http://dx.doi.org/10.1590/1981-86372023002820220013

| ORIGINAL

Sleep disorders are associated with both morning temporal and jaw pain among adults and elderly: a population-based study in Brazil

Distúrbios do sono estão associados à dor temporal matinal e à dor na mandíbula em adultos e idosos: um estudo de base populacional

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ABSTRACT

Objective: To assess the influence of sleep disorders on temporal and jaw pain in the morning in adults and elderly people. **Methods**: Population-based study with representative individuals aged 18 years or over. Individuals were selected using a multistage sampling procedure. The outcomes of morning jaw pain and morning temporal pain were assessed. Sleep bruxism, obstructive sleep apnea, and sleep quality were evaluated as exposure variables. Adjusted analysis was conducted using Poisson regression. All analysis was sex stratified. **Results**: 820 individuals were studied. Female with sleep bruxism were 1.37 times more likely to have morning temporal pain (p=0.041). Male and female with bruxism had a prevalence 160% and 97%, respectively, higher of morning jaw pain (male: p=0.003; female: p<0.001). Women with obstructive sleep apnea were 1.52 times more likely to have morning temporal pain (p=0.023). Men with poor sleep quality had a prevalence 190% higher of morning temporal pain (p=0.005). **Conclusion**: Morning craniofacial pain is more frequent in individuals with sleep disorders, and there are differences between sexes. Since more than one sleep disorder can be present in the same individual, studies that adjust the analyses for possible confounders are important to avoiding possible overlap between them.

Indexing terms: Facial pain. Headache. Obstructive sleep apnea. Sleep bruxism. Sleep quality.

RESUMO

***Objetivo**: Avaliar a influência dos distúrbios do sono nas dores temporais e mandibulares pela manhã em adultos e idosos. **Métodos**: Estudo de base populacional realizado com uma amostra representativa de indivíduos com 18 anos ou mais. Os participantes foram*

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How to cite this article

Schäfer AA, Streck JNZ, Streck EL, Quadra MR, Meller FO. Sleep disorders are associated with both morning temporal and jaw pain among adults and elderly: a population-based study in Brazil. RGO, Rev Gaúch Odontol. 2023;71:e20230028. http://dx.doi.org/10.1590/1981-86372023002820220013

selecionados por meio de um processo amostral com múltiplos estágios. Os desfechos avaliados foram a dor matinal na mandíbula e a dor temporal matinal. Apneia obstrutiva do sono, bruxismo do sono e qualidade do sono foram as variáveis de exposição avaliadas. Análise ajustada foi realizada através da Regressão de Poisson e todas as análises foram estratificadas por sexo. ***Resultados****: Foram estudados 820 indivíduos. Mulheres com bruxismo do sono tiveram 1,37 vezes mais chance de ter dor temporal matinal (p=0,041). Homens e mulheres com bruxismo tiveram uma prevalência 160% e 97%, respectivamente, maior de dor matinal na mandíbula (homens: p=0,003; mulheres: p<0,001). Mulheres com apneia obstrutiva do sono tiveram 1,52 vezes mais chance de ter dor temporal matinal (p=0,023). Homens com má qualidade do sono tiveram prevalência 190% maior de dor temporal matinal (p=0,005).* ***Conclusão****: Dor craniofacial matinal é mais frequente em indivíduos com distúrbios do sono e há diferenças entre os sexos. Uma vez que mais de um distúrbio do sono pode estar presente no mesmo indivíduo, estudos que ajustem as análises para possíveis confundidores são importantes para evitar uma possível sobreposição entre eles.*

Termos de indexação: *Dor facial. Cefaleia. Apneia obstrutiva do sono. Bruxismo do sono. Qualidade do sono.*

INTRODUCTION

Sleep is an essential biological process for regulation of hormones, immune system, memory and cognitive function, and tissue repair [1]. The complex and bidirectional relationship between craniofacial pain and sleep is well reported [3-4]. Sleep disorders, which may include alterations in the circadian rhythm and insomnia, as well as breathing and movement disorders, are commonly associated with primary and secondary headaches and temporomandibular disorders (TMD) [3,5,6].

