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Influence of anxiety on the presence of temporomandibular dysfunction and sleep disorders in adult patients

Influência da ansiedade na presença de disfunção temporomandibular e distúrbios do sono em pacientes adultos

Influencia de la ansiedad en presencia de trastornos temporomandibulares y trastornos del sueño en pacientes adultos

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Abstract
The aim of this study was to evaluate the influence of anxiety on the presence of TMD and sleep disorders in adults by using regression and correlation. The methodology applied consisted of a quantitative cross-sectional study, where 113 patients aged between 20 and 45 years, with one or more symptoms of anxiety and/or temporomandibular dysfunction and/or sleep disorders. Volunteers answered the Beck-BAI, RDC/TMD and Fletcher & Luckett questionnaires for symptom analysis. The results showed that anxiety had a statistically significant influence on all evaluated variables of TMD and sleep disorders. Thus, it was concluded that the signs and symptoms of TMD and sleep disorders are influenced by anxiety.
Keywords: Temporomandibular Joint Dysfunction Syndrome; Anxiety; Sleep disorders.

Resumo
O objetivo deste estudo foi avaliar a influência da ansiedade na presença de DTM e distúrbios do sono em adultos, por meio de regressão e correlação. A metodologia aplicada consistiu em um estudo transversal quantitativo, onde 113 pacientes com idade entre 20 e 45 anos, com um ou mais sintomas de ansiedade e/ou disfunção temporomandibular e/ou distúrbios do sono. Os voluntários responderam aos questionários Beck-BAI, RDC/TMD e Fletcher & Luckett para análise dos sintomas. Os resultados mostraram que a ansiedade teve uma influência estatisticamente significativa em todas as variáveis avaliadas de DTM e distúrbios do sono. Assim, concluiu-se que os sinais e sintomas da DTM e dos distúrbios do sono são influenciados pela ansiedade.
Palavras-chave: Síndrome da Disfunção da Articulação Temporomandibular; Ansiedade; Distúrbios do sono.

Resumen
El objetivo de este estudio fue evaluar la influencia de la ansiedad en la presencia de disfunción temporomandibular y trastornos del sueño en adultos, mediante regresión y correlación. La metodología aplicada consistió en un estudio

cuantitativo transversal, en el que participaron 113 pacientes de entre 20 y 45 años, con uno o más síntomas de ansiedad y/o disfunción temporomandibular y/o trastornos del sueño. Los voluntarios respondieron a los cuestionarios Beck-BAI, RDC/TMD y Fletcher & Luckett para el análisis de los síntomas. Los resultados mostraron que la ansiedad tenía una influencia estadísticamente significativa en todas las variables evaluadas de DTM y trastornos del sueño. Así pues, se concluyó que los signos y síntomas de los DTM y los trastornos del sueño están influidos por la ansiedad.
Palabras clave: Síndrome de la Disfunción de Articulación Temporomandibular; Ansiedad; Trastornos del sueño.

1. Introduction

Temporomandibular dysfunction (TMD) is a collective term to represent pain, disorders, and dysfunctions involving the masticatory system, temporomandibular joints (TMJ), stomatognathic apparatus, and musculoskeletal structures of the head and neck (List & Jensen, 2017). In these dysfunctions, the most frequent symptoms are pain, limited or asymmetric mandibular movement, and TMJ sounds (Benassi *et al.,* 2022; Hotta *et al.,* 2003; Reis *et al.,* 2000).

TMD, therefore, has a multifactorial etiology that results from a combination of structural, physiological, and psychological factors (Uehara *et al*., 2023), in which more than 75% of the population present at least one sign and symptom of temporomandibular dysfunction (Fernandes Azevedo *et al.,* 2018).

According to the World Health Organization (WHO) diseases, disorders, and syndromes are caused by biological, social and psychological components and a biological problem has psychological antecedents (Conti *et al*., 2012). In TMD, stress and anxiety are defined as pillars of psychobiological states, however, there is no demonstration in the literature of the effective correlation between these disorders and TMD (Dutra Dias *et al*., 2021; He *et al.,* 2018).

Benassi *et al*. (2022) found the interaction between sleep and anxiety, being anxiety a sign of internal conflict contributes in parafunctional habits that overload the masticatory muscles and act as initiators of TMD (Fernandes Azevedo *et al.,* 2018). Since the dysfunction triggtriggerate of vigilance at night, sleep is directly affected, and when prolonged, it incapacitates the patient in performing their activities and worsens the quality of life (Benassi *et al.,* 2022).

