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Prevalence and associated factors for temporomandibular disorders in a group of Mexican adolescents and youth adults

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Abstract The objective of the study was to determine the prevalence and associated factors for temporomandibular disorders (TMD) in a university sample of Campeche, Mexico. A cross-sectional study was carried out in 506 subjects aged 14–25 years. The subjects were requested to answer questionnaires concerning sociodemographic variables, history of stress, lifestyle, and anxiety. The Research Diagnostic Criteria for TMD (RDC/TMD) was used as TMD diagnostic system by four examiners capacitated and standardized. Data were analyzed using binary logistic regression in STATA. The results showed that 46.1% of the subjects exhibited some grade of TMD. Logistic regression analysis with TMD as the dependent variable identified sex (women odds ratio [OR]=1.7), bruxism (OR=1.5), anxiety (OR=1.6), unilateral chewing (OR=1.5), and an interaction between number of tooth loss and stress as the most significant associated variables, thus (1) the effect of having high levels of stress in the group of subjects without tooth loss (OR=1.2; 95% confidence interval [CI]=0.7–1.8) and (2) the effect of having high levels of stress in the group of subjects with at least one tooth lost (OR=2.4; 95% CI=1.01–5.9). The variables associated with diagnosis of pain were principally psychosocial (stress and anxiety), whereas for the non-pain diagnosis group, the variables were clinical, such as bruxism, chewing site preference, and restorations in mouth. We found associations among variables that were similar to findings in other studies, such as bruxism, tooth loss, stress, and anxiety. The final model explains that the effect of stress on TMD depends of the tooth loss, controlling for sex, bruxism, unilateral chewing, and anxiety. Finally, it can be concluded that the variables associated with pain and non-pain diagnosis were of distinct nature.

Keywords Temporomandibular disorders · Adolescents · Epidemiology · Logistic regression · Mexico

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Introduction

Despite the fact that dental caries and periodontal disease are the main problems in oral health, temporomandibular disorders (TMD), due to their magnitude and transcendence, are becoming important diseases within dentistry care as well as a public health problem due to the number of people they affect. The term TMD has been described as a cluster of disorders characterized by pain in the preauricular area, temporomandibular joint (TMJ), or the masticator muscles; limitation or deviations in mandibular range of motion; and clicking in the TMJ during mandibular function, and they are not related to growth or development disorders, systematic diseases, or macrotrauma.

In the year 348 BC, Hippocrates described a condition of the dislocation of temporomandibular articulation. Nonetheless, two millennia passed before any study was conducted to collect data on temporomandibular diseases or malfunction. The prevalence of this type of disease, according to the literature, varies between 28 and 88% depending on the type of population studied, as well as the diagnosis system used [39]. The available evidence regarding TMD is not entirely clear [16], although the old paradigm that the disease was a manifestation of the Costen syndrome has been changed and the new paradigm that proposes a multicausal model [11, 33] does not clearly assert what factors are associated with the disease.

The information regarding signs and symptoms of TMD has been collected by clinical examination and questionnaires in some studies or interview in others [10]. A number of authors around the world have found variables associated with TMD. For example, muscular force [17, 42] has been seen to play a principle role in the physiology of the orofacial complex, and changes in muscular force may be reflected in the function of the TMJ. The loss of posterior teeth [1, 11] is a variable that has been associated with TMD. Malocclusions [2, 12, 35, 45], mainly those of class II type I of Angle, have been consistently related to TMD. Relationships have also been found with psycho-emotional factors [7, 33, 37, 39, 40], anxiety, and stress. Nonetheless, the effect of the loss of posterior teeth on TMD [27, 38] has not been clarified as controversy exists between its association with TMD as well as the quality of restorations.

The prevalence of TMDs has been observed most frequently among women [13, 19, 32, 33, 39]. Various authors have also observed that the frequency of the signs and symptoms of TMD increase with age [19, 26, 27, 32]. Parafunctional habits like the bruxism or abnormal decay of the teeth [26, 33, 36, 45], occlussal characteristics like premature contact or interferences on the work side or balance side are associated with TMD [15, 45], as well as the side of chewing preference [20, 41]. These are some of the factors that may be associated in some people with changes in the TMJ.