Obstructive sleep apnea (OSA) has been associated with morning craniofacial pain [4]. Furthermore, sleep bruxism (SB), particularly in TMD individuals, and insomnia have also been associated with morning headaches and facial pain [4,7]. Most epidemiological studies have investigated the association between sleep disorders and pain individually [3]; however, there is an overlap between some chronic pain syndromes that may mislead data interpretation [8].

Few studies have performed adjusted analyses for possible confounders, especially SB in patients presenting OSA or poor quality of sleep. Thus, to better understand the relationship between morning craniofacial pain and sleep disorders, we aimed to assess the influence of sleep disorders on temporal and jaw pain in the morning in adults and elderly people.

METHODS

This is a population-based cross-sectional study carried out in the city of Criciúma, Brazil, located in the southern state of Santa Catarina. Criciúma has about 215,000 inhabitants and the municipality's human development index (HDI) is 0.788 [9].

Individuals aged 18 years or older living in the urban area of the city were studied. Those cognitively unable to complete the survey were excluded from study. The sampling process was conducted in two stages: the primary units, which are the census tracts, and the secondary units, which are the households. First, all urban census sectors with private properties in the municipality of Criciúma were listed according to the code of each sector. Afterwards, 77 of the census sectors were randomly selected, in a total of 15,218 households. The number of households was sampled proportionally to sector size; visits were made to the 618 households selected systematically within the census sectors. Face-to-face data collection was performed from March to December 2019 by previously trained interviewers. Those were revised, coded, and double entered in EpiData 3.1 software.

The outcomes morning jaw pain (MJP) and morning temporal pain (MTP) were assessed by the questions "Do you feel pain or fatigue in your mandible or mouth when you wake up?" and "Do you feel pain in the temples (lateral of the head, above the ears) when you wake up?", respectively. The answer options were either yes or no.

SB, OSA, and sleep quality were evaluated as exposure variables. The question "How often do you grind your teeth or did someone in your family tell you that you grind your teeth during sleep?" was used to classify the individuals

as bruxers. Those who answered "sometimes or frequently" were classified as bruxers while the individuals that answered "never or rarely", as non-bruxers. To assess OSA, the following question was asked: "Has any doctor ever told you that you have obstructive sleep apnea syndrome, that is, you stop breathing while you sleep?" The answer options were either yes or no. Finally, sleep quality was evaluated using the question "How do you rate the quality of your sleep?" with the following answer options: very good, good, regular, poor, very poor. Those that rated their sleep quality as "very good or good" were classified as having better sleep quality while those that responded "regular, poor or very poor" were considered to have worse sleep quality.

The following covariables were also assessed: sex (male/female), age (years), schooling (collected in completed years and categorized into 0–4/5–8/9–11/12 years or more), income (collected in BRL per month and categorized into <500.00/500.00–1,000.00/1,001.00–2,000.00/2,001.00–4,000.00/>4,000.00).

Descriptive analysis of the study variables was performed, and absolute and relative frequencies were found. Crude and adjusted analyses of the association between the outcomes (MJP and MTP) and the exposure variables (SB, OSA, and sleep quality) were performed using Poisson regression with robust variance, presenting the p-value corresponding to the Wald test for heterogeneity, as analyses of cross-sectional studies with binary outcomes fit better using Poisson than logistic regression [10]. Regression results were reported as prevalence ratio (PR) and its corresponding 95% confidence intervals.

A hierarchical model of analysis was used to define the possible confounders. Variables were selected using the backward method, considering each hierarchical level, and those variables associated with exposure and outcome at a 20% significance level (p-value <0.20) remained in the final model. The adjusted models for each exposure variable included all other variables as possible confounders. For example, for the association of SB and MTP, the following variables were included in the model: age, schooling, income, OSA, sleep quality, and MJP. In the association between SB and MJP, the adjusted analyses included: age, schooling, income, OSA, sleep quality, and MTP. All analyses were sex stratified.

The analyses were performed in STATA version 16.1.

This study was approved by the Research Ethics Committee of the University of Southern Santa Catarina in December 2018 under protocol number 3.084.521, and all participants provided written informed consent.