To contribute to the systematization of studies on the subject, enabling the advancement of investigations towards the construction of a true "neurobiology of temporomandibular dysfunctions", this study aims to investigate the influence of anxiety in adult patients with TMD and/or sleep disorders.

2. Methodology

This quantitative cross-sectional study evaluated the influence of anxiety in the presence of temporomandibular dysfunction and/or sleep disorders in adult patients (Pereira *et al.,* 2018; Estrela, 2018; Severino, 2018). The research included 113 voluntary participants aged between 20 and 45 years, with no distinction of age, gender or any other differentiation criterion.

2.1 Inclusion criteria

To participate in the study, volunteers had to present at least one or more symptoms of anxiety and/or temporomandibular dysfunction and/or sleep disorders.

2.2 Exclusion criteria

Excluded from the study were patients outside the age range of 20 to 45 years, total edentulousness, total prosthesis users, smokers, alcohol consumers, illicit drug users, or those who were continuously using medications that could induce sleep or anxiety alterations.

2.3 Data collection method

During the initial researcher-participant contact, a medical history was taken with questions about the general medical history. After the anamnesis, the anxiety, TMD, sleep quality, and sociodemographic questionnaires were applied.

To evaluate the level of anxiety, the Beck-BAI questionnaire (Beck *et al.,* 1988), was used, with 21 evaluation components scored from 0 to 3. The overall sum is 63 points, distributed on the following scale: "0 to 9" (normal or absent); "10 to 18" (mild to moderate); "19 to 29" (moderate to severe); "30 to 63" (severe).

The questionnaire used to evaluate sleep quality was devised by Fletcher/Luckett (1991) using an adapted model, with 38 questions, divided into five categories. The sum of the answers varies from 0 to 114 points, which divided by 38 generates the final score, where values >1 signal the presence of significant symptoms of sleep disturbance.

For TMD analysis, the Diagnostic Criteria for Temporomandibular Disorders - DC/TMD questionnaire was selected (Schiffman *et al.,* 2014). This questionnaire was prepared by Richard Ohrbach (University at Buffalo, NY, US) and Wendy Knibbe (ACTA, Amsterdam, The Netherlands), consisting of 81 questions, divided into six categories and with a score from 0 to 10.

The sum of the answers was made individually for each category, generating individual scores by the "Scoring Manual for Self- Report Instruments". Since it is a continuous variable, the category amplitude was standardized so that it could vary from "0" (none) to "100" (worst possible), allowing the comparison of variables from all the questionnaires.

2.4 Ethics committee

This study was approved by the Ethics Committee on Research involving human beings, under protocol number 88736418.0.0000.5419. Patients who agreed to participate in the study received guidance on their participation in the research, being informed about the objectives, freedom to participate or not in the study and the guarantee of total confidentiality of the information. Subsequently, they signed the Informed Consent Form.

2.5 ***Statistical analysis***

The statistical analysis was performed by describing the dependent variables, which were orofacial pain, functional limitations, parafunctional habits, sleep problems, daytime sleepiness, snoring, apnea, associated complaints, and independent variables such as gender, age, and race.

The technique used for data analysis was Ordinary Least Squares (OLS) and classical linear regression. Then the confirmatory factor analysis test, Cronbach's alpha, was used to analyze the structure of correlations between a set of variables. Subsequently, statistics were performed by multiple linear regression models with Weighted Least Squares (WLS).

3. Results

The regression results are arranged in Table 1 and Table 2.

Table 1 - Multiple linear regression models with weighted least squares to estimate the dependent variable "TMD indices".

	Orofacial Pain	Limitations Functional	Habits Parafunctionals
BAI100	0.984***	0.804***	0.698***
	(-0.175)	(-0.144)	(-0.09)
Age	0.311	0.112	0.156
	(-0.269)	(-0.222)	(-0.138)
Gender	-20.090*	-1.05	-8.973*
	(-10.218)	(-8.429)	(-5.226)
Race	-0.004	1.838	9.745***
	(-7.068)	(-5.831)	(-3.615)
Constant	8.452	-1.519	8.578
	(-13.728)	(-11.324)	(-7.021)
N	113	113	113
R^2	0.25	0.233	0.421
R^2 adjusted	0.222	0.204	0.4

Footnotes: *** significant at the 99% level; ** significant at the 95% level; * significant at the 90% level. Weight information was used to control the variance matrix and covariance of the error term to estimate the statistics in this table. The variance inflation factor (VIF) was calculated for the models and no multicollinearity was found in the models. Source: Own authorship.

Table 2 - Weighted least squares multiple linear regression models for estimating the dependent variable “Sleep Index”.