In Mexico, and specifically in Campeche, no background exists in the way of epidemiological studies conducted on the prevalence or factors associated with TMD. For this reason, the purpose of this study was to determine the prevalence and identify the associated factors to TMD in a university sample in the state of Campeche, Mexico.

Material and methods

Design and study population

The study design followed the ethical review guidelines customarily laid out by the relevant authorities at the University of Campeche, México. A part of methodology has been reported in previous papers [5, 6]. A cross-sectional study was conducted through a questionnaire and clinical examination in subjects aged 14–42 years (originally 524 subjects). A pilot study was conducted on a subsample of 50 subjects (not included in the main study) to test the reliability and applicability of the survey methods, with similar distribution by age and sex. The analyzed sample was selected through a nonprobabilistic sampling, using the lists of students enrolled in the various academic disciplines from some schools of the Autonomous University of Campeche (AUC). The sample size was calculated with a 95% confidence interval, a proportion of 0.42 (estimated prevalence of TMD), and the precision was fixed at 0.05. The inclusion criterion was subjects between the ages of 14 and 25 years that agreed to be in the study. The exclusion criteria were: those subjects (1) with orthodontic or orthopedic therapy at the study time, and (2) that did not know if they have degenerative diseases of his/her temporomandibular joint. The inclusion and exclusion criteria reduced the sample to 506 subjects.

Data collection

The data were collected from various schools (dentistry, nursing and high school) of the AUC. An informative discussion was initiated with the directors of each department, followed by class visits to invite students to participate in the study. Twenty-five classrooms were selected randomly (n~29 subjects by classroom, N=729), and the students were invited to participate. Those that decided to participate (n=524, the response rate was >70%) received and signed a letter of informed consent before filling out the questionnaires. After finishing the questionnaire, the subject was clinically examined by one of the four examiners that have been previously capacitated and standardized in a subsample in the diagnostic criteria. For dependent variable, the reliability intra- and interexaminer levels varied from 0.85 to 0.87 using Cohen's kappa statistics.

The subjects were requested to answer the questionnaire concerning history variables such as age (continuous), sex (0=men, 1=women), orthodontic therapy use (0=no, 1=yes), orthodontic therapy finished (0=no, 1=yes). For the patient's own evaluation on stress, anxiety, and lifestyle, we administered questionnaires with responses on a Likert scale [29, 43]. Individual stress and anxiety were assessed using questionnaires with five response options, including Likert-type scales. Options ranged from 0 (of little consequence) to 4 (very important) and were designed to be age- and culturally appropriate in cognitive somatic anxiety and psychophysiologic stress evaluation [29, 43]. These instruments were developed to measure the clinical impact of psychosocial factors on health in adolescents and younger adults. The instruments include 44 items targeting stress and 14 items targeting anxiety, with total scores ranging from 0 (not anxious at all) to 56 (extremely anxious) and from 0 (not stressed at all) to 176 (extremely stressed). The instrument for the lifestyle assessment was part of the same battery of questionnaires developed using similar procedures and validated for use in the age, language, and cultural groups participating in the present study. The lifestyle questionnaire included numeric scales from 0 (favorable) to 11 (unfavorable), evaluating factors related to lifestyle and health in 20 items. Total scores ranged from 0 (favorable lifestyle) to 220 (unfavorable lifestyle). For the statistical analyses, total scores of stress, anxiety, and lifestyle were divided into two groups: first and second quartiles vs third and fourth quartiles, to represent subjects with low and high stress in the sample. The questionnaires and ancillary support information are available from the corresponding author.

Clinical examination

Clinical data collection was carried out during the daylight. The examiner was located in front of the subject for the examination of the inner mouth, the masticator muscles, and the external articulations. For the measurements that required millimeters, a Scala brand ruler with vernier was used. For the exploration of the mouth, the examiners wore latex gloves the entire time and used a wooden tongue depressor for moving soft tissue out of the way in order to conduct a better observation of the areas of the mouth. Once the clinical examination was finished, patients were informed of the oral health status.

