD report that the symptoms started during adolescence [6]. For example, a 2018 population-based study with adolescents in Brazil reported a prevalence of 34.9% [1], a high index. However, the understanding of the importance of studying TMD in adolescents is recent, and so as the knowledge of the psychosocial role in the development of this condition; therefore, this population has not yet been fully investigated.

TMD etiology still is a controversial topic in dentistry. This condition is not considered an entity but a group of various conditions of different etiologies [7], seen as a complex and multidimensional process in which several psychosocial and environmental factors are of utmost relevance [3]. Therefore, it is necessary to know all the related features and carefully evaluate the associations between multiple factors and symptoms because simple strategies are not able to deal with such a complex condition [3,6].

Genetic factors [8], sex [1,7,9], stress, depression, anxiety [2], headaches, body pain [10], sleep quality, parafunctional habits, sleep bruxism, awake bruxism [3], and malocclusions [3,11] seem to be associated with TMD.

Considering that signs and symptoms may increase with age, clinicians and especially pediatric dentists should be prepared to diagnose early signs of TMD [1] to prevent or minimize the consequences of this condition and to reduce the impact on adolescents' lives [10]. Also, as a principle of holistic dentistry, the patient must be seen as a whole; therefore, the psychosocial profile of patients with TMD must be considered in the diagnosis and treatment. However, there are not many studies on TMD in this population, and as it is a condition influenced by social and emotional issues, it is interesting to investigate in different contexts and the possible associations within this disorder to better understand it. Therefore, this study aimed to assess the association between sociodemographic factors, health-related factors, and oral conditions with TMD in adolescents. We hypothesize that TMD is influenced by several aspects within these categories.

Material and Methods

Study Design and Population

This study used the STROBE guideline. This cross-sectional study included 89 adolescents, of both sexes, aged 13 to 18 years old, attending a university's dental clinic in the city of Belo Horizonte, MG, Brazil, between May and December 2019. The city has approximately 2.521.564 inhabitants and has a Human Development Index of 0.810. The exclusion criteria were individuals ongoing orthodontic treatment or with cognitive impairment.

Training and Calibration Exercise

The two examiners (A.L.P.B and G.A.F.) who performed clinical data collection previously participated in training and calibration exercises. Professionals with experience in using the indexes conducted the training. The training and calibration exercises were carried out in two stages. The first step was theoretical training for each of the indexes and criteria used. The second step was the practical part, the calibration itself, performed with patients, figures, or plaster models, depending on the index.

To administer the clinical criteria of the Research Diagnostic Criteria for Temporomandibular Disorders instrument (RDC / TMD) Axis I, the examiners were calibrated through clinical examinations of 28 patients. The inter-examiner and intra-examiner (Kappa) agreement coefficient for RDC / TMD was 0.907 and 0.804, respectively.

Calibrations for the DMFT index, dental trauma index (Andreassen & Andreassen index), and tooth wear diagnosis were performed through photographs. For the calibration of the dental aesthetic index and Angle malocclusion index, 15 plaster models were used. One week after calibration, the retest was applied. The intra-examiner and inter-examiner (Kappa) agreement coefficient for all indexes was ≥ 0.80.

Pilot Study

Before the beginning of data collection, a pilot study was conducted with 10 adolescents to evaluate the methodology. The results of the pilot study were satisfactory, not requiring changes in the methodology; therefore, participants in this stage were included in the main study.

Clinical Data Collection

Data were collected in a single moment by two dentists assisted by two research assistants. Clinical exams were performed in the dental office, with proper artificial light and suction, at the university's dental clinic. Disposable gloves and masks, coat, cap, and glasses were used as personal protective equipment. The sterile clinical kit was used for the exam, after cleaning and drying the teeth with sterile gauze and cotton rolls.

The outcome of this study is TMD and was obtained through the application of the validated Brazilian version of the RDC / TMD Axis I [12]. This instrument encompasses a clinical exam that provides TMD diagnostics divided into three groups: Muscle disorders (myofascial pain and myofascial pain with opening limitation), Disc displacement (with reduction, without reduction, or without reduction with opening limitation), and Joint disorders (arthralgia, osteoarthritis and, osteoarthrosis). The presence of any of these diagnoses classifies the patient as having TMD.