	Sleep Problems	Daytime Complains Sleepiness	Snoring	Apnea	Mixed Complains
BAI100	0.708***	0.629***	0.339***	0.442***	0.750***
	(-0.077)	(-0.128)	(-0.122)	(-0.156)	(-0.084)
Age	0.157	0.211	0.476**	0.601***	0.15
	(-0.119)	(-0.198)	(-0.188)	(-0.24)	(-0.129)
Gender	2.641	2.403	-13.207*	-4.046	-3.144
	(-4.512)	(-7.492)	(-7.139)	(-9.121)	(-0.895)
Race	5.137***	1.048	-6.369	-10.965*	0.298
	(-1.121)	(-5.182)	(-4.938)	(-6.309)	(-3.386)
Constant	16.214***	10.335	23.645**	17.876	17.957***
	(-6.062)	(-10.065)	(-9.591)	(-12.254)	(-6.576)
N	113	113	113	113	113
R^2	0.461	0.186	0.139	0.086	0.434
R^2 adjusted	0.441	0.156	0.108	0.053	0.413

Footnotes: *** significant at the 99% level; ** significant at the 95% level; * significant at the 90% level. Weight information was used to control the variance matrix and covariance of the error term to estimate the statistics in this table. The variance inflation factor (VIF) was calculated for the models and no multicollinearity was found in the models. Source: Own authorship.

3.1 Orofacial pain

The orofacial pain index assumes a direct relationship with the BAI anxiety index, with statistical significance at the 99% level. The association and the presence of the variable in the orofacial pain index are corroborated by the mean correlation in the value of 0.45, also with statistical significance at the 99% level. Males have an inverse impact on orofacial pain, but this variable is statistically significant at the 90% level.

3.2 Functional limitations

In the functional loss index, the variable of interest shows statistical significance at the 99% level in both dimensions of analysis (regression and correlation), the correlation being a mean association of 0.47.

3.3 Parafunctional habits

In parafunctional habits, anxiety showed statistical significance at the 99% level in both regression and correlation models.

3.4 Sleep Problems

The sleep problems index is influenced by BAI anxiety to a similar extent as the previous models, at the 99% level of statistical significance in the correlation and causality model. The association assumes a mean value of 0.66. The variable race also presents statistical significance at the 99% level, which assumes great relevance to explain sleep quality. That is, individuals who declare themselves as white have greater sleep problems compared to non-white individuals.

3.5 Daytime sleepiness

Regarding the daytime sleepiness index, the variable of interest shows statistical significance at the 99% level in both dimensions of analysis, with the correlation being a mean association of 0.42.

3.6 Snoring

The snoring index shows statistical significance at the 99% level. However, the correlation, even being significant at the 90% level, is low. The variable age assumes a direct relationship and is also statistically significant at 99%. In this sense, the older the individual, the greater the problems with snoring.

3.7 Apnea

For apnea, the variable has presence at the 99% level. However, the correlation is low, assuming the association value of 0.23 with statistical significance at the 90% level. The variables age and race were also significant in explaining the model. The former assumes a direct relationship, since as the individual's age increases, so do the cases of apnea. The latter assumes an inverse relationship, in which non-whites report higher rates of apnea.

3.8 Mixed complaints

The index of varied complaints also shows statistical significance at the 99% level, both in the regression and correlation models, with a mean correlation value of 0.65. Men have fewer sleep complaints when compared to women.

4. Discussion

The influence of anxiety in TMD and sleep disorders is not expressively evaluated in the literature, although Benassi *et al*. (2020), Manfredini *et al.* (2004), Manfredini & Lobbezoo (2009) point out through questionnaires and literature reviews that anxiety plays a relevant role in these cases because it is associated with manifestations in the body, such as pain in the face region and difficulty in the quality of sleep. The overlapping of symptoms indicates the relationship of the disorders, such as the privatization of sleep, which brings the patient difficulty of concentration, sleepiness and stress, symptoms present in anxious people (Benassi *et al*., 2020).

In this study, when analyzing the results through the questionnaires applied (Beck-BAI, RDC/TMD, and Fletcher & Luckett), there was a statistically significant correlation level of anxiety in TMD and sleep disorders, which corroborates the literature, which reports the influence of anxiety in patients with TMD and/or sleep disorders (Benassi *et al*., 2020; Yap & Marpaung, 2021; Dutra Dias *et al.,* 2021; Florjański & Orzeszek, 2021; Weissman-Fogel *et al*., 2011). The information collected in the sociodemographic questionnaire did not influence the correlation between the signs and symptoms assessed in this study.