The occlusal characteristics examined were: malocclussion—Angle's classification 0=I, 1=II and III—number of restorations (continuous), number of defective restorations (continuous), contact in balance in the right site (0=no, 1=yes), contact in balance in the left site (0=no, 1=yes), contact in work right site (0=no, 1=yes), contact in work left site (0=no, 1=yes), chewing site preference (0=bilateral, 1=unilateral), clinical signs of bruxism [14], number of teeth, and number and quality of restorations (recorded as 0=acceptable or 1=not acceptable).

For TMD (dependent variable), we used a systematically translated Spanish version of the Research Diagnostic Criteria for TMD (RDC/TMD) [9, 21], in which the diagnoses are divided into three groups:

1. Muscular diagnosis: (a) myofascial pain, (b) myofascial pain with limited opening
2. Displaced disk: (a) displaced disk with reduction, (b) displaced disk without reduction, with limited opening, (c) displaced disk without reduction, without limited opening
3. Arthralgia, arthritis, arthrosis: (a) arthralgia, (b) osteoarthritis of the TMJ, (c) osteoarthrosis of the TMJ

Statistical analysis

The variables were first evaluated to obtain their percentages and distributions. We then conducted bivariate logistical regressions to identify the associated factors, observing odds ratios (OR) and confidence intervals of 95% (95% CI). In the analyses, the dependent variable was analyzed as dichotomy 0=no signs and/or symptoms of TMD, 1=at least one clinical sign and/or symptom of TMD (to receive a myofacial pain diagnosis, at least three tender points have to be detected upon palpation of the masticatory muscles), according RDC/TMD [9, 21]. A multivariate logistic regression model was constructed in which we only took into account those variables that had a statistical significance ($p<0.20$) in the bivariate analysis. We conducted a variance inflation factor (VIF) test with the purpose of analyzing and avoiding multi-colinearity between independent variables. All possible interactions were tested and included if their statistical significance was less than 0.15. Specification error test (linktest) was used to verify the assumption that the logit of the response variable is a linear combination of the independent variables. The ad-

Table 1 Distribution of selected characteristics in 506 subjects according to sex

Variables	Characteristics	Men	Women	*P* value
Age (years)	Mean±SD	17.05±2.71	17.35±2.67	NS
Number of tooth loss	Mean±SD	0.25±0.74	0.46±1.05	<0.05
Number of restorations	Mean±SD	2.71±3.95	3.53±4.23	<0.05
		n (%)	*n* (%)	
Orthodontic therapy	No	201 (86.6)	220 (80.3)	
	Yes	31 (13.4)	54 (19.7)	<0.10
Malocclussion	Angle's I	185 (80.4)	234 (85.7)	
	Angle's II	21 (9.2)	24 (8.8)	
	Angle's III	24 (10.4)	15 (5.5)	NS
Defective restorations	No	151 (65.1)	148 (54.0)	
	At least one	81 (34.9)	126 (46.0)	<0.05
Clinic bruxism	No evidence	141 (61.0)	153 (56.0)	
	Evidence	90 (39.0)	120 (44.0)	NS
Chewing site preference[a]	Bilateral	125 (55.6)	150 (55.6)	
	Right or left	100 (44.4)	120 (44.4)	NS
Lifestyle	1st and 2nd quartiles	118 (50.9)	135 (49.3)	
	3rd and 4th quartiles	114 (49.1)	139 (50.7)	NS
Stress	1st and 2nd quartiles	142 (61.2)	120 (43.8)	
	3rd and 4th quartiles	90 (38.8)	154 (56.2)	<0.01
Anxiety	1st and 2nd quartiles	134 (57.8)	140 (51.1)	
	3rd and 4th quartiles	98 (42.2)	134 (48.9)	NS

[a] In some sums existing missing values

justment of the model was evaluated with the Pearson's goodness-of-fit test [3]. In the multivariate analysis, the variables were introduced to model as dummy variable. The multivariate analysis and the adjustments were done in STATA 7.