The dental condition was also examined for the clinical diagnosis of dental caries (DMFT) [13], dentofacial abnormalities (Dental Aesthetic Index - DAI) [14,15], classification of malocclusions [16], dental trauma [17], and dental wear [18] as these are possible variables related to TMD.

Non-Clinical Data Collection

The RDC / TMD Axis II is a validated self-reported questionnaire [19] that uses a psychometric scale, found in instrument question 20, that assesses the psychosocial functioning of the patient and his pain-related disability. The score for each one of the 32 items ranges from 0 to 4 points. The average value is calculated, then Chronic pain, Depression, Unspecified physical symptoms including pain, and Generalized anxiety disorder are classified as absent, moderate, or severe. For data analysis, the presence of signs and symptoms of these conditions were categorized as Yes (moderate and severe) and No (absent) [2,20].

The Brazilian validated version of the Subjective Happiness Scale (SHS) was applied to the adolescents. This instrument provides a measure of subjective global happiness through self-report, which assesses whether the respondent considers himself a happy or unhappy person [21,22]. SHS consists of four affirmative items where the respondent indicates their happiness through a visual analog scale with seven positions. The scale is in ascending order of happiness, where score 1 refers to the worst feeling of happiness, and score 7 refers to the best [23]. In the present study, the total score was used to analyze the data.

To collect socio-economic and demographic data, the adolescents and their parents/guardians filled out two forms. The instrument directed to the adolescents consisted of questions related to themselves, such as name, address, birthday, age, sex, and self-reported skin color. There were also questions regarding possible awake and sleep bruxism. In the instrument directed to the parents/guardians, there were questions about themselves (age, number of children, degree of kinship with adolescents, and education) and questions about their families (income and number of people living at the same house). Also, the form contained questions about the adolescents' general and dental health history (questions about health problems, parafunctional habits, breathing problems, sleep quality, headaches, teeth grinding, if they use medications and, parents/caregiver's perception of the adolescent's general and oral health).

Data Analysis

Data were submitted to descriptive statistics to characterize the sample. Unadjusted and adjusted binary logistic regression models were used to assess the association between the main dependent variable (TMD: Present/Absent) and the socio-economic, demographic, health-related, and clinical variables. Those variables with $p \leq 0.20$ in the univariate analysis were selected for the multiple models. The selected variables were tested for the presence of multicollinearity and when collinearity was identified between a pair or a group of variables, only one of them entered the model, considering the underlying theoretical framework. Wald's backward method was used to build the final model, generating adjusted Odds Ratios (OR) and respective 95% CI for TMD between independent variables categories.

P-value was considered statistically significant if were < 0.05. For data analysis, Microsoft Excel and the Statistical Package for the Social Sciences (SPSS, version 22.0, IBM Corp., Armonk, NY, USA) were used.

Ethics Approval

This research received approval, according to the Helsinki convention, from the Human Research Ethics Committee of the Federal University of Minas Gerais (Protocol #01936918.8.0000.5149). Parent/caregiver and those adolescents with 18 years old received written information about the study and signed the informed consent form. Adolescents under 18 years old who participated in the study signed an informed acceptance form.

Results

A total of 105 adolescents were invited to participate in the present study. Of those, 89 adolescents returned the signed consent form, agreed to participate and underwent all clinical examinations (a response rate of 84.8%). Of the participants, 51.7% (n=46) were girls, and 48.3% (n=43) were boys. The mean age of the participants was 15.9 years old; 73% were nonwhite, and 27% were white; 36% of parents/caregivers had studied 8 years or less; 30.5% of the adolescents' families received up to 1 Brazilian minimum wage per month (one Brazilian minimum wage corresponds to $196,84 at the time of data collection) and 56.1% received 1 to 3 Brazilian minimum wage per month. The prevalence of TMD was 42% (95% CI: 31-53), with 23 (57.5%) girls and 17 (42.5%) boys reporting symptoms.