RESULTS

A total of 820 individuals were evaluated (86.1% of response rate) with mean age of 54.8 (±17.4) years old. The majority were females (63.8%) and had no more than 8 years of education (53.8%). Moreover, almost 10% of the individuals frequently reported having SB (8.3%) and OSA (8.5%), and about half of the individuals had regular, poor or very poor sleep quality (48.2%). Prevalence rates of MJP and MTP were 18.3% and 17.2%, respectively (table 1).

Table 1. Characteristics of adults aged 18 years or older in Criciúma, Santa Catarina, Brazil, 2019 (n=820).

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Variables	n	%
Sex		
Male	297	36.2
Female	523	63.8
Age (years)		
Mean	54.8	
SD	17.4	

Table 1. Characteristics of adults aged 18 years or older in Criciúma, Santa Catarina, Brazil, 2019 (n=820).

Variables	n	%
Schooling (years)		
0-4	219	26.7
5-8	220	26.9
9-11	266	32.5
≥12	114	13.9
Income (BRL per month)*		
<500.00	151	19.0
500.00-1,000.00	166	20.9
1,001.00-2,000.00	248	31.2
2,001.00-4,000.00	164	20.6
>4,000.00	66	8.3
Sleep bruxism		
Never	665	83.1
Rarely	25	3.1
Sometimes	44	5.5
Frequently	66	8.3
Obstructive sleep apnea		
No	734	91.5
Yes	68	8.5
Sleep quality		
Very good	65	7.9
Good	360	43.9
Regular	232	28.3
Poor	111	13.5
Very poor	52	6.4
Morning temporal pain		
No	668	81.7
Yes	150	18.3
Morning jaw pain		
No	675	82.8
Yes	140	17.2

Note: SD: standard deviation. *Variable with highest number of missing data points (n=25).

Table 2 shows the crude and adjusted analyses of association between SB and morning pain among males and females, and in the total population. After the adjusted analyses for possible confounders, SB was associated with MTP in women only (PR: 1.37; CI95% 1.01;1.85). SB remained associated with MJP in both sexes. Men and women that referred to SB had a prevalence 160% and 97%, respectively, higher of MJP compared to those without SB (male: p=0.003; female: p<0.001).

Table 3 shows the crude and adjusted PR of the relationship between OSA and pain stratified by sex. After adjustment for possible confounders, OSA was associated with MTP in women only. Those who had referred OSA were 1.52 (CI95% 1.01;2.29) times more likely to have pain than their pairs. OSA was not associated with MJP.

Table 4 shows the crude and adjusted analyses of association between sleep quality and pain according to sex. Sleep quality was associated with MTP among men only. The prevalence of pain was 190% higher among those with poor sleep quality when compared to their pairs (p=0.005). There was no association between sleep quality and MJP.

Table 2. Crude and adjusted analyses of association between sleep bruxism and pain stratified by sex. Criciúma, Santa Catarina, Brazil, 2019 (n=820).

	Sleep bruxism					
	Crude analysis			Adjusted analysis		
	Total	Male	Female	Total	Male	Female
	PR (95%CI)	PR (95%CI)	PR (95%CI)	PR (95%CI)	PR (95%CI)	PR (95%CI)
Morning temporal pain[a]	*p<0.001*	*p=0.806*	*p<0.001*	*p=0.086*	*p=0.838*	*p=0.041*
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	2.11 (1.54;2.88)	1.12 (0.45;2.82)	2.66 (1.97;3.61)	1.28 (0.97;1.70)	0.91 (0.39;2.15)	1.37 (1.01;1.85)
Morning jaw pain[b]	*p<0.001*	*p=0.005*	*p<0.001*	*p<0.001*	*p=0.003*	*p<0.001*
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	2.85 (2.10;3.86)	2.57 (1.32;4.98)	3.21 (2.32;4.43)	2.06 (1.54;2.75)	2.60 (1.39;4.88)	1.97 (1.43;2.71)

Note: [a]Adjusted for age, schooling, income, apnea, sleep quality, and morning jaw pain. [b]Adjusted for age, schooling, income, apnea, sleep quality, and morning temporal pain.