Results

In this analyses, we included 506 subjects aged 14–25 years (506/524=96.6%), of whom 54.2% (n=274) were women and 45.8% were men (n=232); the mean of age was 17.2±2.7 years. The general characteristics of the sample are shown in Table 1. We observed difference statistically significant ($p<0.05$) according to sex in the variables: number of tooth loss, number of restorations, defective restorations, and stress. According to RDC/TMD, the prevalence of TMD was 46.1% (n=233). In the distribution of frequencies of TMD subgroup, four principal groups were found: anterior displacement of the disk with reduction was the most prevalent at 15.6% (95% CI= 12.6–19.1; n=79), followed by myofascial pain at 10.9% (95% CI=8.3–13.9; n=55), anterior displacement of the disk without reduction without limited mouth opening at 6.1% (95% CI=4.2–8.6; n=31), and anterior displacement of the disk without reduction with limited mouth opening at 5.9% (95% CI=4.0–8.4; n=30). No arthralgia, arthritis, or arthrosis was found in this sample. Women have higher prevalence of TMD (52.9 vs 37.9%) than men ($p<0.01$). The mean age was higher within the group with TMD (17.6±2.9 vs 16.9±2.5) than within the group without TMD ($p<0.01$).

Bivariate results

Significant relationships that resulted from simple binary logistic regression analyses are shown in Table 2. We used the TMD as the dependent variable, which we dichotomized into 0=without TMD and 1=with TMD (in all groups or their combinations based on the previously established criteria). Self-reported higher levels of stress and anxiety were associated to TMD. Women were more likely (OR=1.8) to have TMD than men. We observed a positive relationship between age, tooth loss, number of restorations, and number defective of restorations and TMD; one unit of increase in those variables increased the odds of having TMD. Subjects with bruxism were more likely (OR=1.6) to have TMD than subjects without bruxism. Unilateral chewing was marginally (p=0.067) associated to TMD. No relationship between lifestyle and TMD was found.

Table 2 Bivariate analysis (variables $p<0.20$) for temporomandibular disorders in 506 subjects

Variables	OR (crude)	95% CI	*P* value
Age (years)	1.1	1.1–1.2	0.002
Tooth loss	1.3	1.1–1.5	0.025
Number of restorations	1.1	1.1–1.1	0.018
Defective restorations	1.1	1.0–1.2	0.040
Sex			
Men	1[a]		
Women	1.8	1.3–2.6	0.001
Bruxism			
With bruxism	1[a]		
Without bruxism	1.6	1.1–2.3	0.010
Chewing site preference			
Bilateral	1[a]		
Unilateral	1.4	1.0–2.0	0.067
Stress			
1st and 2nd quartiles	1[a]		
3rd and 4th quartiles	1.8	1.3–2.6	0.001
Anxiety			
1st and 2nd quartiles	1[a]		
3rd and 4th quartiles	1.9	1.3–2.6	0.001
Lifestyle			
1st and 2nd quartiles	1[a]		
3rd and 4th quartiles	1.3	0.9–1.8	0.181

[a]Reference category

Table 3 Final model for temporomandibuar disorders among university

Variables	AOR (95% CI)	*P* value
Sex		
Men	1[a]	
Women	1.7(1.2–2.5)	0.006
Bruxism		
With bruxism	1[a]	
Without bruxism	1.5(1.1–2.2)	0.029
Anxiety		
1st and 2nd quartiles	1[a]	
3rd and 4th quartiles	1.6(1.1–2.2)	0.032
Chewing site preference		
Bilateral	1[a]	
Unilateral	1.5(1.0–2.1)	0.055
Tooth loss		
No	1[a]	
At least one	[b]	0.395
Stress		
1st and 2nd quartiles	1[a]	
3rd and 4th quartiles	[b]	0.514
Tooth loss by stress	[b]	0.130
Stress in without tooth loss	1.2(0.7–1.8)	0.514
Stress in with tooth loss	2.4(1.01–5.9)	0.049

AOR adjusted by variables contained in the table. Goodness-of-fit test Hosmer–Lemeshow: p=0.4495. Specification error test (*linktest*): predicted value p=0.000; predicted value squared p=0.237