4.1 Orofacial pain

Anxiety influenced 98.4% on orofacial pain, the main symptom of TMD, as present in studies on the subject, which report the correlation of psychosocial disorder with orofacial pain, with individuals with orofacial pain having more anxiety than healthy patients (Nadendla *et al.,* 2014), although the cause and effect relationship has not been discussed. (Golanska *et al*., 2021; Wieckiewicz *et al.,* 2017). Wieckiewicz *et al*. (2017) state the association of the problem mainly to the female gender, which corroborates with the results of this research.

Increased pain due to long-term muscle hyperactivity relates to the masseter, sternocleidomastoid, and temporalis muscles, which experience tension during psychological crises and are tensed in response to orofacial pain and anxiety disorders (Wieckiewicz *et al*., 2017; Hung *et al.,* 2016).

4.2 Mandibular functional limitations

With respect to the functional aspect, the influence of the variable was 80.4% on functional limitations. Liu *et al.* (2019) explain that masseter hyperactivity involves the mesencephalic nucleus of the trigeminal nerve (MTN), as in anxiety, which has its emotional modulation through the lateral habenula with direct projections to the (MTN).

4.3 Parafunctional habits

Parafunctional habits are pointed out as elements that contribute to or worsen TMD and sleep disorders (Manfredini; Lobbezoo, 2021; Giovanni & Giorgia, 2021) and are influenced by anxiety in 69.8% also in correspondence with studies on the subject, which state the direct relationship of these habits with TMN and consequently worsening or initiation of anxiety symptoms (Giovanni & Giorgia, 2021; Kalamir *et al.,* 2007; Ohrbach & Michelotti, 2018).

The neurons of the mesencephalic trigeminal nucleus (MTN) innervate the jaw elevator muscles and receptors of the periodontal ligament and parafunctional habits are responsible for activating the MTN by exerting a disordered, excessive function (Giovanni & Giorgia, 2021; Beddis & Pemberton, 2018).

4.4 Sleep disorders

The relationship between TMD and sleep disorders (problems with sleep, daytime sleepiness, snoring, apnea, various complaints with sleep) is reported in the literature by Benassi *et al.* (2020) by triggering a state of wakefulness during the night

and in consequence restless sleep. Dysfunctions have chronic pain as the main symptom, and pain patients report deprivation of sleep quality (Ekici, 2020). Symptoms such as fatigue, muscle pain and sleepiness indicate the reduction of melatonin in the pineal gland, which impairs the immune system and favors frequent infections (Patel *et al.*, 2020).

The data found in this research indicate greater presence of anxiety in individuals with sleep problems (70.8%) and various complaints (75%). Sleep disorders are influenced by psychological problems due to the stress generated by the lack of a good night's sleep, which directly affects the patient's life in relation to productivity, psychomotor performance, and sleepiness during the day Benassi *et al.* 2020; Pala Mendes *et al.*, 2022). The relationship between anxiety/stress and sleep disorders activates the hypothalamic-pituitary-adrenal (HPA) and the autonomic nervous system, which can increase cortisol levels in the blood plasma and affect the individual's health (Ekici, 2020; Kessing *et al.*, 2011).

The results report the presence and influence of anxiety in TMD and sleep disorders, however, it is still unclear how or through which brain network these causes can be associated. The neurobiological explanation for this fact may be found in a brainstem structure called the "Locus Coeruleus," from which one of the main noradrenergic pathways, which plays a role in attention and stress response, originates (Benarroch, 2018; Dahl *et al.*, 2022). The "Locus Coeruleus" is believed to have dominance in the sleep-wake cycle, regulation of facial muscle tone, nociception (pain modulation), anxiety, and psychobiological problems (Benarroch, 2018; Borodovitsyna *et al.*, 2018; Morris *et al.*, 2020*;* Van Egroo *et al.*, 2022).

Thus, the results derived from this study showed influence between signs and symptoms of anxiety, TMD, and sleep disorders, and it is possible to determine that there is a concomitant presence of both alterations, but no explanation of their cause and effect.

5. Conclusion

Can be observed the presence and influence of anxiety in the signs and symptoms of TMD and sleep disorders in adult patients, without being able to explain the mechanism of action of the pathologies evaluated, that is, how anxiety acts in the potentiation of TMD and/or sleep disorders.

In the future, studies that evaluate in a cross-sectional quantitative manner other Brazilian populations may contribute to the methodology proposed in this study in order to consolidate or refute the present data. In addition, studies that evaluate the mechanism of action of these pathologies can be carried out to consolidate and provide a basis for future discussions.

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