Table 1 presents the prevalence of each specific TMD diagnostic in this study. In Axis I, the most prevalent diagnosis was Joint disorders (34% on the right side and 27% on the left side), followed by muscle disorders (16%) and disc displacements (7% for both sides). In Axis II, the most prevalent diagnosis was depression (46%), followed by unspecified physical symptoms, including pain (45%) and generalized anxiety disorder (41%). Chronic pain prevalence was 27%.

Table 1. Prevalence and Confidence Interval of each specific TMD diagnostic.

Variables	Prevalence (%) (95% CI)
TMD Axis I Diagnosis	
Signals of TMD*	42 (31-53)
Muscle Disorders	16 (8-24)
Disc Displacement on the Right Side	7 (2-3)
Disc Displacement on the Left Side	7 (2-3)
Joint Disorders on the Right Side	34 (23-44)
Joint Disorders on the Left Side	27 (17-36)
TMD Axis II Diagnosis	
Chronic Pain	27 (17-36)
Depression	46 (35-57)
Unspecified Physical Symptoms Including Pain	45 (34-55)
Generalized Anxiety Disorder	41 (30-52)

*The presence of any diagnoses obtained by RDC/TMD Axis I (Muscle disorders, Disc displacements or Joint disorders) classifies the patient as having TMD.

No socio-economic or demographic variables were associated with TMD in univariate analyses (Table 2). TMD was associated in the univariate analysis with the use of medications (p=0.024; Table 3) and the presence of dental wear (p=0.045; Table 4). In addition, there was a tendency of TMD to be associated with the presence of probable sleep bruxism (p=0.069), as described in Table 4.

Table 2. Univariate logistic regression models for socio-economic and demographic variables associated to TMD in adolescents.

Predictor Variables	TMD		p-value*	Crude OR	95%CI
	With N (%)	Without N (%)			
Sex					
Male (ref)	17 (39.5)	26 (60.5)			
Female	23 (50.0)	23 (50.0)	0.322	1.53	0.66-3.55
Skin Color (Adolescents' Report)					
White (ref)	7 (29.2)	17 (70.8)			
Nonwhite	33 (50.8)	32 (49.2)	0.074	2.50	0.92-6.85
Income (in Real**)	1616.25 (786.05)	2877.52 (3804.53)	0.26	1.00	0.99-1.00
Adolescent age (in Years) [Mean and SD]	16.4 (1.5)	15.4 (1.8)	0.17	1.20	0.93-1.55
Parents/Caregivers Age (in Years) [Mean and SD]	43. (9.5)	40.2 (12.0)	0.65	1.01	0.97-1.05
Parents Educational Level					
≤ 8 Study Years (ref)	16 (54.6)	15 (48.4)			
>8 ≤ 11 Study Years	17 (40.5)	25 (59.5)	0.35	0.64	0.25-1.62
≥ 12 Study Years	4 (33.3)	8 (66.7)	0.29	0.47	0.12-1.88

*Persons' chi-square test; **One Brazilian reals corresponds to 0.24-dollar cents at the time of data collection; Values different than 89 were individual missings of each variable.

Table 3. Univariate logistic regression models for health-related variables associated to TMD in adolescents.

Predictor Variables	TMD		p-value*	Crude OR	95%CI
	With N (%)	Without N (%)			
Adolescent General Health (Parents' Report)					
Good/Very Good (ref)	34 (45.9)	40 (54.1)			
Moderate/Bad/Very Bad	6 (40.0)	9 (60.0)	0.673	0.78	0.25-2.43
Medication (Parents' Report)					
No (ref)	22 (37.9)	36 (62.1)			
Yes	18 (64.3)	10 (35.7)	0.024	2.94	1.15-7.52
Sleep Quality (Parents' Report)					
Very Good (ref)	10 (45.5)	12 (54.5)			
Good	22 (45.8)	26 (54.2)	0.976	1.01	0.37-2.80
Moderate	8 (47.1)	9 (52.9)	0.921	1.07	0.30-3.80

Sleep Hours (Parents' Report)					
Less than 8 Hours a Night (ref)	25 (46.3)	29 (53.7)			
More than 8 Hours a Night	14 (42.4)	19 (57.6)	0.725	0.85	0.36-2.05
Subjective Happiness Scale [Mean and SD]	18.23 (3.6)	18.45 (3.5)	0.763	0.98	0.87-1.11

*Persons' chi-square test; Values different than 89 were individual missings of each variable.