AOR Adjusted odds ratios

[a]Reference category

[b]The interaction term, significative at $p<0.15$

Table 4 Multivariate analysis of group of myofacial pain

Variables	Model 1 (*n*=365) OR (95% CI)	Model 2 (*n*=328) OR (95% CI)
Age	1.2(1.1–1.3)‡	1.2(1.1–1.3)
Sex		
Men	1[a]	1[a]
Women	2.3(1.3–4.1)‡	2.3(1.2–4.5)
Anxiety		
1st and 2nd quartiles	1[a]	1[a]
3rd and 4th quartiles	2.2(1.2–4.3)	3.4(1.6–7.2)‡
Tooth loss		
No		–
At least one	b	
Stress		
1st and 2nd quartiles		1[a]
3rd and 4th quartiles	b	2.0 (1.0-4.3)§
Tooth loss by stress	b	–
Goodness-of-fit test	0.805	0.513

Model 1 included subjects that present myofacial pain combined with other TMD (n=93). Model 2 included subjects that present only myofacial pain (n=55)
‡p<0.01; ¶p<0.05; §p<0.10
[a]Reference category
[b]Interaction term, significant at p<0.10 (stress in the group of subjects without tooth loss OR=1.2; 95% CI=1.0–3.8 and stress in the group of subjects with tooth loss OR=6.3; 95% CI=1.8–21.8)

Multivariate results

Multivariate logistic regression model is shown in Table 3. This final model consists of six principal effects and one interaction. Women were more likely (OR=1.7) to have TMD than men. The odds of having TMD were significantly greater (OR=1.5) among subjects with clinical bruxism compared with those without bruxism. TMD was more likely among subjects with self-reported higher levels of anxiety (OR=1.6) and those with unilateral chewing preference (OR=1.5). Finally, it was observed that the stress effect depended on tooth loss. In this sense, the effect of having high levels of stress (third and fourth quartiles) in the group of subjects without tooth loss was OR=1.2 (95% CI=0.7–1.8), whereas the effect of having high levels of stress (third and fourth quartiles) in the group of subjects with at least one tooth lost was OR=2.4 (95% CI=1.01–5.9).

Once the final model was complete, we evaluated the adjustment using the Hosmer–Lemeshow goodness-of-fit test, in which values greater than 0.05 indicate that the data adjust well to the model. In this test, it can be observed that the presented model has a good adjustment; the probability patterns observed were similar to the probabilities predicted. The assumption of logistic regression was satisfactorily complimented (Table 3).

A multivariate analysis was carried out for pain and no-pain diagnosis separately (Tables 4 and 5). The results adjusted indicated that the associated variables to pain diagnosis (Table 4) were principally sociodemographic and psychosocial. In this way, pain diagnosis was associated (p<0.05) with variables such as age (OR=1.2; 95% CI=1.1–1.3), female sex (OR=2.3; 95% CI=1.2–4.5), high anxiety level (OR=3.4; 95% CI=1.6–7.2), and high stress level (OR=2.0; 95% CI=1.0–4.3; p=0.064). On the other hand, no-pain diagnosis (Table 5) was associated with clinical variables: subjects with bruxism (OR=1.7; 95% CI=1.1–2.6) and unilateral chewing site (OR=1.6; 95% CI=1.1–2.4) showed higher odds ratio.

Table 5 Multivariate analysis for group no-pain

Variables	Model 1 (*n*=437) OR (95% CI)	Model 2 (*n*=401) OR (95% CI)
Sex		
Men	1[a]	1[a]
Women	1.6(1.1–2.4)	1.4(0.9–2.2)§
Restorations in mouth		
No	1[a]	–
At least one	1.5(1.0–2.3)§	
Clinic bruxism		
No evidence	1[a]	1[a]
Evidence	1.6(1.1–2.4)	1.7(1.1–2.6)
Chewing site preference		
Bilateral	1[a]	1[a]
Unilateral	1.6(1.1–2.4)	1.6(1.1–2.4)
Goodness-of-fit test	0.782	0.802