Table 3. Crude and adjusted analyses of association between obstructive sleep apnea and pain stratified by sex. Criciúma, Santa Catarina, Brazil, 2019 (n=820).

	Obstructive sleep apnea					
	Crude analysis			Adjusted analysis		
	Total	Male	Female	Total	Male	Female
	PR (95%CI)	PR (95%CI)	PR (95%CI)	PR (95%CI)	PR (95%CI)	PR (95%CI)
Morning temporal pain[a]	*p=0.009*	*p=0.435*	*p=0.002*	*p=0.023*	*p=0.077*	*p=0.046*
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	1.71 (1.15;2.56)	1.48 (0.55;3.99)	1.92 (1.28;2.90)	1.52 (1.06;2.17)	2.07 (0.92;4.63)	1.52 (1.01;2.29)
Morning jaw pain[b]	*p=0.565*	*p=0.880*	*p=0.306*	*p=0.277*	*p=0.764*	*p=0.517*
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	1.16 (0.70;1.94)	0.92 (0.30;2.83)	1.34 (0.77;2.35)	0.76 (0.47;1.24)	0.85 (0.28;2.53)	0.83 (0.48;1.45)

Note: [a]Adjusted for age, schooling, income, sleep bruxism, sleep quality, and morning jaw pain. [b]Adjusted for age, schooling, income, sleep bruxism, sleep quality, and morning temporal pain.

Table 4. Crude and adjusted analyses of association between sleep quality and pain stratified by sex. Criciúma, Santa Catarina, Brazil, 2019 (n=820).

	Sleep quality					
	Crude analysis			Adjusted analysis		
	Total	Male	Female	Total	Male	Female
	PR (95%CI)	PR (95%CI)	PR (95%CI)	PR (95%CI)	PR (95%CI)	PR (95%CI)
Morning temporal pain[a]	*p<0.001*	*p=0.003*	*p=0.001*	*p=0.291*	*p=0.005*	*p=0.718*
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	2.09 (1.54;2.85)	3.26 (1.48;7.16)	1.77 (1.28;2.47)	1.29 (0.80;2.07)	2.90 (1.37;6.14)	1.10 (0.66;1.84)
Morning jaw pain[b]	*p=0.109*	*p=0.532*	*p=0.220*	*p=0.176*	*p=0.752*	*p=0.775*
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	1.28 (0.95;1.73)	1.23 (0.65;2.34)	1.24 (0.88;1.74)	0.70 (0.42;1.17)	0.91 (0.49;1.68)	0.96 (0.71;1.29)

Note: [a]Adjusted for age, schooling, income, sleep bruxism, apnea, and morning jaw pain. **b**Adjusted for age, schooling, income, sleep bruxism, apnea, and morning temporal pain.

DISCUSSION

This study that analyzed the association of sleep disorders with temporal and jaw pain upon awakening showed that SB and OSA are associated with TMP in women, SB is associated with TJP in both sexes, and poor quality of sleep is associated with TMP in men.

Morning headaches are a frequent complaint among individuals with sleep disorders [8]. SB is a sleep-related movement disorder, characterized by teeth grinding and clenching during sleep as a consequence of masticatory muscle activity [11]. Few studies have investigated the association between morning headache and SB [7,12,13].

Vieira et al. [7] found a significant relationship ($p<0.001$) between frequency of SB and morning headaches. Their research sample had a much higher percentage of female than male patients, as the analysis was not stratified by sex, it could have influenced the results [7]. This may justify the similar findings of the present study, in which women with SB showed a higher risk of developing TMP. Further, a study with children found a positive association between morning headache and SB, and headaches were associated with increased risk of painful signs of TMD [14]. Carra et al. [15] evaluated the use of mandibular advancement devices in teenagers with SB and frequent headache and found a significant reduction in morning headaches ($p=0.03$). However, their study had a small sample and there could have been an overlap with sleep breathing disorders, because the mandibular advancement is used for treatment of light and moderate OSA patients, and SB is frequently reported by these individuals [16]. Another study using mandibular advancement devices, found a significant reduction in morning headache and orofacial pain in individuals with frequent complaints of morning headache [13]. The authors concluded that the reduction in the frequency of headaches may be related with a concomitant reduction in rhythmic masticatory muscle activity (RMMA) [13].