Table 4. Univariate logistic regression models for oral conditions associated to TMD in adolescents.

Predictor Variables	TMD With N (%)	TMD Without N (%)	p-value*	Crude OR	95%CI
Probable Sleep Bruxism[1]					
Absence (ref)	32 (42.1)	44 (57.9)			
Presence	8 (72.7)	3 (27.3)	0.069	3.67	0.90-14.91
Probable Awake Bruxism[2]					
Absence (ref)	34 (42.0)	47 (58.0)			
Presence	5 (8.3)	1 (16.7)	0.084	6.91	0.77-61.87
Dental Caries Prevalence					
No (DMFT=0) (ref)	14 (58.3)	10 (41.7)			
Yes (DMFT≥1)	26 (40.0)	39 (60.0)	0.126	0.48	0.18-1.23
Dental Trauma (Clinical Exam)					
Absence (ref)	29 (39.2)	45 (60.8)			
Presence	6 (75.0)	2 (25.0)	0.071	4.65	0.88-24.65
Malocclusion					
No (DAI ≤ 25) (ref)	17 (56.7)	13 (43.3)			
Yes (DAI ≥ 26)	32 (54.2)	27 (45.8)	0.829	1.10	0.46-2.67
Dental Wear (Clinical Exam)					
Absence (ref)	23 (37.7)	38 (62.3)			
Presence	17 (60.7)	11 (39.3)	0.045	2.55	1.02-6.40

[1]Parents' report and clinical exam; [2]Adolescentes' report and clinical exam; *Persons' chi-square test; **It wasn't possible to obtain this result due to the low prevalence of this variable. There is a cell without any observation; Values different than 89 were individual missings of each variable.

The multiple regression showed that, when adjusted by other variables, TMD was associated with to use of medications in the past year (p=0.020), previous dental trauma (p=0.030), and skin color (p=0.040). Also, it tended to be associated with the presence of probable awake bruxism (p=0.053) (Table 5). As the COVID-19 pandemic prevented us from proceeding with data collection, we did a power analysis with our sample on the *oppenepi.com* website.

Table 5. Multiple logistic regression models for variables associated to TMD in adolescents.

Predictor Variables	p-value	Adjusted OR	95% CI	Power
Skin Color (Adolescents' Report)				
White (ref)				
Nonwhite	0.040	4.42	1.07-18.24	46%
Medication (Parents' Report)				
No (ref)				
Yes	0.020	3.57	1.22-10.40	62%
Probable awake bruxism[1]				
No (absence) (ref)				
Yes (presence)	0.053	11.31	0.96-132.65	50%
Dental trauma (Clinical Exam)				
No (absence) (ref)				
Yes (presence)	0.030	9.41	1.24-71.18	50%

[1]Adolescentes' report and clinical exam.

Discussion

TMD in adolescents between 13 and 18 years old was found in the present study to be 42% prevalent. This value is slightly higher than the result found in an important study in 2018, which was 34.9% [1]; also, in Brazilian adolescents, this would be expected because it is a sample collected during clinical appointments and because they were a little older. Furthermore, joint disorders were the most prevalent diagnosis (34% on the right side and 27% on the left side), different from the result found by the other study that used the same diagnostic tool [1]. However, TMD prevalence in adolescents varies widely in the literature, due to population differences and diagnostic criteria [24]. To avoid this bias, this study was conducted with a recognized and validated diagnostic tool with a standardized examination protocol.

Many studies have described high levels of psychosocial disorders in patients with TMD [2,5,25-29], and in the present study, we found a high prevalence of depression and unspecified physical symptoms, including pain and anxiety, confirming a relationship between TMD and psychosocial disorders. This study indicates that some sociodemographic factors, health-related factors, and oral conditions are associated with TMD. Skin color, the use of medications in the past year, probable awake bruxism previous dental trauma increased the likelihood of adolescents presenting TMD signs and symptoms.