Model 1 included subjects that present no pain combined with other TMD (n=177). Model 2 included subjects that present only non-pain diagnosis (n=140)
‡p<0.01; ¶p<0.05; §p<0.10
[a]Reference category

Discussion

This is the first study on TMD carried out in a Mexican young sample. We found a TMD prevalence of 46.9%, similar to that found by other authors. Shiau and Chang [39] reported a prevalence of 42.9% among university students, Nilner and Lassing [31] observed a 71.6% prevalence of TMD in children from the ages of 7 to 14 years, and Nilner [30] reported a 67.7% prevalence of one or more signs of TMD in adolescents from 15 to 18 years of age. However, Verdonck et al. [44] observed a prevalence of 23% in Japanese children 12 to 15 years old. In addition, the percentages of each subgroup of TMD found in this study were different from that reported by other studies [22, 28, 34, 47]. While in this study, the principal group of TMD was axis II, followed by pain diagnosis, Yap et al. [47] reported that axis I is the principal group. They observed subjects of axis III, whereas this study did not find any subject in this category. In this sense, only one study reports the same distribution across TMD groups as the results presented in this work [46]. These differences could be due to the fact that populations under study were different in race, culture, and socioeconomic characteristics, which could have an effect on TMD. In addition, this is the first study undertaken in a Mexican population; therefore, it is difficult to assess its comparability with similar populations.

The frequency and distribution of TMD have been reported in various studies, primarily conducted among adults and in patient populations. Recently, a strong emphasis has been given to the prevention and identification of TMD at earlier ages. Although there are similarities among the studies conducted by other authors, the differences between the operational definitions for different indices used in the observation of signs and symptoms of TMD are substantial obstacles for making comparisons. The variations in factors like age and prevalence found may be due, according to Clark et al. [8], to the fact that the term TMD is very ambiguous and unrestrictive.

Reviewing the assertions made by Clark et al. [8], not all of which we are in agreement with, although it is clear that the natural history of the disease has not been clearly defined and that many of the various indices used in different studies lack validity and operational definitions, what a TMD is seems clear to each researcher, regardless of the amount of time that the patient has had the disease. Because of this, we can be certain that the differences and/or similarities in the prevalences found in the studies are due to the fact that each researcher operates on a different definition and not due to their lack of knowledge about the disease.

A number of studies like those carried out by Koidis et al. [19] and Shiau and Chang [39] have demonstrated that women have a greater percentage of problems relating to TMD than do men. We documented a similar tendency, with women having a 62% greater likelihood of having TMD than men. Likewise, women were more likely to have pain and non-pain diagnoses, with odds almost double for pain diagnosis. Although attempts have been made to provide an explanation for this difference, as in the case of Parker [33] who proposes that it is due to the structural differences between men and women in the components of the articulation, we still lack studies that can truly establish the differences between the sexes that result in a higher percentage of women having the disease.

Unilateral chewing was an independent predictor of TMD, and we found that the subjects with higher rates of this variable have higher rates of TMD than those who chew bilaterally. Tay et al. [41] suggests that the subjects with severe TMDs tend to divert chewing to the side of the lesion. These patterns of characteristic movements seem to be adaptive responses that allow for the work of chewing to be handled with the least amount of pain and damage. Although the alterations observed in the chewing patterns of patients with TMD are probably direct consequences of TMD and/or muscular disorders, this does not eliminate the possibility that chronic unilateral chewing during developmental stages and while growing up could predispose an individual to certain articular intracapsular dysfunction, as well as internal degeneration. Because of this, unilateral chewing may be a factor that is highly associated with TMD and may even be a cause of the problem.

A relationship has been shown between the habits of bruxism and TMD [26, 33, 36, 45]. Wabeke and Spruijt [45] and Koidis et al. [19] also found a significant association between bruxism and TMD, consistent with our findings, in which the subjects with any degree of bruxism had a higher rate of TMD than those who showed no degree of bruxism. On the other hand, Shiau and Chang [39] and Lobbezoo and Lavigne [24] did not find these significant differences between subjects with bruxism and TMD.