The present study shows an association of SB and morning craniofacial pain in both sexes, as previously reported [15]. However, women were associated with both temporal and jaw morning pain, while men were associated with jaw morning pain only. Orofacial pain has been reported in 66 to 84% of patients with SB [17]. This association occurs specially in TMD patients and individuals with primary headaches [18], even though this relation might not be related to pain intensity [19]. Nevertheless, the cause of morning craniofacial pain can be related to SB, TMD or other primary headaches, as comorbid entities [17,18].

Painful TMD is the most prevalent type of orofacial pain and is two to three times more common in women, especially those of muscular origin [20,21]. Muscular TMD painful symptoms include pain in muscles temporalis and masseter, reported as temporal headache and jaw pain [22]. A longitudinal study with 135,800 individuals, found that women had 2.37 times more risk of developing orofacial pain and have a higher risk of pain [23].

The hypothesis that SB is a risk factor to develop TMD [18] and that TMD is comorbid disorders with high prevalence in women [24], may justify the significant association between temporal and jaw morning pain and SB in the female participants in the present study.

Other possible causes of morning craniofacial pain have also been reported. According to the International Classification of Headaches Disorders (ICHD-3), there is a secondary headache attributed to OSA, characterized by transient bilateral headache in the morning [25]. A longitudinal study with 2,827 patients, found gender differences in OSA patients and, although this disorder is more frequent in men, morning headaches were more common in women [26]. Those results endorse our findings that women reporting OSA have are 1.52 times more likely to have morning headaches than men. Kristiansen et al. [27] reported a higher frequency of morning headache in OSA patients, but the causal relation with hypoxia is questionable. Wieckiewicz, et al. [28] found genetic polymorphism that might help explain an association between SB and OSA. Once more, comorbidity between other sleep disorders must be addressed.

Sleep has a great influence on several craniofacial pain disorders [5,29]. Fragmented sleep can cause usual awakenings and changes in sleep position at night and also be a trigger to both primary and secondary headaches [5]. Migraine has been associated with insomnia, OSA, restless legs syndrome, parasomnias and SB, while Tension-Type Headache (TTH) has a limited association with OSA, but is frequently reported in individuals with SB and insomnia [4,29]. Insomnia is the sleep disorder most commonly associated with TTH and OSA [29,30], and both disorders present overlapping symptoms with muscular painful TMD [24,25].

In this cross-sectional study, after adjusting the analysis for confounders, we found a higher risk for TMP in men only, when reporting poor quality of sleep. A poor sleep quality may be related to many factors, including psychiatric disorders, such as anxiety and depression, headache and sleep disorders, and they all can be influenced by environment and social factors [2].

However, we need to report the limitations of this study. The cross-sectional design does not establish whether the associations are causal. Therefore, the findings may be subject to reverse causality bias and should be interpreted with caution. A self-reported questionnaire was used to assess SB, OSA and sleep quality; however, diagnostic interviews are not feasible in a population-based study.

The strengths of this study are the representative sample, and a multivariable analysis which included a hierarchical model based on the literature about sleep disorders and temporal and jaw pain. Moreover, all analyses were sex stratified.

CONCLUSION

The present study shows that sleep disorders are associated with both morning jaw and temporal pain. SB was associated to MTP among females and MJP in both sexes. OSA was related to MTP among females and total sample. Also, poor sleep quality was associated to MTP among males. This finding shows the needed to identify early individuals with sleep disorders for avoiding and/or treat craniofacial pain.

Collaborators

AA Schäfer and FO Meller, participated in the project administration, conceptualization, methodology, data analysis and writing (review and editing). JNZ Streck, EL Streck and MR Quadra, participated in the data interpretation and writing (review and editing). All authors approved the final version of the article.

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Received on: 18/2/2022
Approved on: 20/12/2022

Assistant editor: Luciana Butini Oliveira