In the present study, skin color was associated with TMD, with nonwhite adolescents being more likely to present signs and symptoms. This finding confirms the vulnerability of this population and persistent inequality over decades. Besides all many possible biological issues included in the development process of this condition, when the patient is part of a population socially vulnerable, that commonly faces discrimination and racism, this can generate chronic stress and influence the patient's ability to deal with pain [9,30,31]. Nonwhite individuals, who represented 73% of the adolescents in this study, often have their health conditions exacerbated due to unequal access to health and information, as well as worse health outcomes [9,32]. Beyond that, previous studies have reported greater sensitivity to painful stimuli among nonwhites compared to white [30,33].

The decision to evaluate the use of medications was due in part to the need to know if the girls participating in the study used birth control pills since some studies have already reported an association between estrogen and TMD [34]. However, none of the girls reported using this medication, although 33,3% of the participants reported taking some medication, which called for our attention. Therefore, we chose to measure the association between medication use and TMD, and we found a significant association. However, further studies with larger samples are needed to better understand these findings.

Although studies specifically on dental trauma and TMD have not been found, some studies show a higher prevalence of TMD signs and symptoms in individuals with a history of facial trauma [35,36]. The triggering episode of dental trauma (e.g., traffic accidents, falling-down injuries, blows in the facial area, and violence-related injuries) may also have caused facial trauma, not addressed in this study, which may have increased by up to four times the chance of TMD signs and symptoms [36]. Another hypothesis is that dental trauma is due to parafunctional habits such as awake bruxism and that these behaviors are directly associated with TMD [3].

This study also finds a borderline association between TMD and probable awake bruxism, as reported in previous studies [3,10,37]. Probable awake bruxism is a nonfunctional behavior that exceeds the individual's physiological tolerance leading to a breakdown of the stomatognathic system [3]. Many times, probable awake bruxism is linked with probable sleep bruxism [37], but this association was not seen in this study.

Although the associations between sex [1,7,9], depression [2], headaches, body pain [10], sleep quality, sleep bruxism [3], and malocclusions [11] have been shown in other studies, we did not find these associations.

The relationship between sex and TMD is a classic association, with a higher risk for girls, justified mostly in adolescents by hormonal changes during puberty, and was reported several times [1,7,9]. However, this study didn't find this relationship, as few previous in the literature [10].

The association between malocclusions and TMD is polemic in the literature. Many studies believe in the role of occlusion in the development of this condition [11,38]. However, in 2017 an important systematic review was published [39] that encouraged to "abandon the old gnathological paradigm" between TMD and occlusion, and many other studies followed this same path [40]. In the present study, there wasn't any association between malocclusion and TMD.

This study carries the limitation of a sample collected in the university clinic where individuals have more diseases than a community sample and a study design that impossibility of establishing a causal relationship. The sample size is also a limitation, which decreased the power of the associations and may have contributed to the fact that some expected associations were not detected. However, the methodology had important strengths; Kappa values ranging between substantial and almost perfect, which improves the data reliability, the diagnostic tool used to measure TMD is the gold standard, clinical examinations being performed with the entire support of a university clinic and several clinical conditions that may be associated with TMD were also evaluated.

General dentists and especially pediatric dentists should be able to understand that TMD signs and symptoms can start at an early age and that this condition impact patients' daily life. The ability to consider the many possible factors involved in this disorder and to be capable to detect, monitor, and, if possible, treat these patients is also imperative. Sociodemographic factors, health-related factors, and oral conditions may be playing a role in TMD development. Reinforcing holistic dentistry and the importance of transdisciplinary work, we should see this disorder as a dynamic process that occurs far beyond oral concerns. Psychologic, environmental, social, and clinical factors are of utmost relevance.

Conclusion

TMD is a complex condition with sociodemographic, health-related, and oral conditions playing a role in this development. Therefore, these findings highlight the importance of dentists to look to the patient far beyond the oral cavity, assess all possible variables that might be associated with the disorder, to be able to identify the adolescents with greater odds to present, to detect, monitor, and, if possible, treat this disorder.