Bruxism is a parafunctional habit that consists of forceful grinding and clenching of the teeth. Bruxism may result in a variety of pathologic conditions, but the effect reported most commonly is excessive tooth wear [4, 18, 23]. One of the most important aspects that still remain troubling is how to diagnose bruxism. The technique utilized is the evaluation of dental wear, but this is effectively no more than a register of the accumulative functional and parafunctional wear, and therefore does not provide evidence of whether the bruxism is recent or from the past. This suggests that dental wear is a measure of bruxism with less validity and reliability than desired and adds to the basic problem of temporal ambiguity in cross-sectional studies. Parker [33] mentions that for a long time bruxism was thought to be the result of occlussal problems. Recently, however, scientific evidence has suggested that a stressful life may be a serious factor in nocturnal bruxism. The relationship between bruxism and TMDs is still not clear. Epidemiological studies with better designs and sufficient numbers of evaluation are needed to determine the exact role of bruxism on TMD.

Psychological factors provided some very interesting data in our study. Of the three questionnaires that we administered, two (anxiety and stress) provided significant results in relation to TMD. Anxiety was significant in our finding that the most anxious subjects had a 1.58 greater likelihood than those with less anxiety. These results agree with those of Shiau and Chang [39] and those of Lundeen et al. [25] who found associations between TMD and anxiety. Many theories have been proposed to explain the mechanism of stress on TMD, and many different types of questionnaires have been used to measure this significant variable. Nonetheless, possible interactions may exist within a multicausal interaction that would lead to the rewriting of these theories. However, it is necessary to highlight that the psychosocial variables were not statistically significant in the non-pain diagnosis group.

It is evident that although a large number of investigators have found similar evidence that affective–emotional factors are associated with TMD, the lack of standardized tests, an adequate operational definition of anxiety, and more powerful statistical analysis in the research allow for the questioning of the findings. Above all, we know that it is difficult to measure a variable as subjective as anxiety, and although an effort has been made to validate the questionnaires, variables like sex, age, race, climate, time, and social condition all arise as factors that may or may not influence anxiety.

The loss of teeth has been associated with TMD, but this association may be questionable when the evaluation is controlled for age effects. The adaptive capacity of the chewing system is very great, and the majority of people who have lost teeth may have acceptable chewing function and do not increase the signs or symptoms of TMD. Our study found an association between the number of teeth lost and TMD, a result also found by Helkimo [11] and Agerberg and Carlsson [1]. Furthermore, we found not only a significant relationship, but also an interaction between lost teeth and stress. We conclude, therefore, that the effect of stress on TMD depends on the number of teeth lost.

The combination of factors should be studied in multifactor analyses rather than separately as it is obvious that individual occlusive factors do not act in isolation from one another. With a multiple factor analysis, estimation can be made of the relative contribution of each factor on the characteristics of the patient. McNamara et al. [27] assure us that any association between symptoms at a specific stage of the disease can be obscured when only that one symptom is monitored in an isolated manner.

Our final model brings a new perspective to TMD research. It considers not only associations, but also variables that interact between them, adjusting for other variables. Thus, it considers characteristics inherent to the patient like gender, psychoemotional variables (stress and anxiety), and clinical variables (number of lost teeth, bruxism, and side of preference for chewing). Helping to clarify that the study of variables in an isolated manner does not allow for a view of the data to sufficiently make sense of the phenomenon, and although multivariate analyses can be complicated, they show the relationships of the indicators of the disease in a more objective manner.

Based on our results, we conclude that the prevalence of TMD was relatively high (46.1%), taking into account that the average age of the sample was 17.2 years, which shows us that the disease appears even in a young population. We found associations among variables that were similar to findings in other studies, such as bruxism, tooth loss, stress and anxiety. The final model explains that the effect of stress on TMD depends on tooth loss, controlling for sex, bruxism, unilateral chewing, and anxiety. Additionally, the variables associated with diagnosis of pain were principally psychosocial (stress and anxiety), whereas for the non-pain diagnosis group, the variables were clinical, such as bruxism, chewing site preference, and restorations in mouth. These observations suggest, maybe, a distinct nature in the subgroup of TMD and could be studied in others studies.

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