Authors' Contributions

ALPB	https://orcid.org/0000-0003-2814-3401	Conceptualization, Methodology, Formal Analysis, Investigation and Writing - Original Draft.
GAF	https://orcid.org/0000-0001-6796-1496	Methodology and Writing - Review and Editing.
RS	https://orcid.org/0000-0002-4911-6413	Conceptualization, Formal Analysis and Writing - Review and Editing.
MLLD	https://orcid.org/0000-0001-6850-764X	Methodology and Writing - Review and Editing.
RCM	https://orcid.org/0000-0002-8911-0040	Conceptualization, Formal Analysis and Writing - Review and Editing.
SMP	https://orcid.org/0000-0002-3968-1638	Conceptualization, Formal Analysis and Writing - Review and Editing.
FMF	https://orcid.org/0000-0001-9400-1167	Conceptualization, Methodology, Formal Analysis, Data Curation, Writing - Review and Editing, Visualization and Supervision.

All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

Financial Support

None.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

References

[1] Bertoli FMP, Bruzamolin CD, Pizzatto E, Losso EM, Brancher JA, de Souza JF. Prevalence of diagnosed temporomandibular disorders: A cross-sectional study in Brazilian adolescents. PLoS One 2018; 13(2):e0192254. https://doi.org/10.1371/journal.pone.0192254

[2] Simoen L, Van den Berghe L, Jacquet W, Marks L. Depression and anxiety levels in patients with temporomandibular disorders: comparison with the general population. Clinical Oral Investig 2020; 24(11): 3939-45. https://doi.org/10.1007/s00784-020-03260-1

[3] Fernandes G, Franco-Micheloni AL, Siqueira JT, Gonçalves DA, Camparis CM. Parafunctional habits are associated cumulatively to painful temporomandibular disorders in adolescents. Braz Oral Res 2016; 30(1). https://doi.org/10.1590/1807-3107BOR-2016.vol30.0015

[4] Al-Khotani A, Naimi-Akbar A, Albadawi E, Ernberg M, Hedenberg-Magnusson B, Christidis N. Prevalence of diagnosed temporomandibular disorders among Saudi Arabian children and adolescents. J Headache Pain 2016; 17(1): 1-11. https://doi.org/10.1186/s10194-016-0642-9

[5] Resende C, Rocha L, Paiva RP, Cavalcanti C, Almeida EO, Roncalli AG, Barbosa G. Relationship between anxiety, quality of life, and sociodemographic characteristics and temporomandibular disorder. Oral Surg Oral Med Oral Pathol Oral Radiol 2020; 129(2):125-32. https://doi.org/10.1016/j.oooo.2019.10.007

[6] Karibe H, Shimazu K, Okamoto A, Kawakami T, Kato Y, Warita-Naoi S. Prevalence and association of self-reported anxiety, pain, and oral parafunctional habits with temporomandibular disorders in Japanese children and adolescents: a cross-sectional survey. BMC oral health 2015; 15(1):1-7. https://doi.org/10.1186/1472-6831-15-8

[7] Bonjardim LR, Gavião MB, Pereira LJ, Castelo PM, Garcia RC. Signs and symptoms of temporomandibular disorders in adolescents. Braz Oral Res 2005; 19(2):93-8. https://doi.org/10.1590/s1806-83242005000200004

[8] Melis M, Di Giosia M. The role of genetic factors in the etiology of temporomandibular disorders: a review. Cranio 2016; 34(1):43-51. https://doi.org/10.1179/2151090314Y.0000000027

[9] Gillborg S, Åkerman S, Lundegren N, Ekberg EC. Temporomandibular disorder pain and related factors in an adult population: a cross-sectional study in southern Sweden. J Oral Facial Pain Headache 2017; 31(1):37-45. https://doi.org/10.11607/ofph.1517

[10] Fernandes G, van Selms MK, Gonçalves DA, Lobbezoo F, Camparis CM. Factors associated with temporomandibular disorders pain in adolescents. J Oral Rehabil 2015; 42(2):113-9. https://doi.org/10.1111/joor.12238

[11] Marangoni AF, de Godoy CH, Biasotto-Gonzalez DA, Alfaya TA, Fernandes KP, Mesquita-Ferrari RA, et al. Assessment of type of bite and vertical dimension of occlusion in children and adolescents with temporomandibular disorder. J Bodyw Mov Ther 2014; 18(3):435-40. https://doi.org/10.1016/j.jbmt.2013.10.001

[12] Franco-Micheloni AL, Fernandes G, Gonçalves DA, Camparis CM. Temporomandibular disorders among Brazilian adolescents: reliability and validity of a screening questionnaire. J Appl Oral Sci 2014; 22(4):314-22. https://doi.org/10.1590/1678-77572013069

[13] Organização Mundial de Saúde. Levantamentos Básicos em Saúde Bucal. 4 th. ed. São Paulo: Santos; 1999. 66p. [In Portuguese].

[14] Cardoso CF, Drummond AF, Lages EM, Pretti H, Ferreira EF, Abreu MH. The Dental Aesthetic Index and dental health component of the Index of Orthodontic Treatment Need as tools in epidemiological studies. Int J Environ Res Public Health 2011; 8(8):3277-86. https://doi.org/10.3390/ijerph8083277

[15] Costa RN, Abreu MH, Magalhães CS, Moreira NA. Validity of two occlusal indices for determining orthodontic treatment needs of patients treated in a public university in Belo Horizonte, Minas Gerais State, Brazil. Cad Saude Publica 2011; 27(3):581-90. https://doi.org/10.1590/s0102-311x2011000300018

[16] Angle EH. Classification of malocclusion. Dent Cosmos 1899; 41:350-375.

[17] Andreasen JO, Andreasen FM, Bakland LK, Flores MT. Traumatic Dental Injuries: A Manual. 2nd ed. Oxford: Blackwell; 2004.

[18] Lobbezoo F, Ahlberg J, Raphael KG, Wetselaar P, Glaros AG, Kato T, et al. International consensus on the assessment of bruxism: Report of a work in progress. J Oral Rehabil 2018; 45(11):837-44. https://doi.org/10.1111/joor.12663

[19] de Lucena LB, Kosminsky M, da Costa LJ, de Góes PS. Validation of the Portuguese version of the RDC/TMD Axis II questionnaire. Braz Oral Res 2006 20(4):312-17. https://doi.org/10.1590/s1806-83242006000400006

[20] Barbosa ACDS, Pinho RCM, Vasconcelos MMVB, Magalhães BG, Dos Santos MTBR, de França Caldas Júnior A. Association between symptoms of depression and oral health conditions. Spec Care Dentist 2018; 38(2):65-72. https://doi.org/10.1111/scd.12278

[21] de Medeiros ED, Nascimento AM, Mariano TE, Sales HFS, Medeiros PCB. Happiness Scale from Lima: factorial validity and internal consistency. Psicol Pesqui 2014; 8:150-8. https://doi.org/10.5327/Z1982-1247201400020004

[22] Strizzi J, Fernández-Agis I, Parrón-Carreño T, Alarcón-Rodríguez R. Enacted Sexual Stigma, Stigma Consciousness, and Subjective Happiness Scale Adaptation: A Two-Country Study. J Interpers Violence 2016; 31(2):316-38. https://doi.org/10.1177/0886260514555372

[23] Pais-Ribeiro JL. Validação transcultural da escala de felicidade subjectiva de Lyubomirsky e Lepper. Psicologia, Saúde e Doenças 2012; 13(2):157-68. [In Portuguese].

[24] Sena MF, Mesquita KS, Santos FR, Silva FW, Serrano KV. Prevalence of temporomandibular dysfunction in children and adolescents. Rev Paul Pediatr 2013; 31(4):538-45. https://doi.org/10.1590/S0103-05822013000400018

[25] De La Torre Canales G, Câmara-Souza MB, Muñoz Lora V, Guarda-Nardini L, Conti P, Rodrigues Garcia RM, et al. Prevalence of psychosocial impairment in temporomandibular disorder patients: A systematic review. J Oral Rehabil 2018; 45(11):881-9. https://doi.org/10.1111/joor.12685

[26] de Melo Júnior PC, Aroucha J, Arnaud M, Lima M, Gomes S, Ximenes R, et al. Prevalence of TMD and level of chronic pain in a group of Brazilian adolescents. PloS one 2019; 14(2):e0205874. https://doi.org/10.1371/journal.pone.0205874

[27] Dean D. The first medications in my TMD toolbox. Cranio 2020; 38(1):1-4. https://doi.org/10.1080/08869634.2020.1691707

[28] Li Y, Fang M, Niu L, Fan Y, Liu Y, Long Y, et al. Associations among gastroesophageal reflux disease, mental disorders, sleep and chronic temporomandibular disorder: a case-control study. CMAJ 2019; 191(33):E909–E915. https://doi.org/10.1503/cmaj.181535

[29] Khan K, Muller-Bolla M, Anacleto Teixeira Junior O, Gornitsky M, Guimarães AS, Velly AM. Comorbid conditions associated with painful temporomandibular disorders in adolescents from Brazil, Canada and France: A cross-sectional study. J Oral Rehabil 2020; 47(4):417-24. https://doi.org/10.1111/joor.12923

[30] Edwards CL, Fillingim RB, Keefe F. Race, ethnicity and pain. Pain 2001; 94(2):133-7. https://doi.org/10.1016/s0304-3959(01)00408-0

[31] Magalhães BG, de-Sousa ST, de Mello VV, da-Silva-Barbosa AC, de-Assis-Morais MP, Barbosa-Vasconcelos MM, et al. Risk factors for temporomandibular disorder: binary logistic regression analysis. Med Oral patol Oral Cir Bucal 2014; 19(3):e232–e236. https://doi.org/10.4317/medoral.19434

[32] Waisel DB. Vulnerable populations in healthcare. Curr Opin Anaesthesiol 2013; 26(2):186-92. https://doi.org/10.1097/ACO.0b013e32835e8c17

[33] Widmalm SE, Christiansen RL, Gunn SM, Hawley LM. Prevalence of signs and symptoms of craniomandibular disorders and orofacial parafunction in 4-6-year-old African-American and Caucasian children. J Oral Rehabil 1995; 22(2):87-93. https://doi.org/10.1111/j.1365-2842.1995.tb00240.x

[34] Robinson JL, Johnson PM, Kister K, Yin MT, Chen J, Wadhwa S. Estrogen signaling impacts temporomandibular joint and periodontal disease pathology. Odontology 2020; 108(2):153-65. https://doi.org/10.1007/s10266-019-00439-1

[35] Kim HI, Lee JY, Kim YK, Kho HS. Clinical and psychological characteristics of TMD patients with trauma history. Oral Dis 2010; 16(2):188-92. https://doi.org/10.1111/j.1601-0825.2009.01626.x

[36] Sharma S, Wactawski-Wende J, LaMonte MJ, Zhao J, Slade GD, Bair E, et al. Incident injury is strongly associated with subsequent incident temporomandibular disorder: results from the OPPERA study. Pain 2019; 160(7):1551-61. https://doi.org/10.1097/j.pain.0000000000001554

[37] Reissmann DR, John MT, Aigner A, Schön G, Sierwald I, Schiffman EL. Interaction between awake and sleep bruxism is associated with increased presence of painful temporomandibular disorder. J Oral Facial Pain Headache 2017; 31(4):299-305. https://doi.org/10.11607/ofph.1885

[38] de Paiva Bertoli FM, Bruzamolin CD, de Almeida Kranz GO, Losso EM, Brancher JA, de Souza JF. Anxiety and malocclusion are associated with temporomandibular disorders in adolescents diagnosed by RDC/TMD. A cross-sectional study. J Oral Rehabil 2018; 45(10):747-55. https://doi.org/10.1111/joor.12684

[39] Manfredini D, Lombardo L, Siciliani G. Temporomandibular disorders and dental occlusion. A systematic review of association studies: end of an era?. J Oral Rehabil 2017; 44(11):908-23. https://doi.org/10.1111/joor.12531

[40] Aboalnaga AA, Amer NM, Elnahas MO, Salah Fayed MM, Soliman SA, ElDakroury AE, et al. Malocclusion and temporomandibular disorders: verification of the controversy. J Oral facial Pain Headache 2019; 33(4):440-50. https://doi.org/10.11607/ofph.2260