

# Sleep Disorders in Patients with Temporomandibular Disorders (TMD) in an Adult Population–Based Cross-Sectional Survey in Southern Brazil

Daniela D. S. Rehm, DDS, MS, PhD

Specialty Program in Temporomandibular Disorders and Orofacial Pain, Brazilian Dental Association, State of Rio Grande do Sul, Brazil.

Patrícia S. Progiante, DDS, MS, PhD

Postgraduate Program in Dentistry (Prosthodontics), School of Health Sciences, Pontifical Catholic University of Rio Grande do Sul, Porto Alegre, Brazil.

Marcos P. Pattussi, DDS, MSc, PhD

Postgraduate Program in Public Health, Vale do Rio dos Sinos University (UNISINOS), São Leopoldo, Brazil.

Eduardo P. Pellizzer, DDS, MS, PhD

Department of Dental Materials and Prosthodontics, Araçatuba Faculty of Dentistry, State University of São Paulo, São Paulo, Brazil.

Patrícia K. Grossi, BSW, MSW, PhD

Postgraduate Program in Social Work, School of Humanities, Pontifical Catholic University of Rio Grande do Sul, Porto Alegre, Brazil.

Márcio L. Grossi, DDS, MS, PhD

Postgraduate Program in Dentistry (Prosthodontics), School of Health Sciences, Pontifical Catholic University of Rio Grande do Sul, Brazil.

**Purpose:** To verify the prevalence of sleep disorders in temporomandibular disorders (TMD) subjects in a Brazilian population-based, cross-sectional survey (N = 1,643). **Materials and Methods:** Patients were assessed with the Research Diagnostic Criteria for TMD (RDC/TMD) Axes I and II and the Sleep Assessment Questionnaire. Student *t* test and Pearson chi-square test were used for continuous and categorical data analyses, respectively. **Results:** TMD subjects had significantly worse sleep disorders than controls (Graded Chronic Pain Severity categories I through IV vs 0, respectively) in RDC/TMD Axis II variables. Sleep disorders were also worse in the Axis I TMD groups (myofascial pain and arthralgia/osteoarthritis/osteoarthrosis), with the exception of disc displacements. **Conclusion:** TMD subjects had worse sleep disorders, mainly in Axis I TMD groups, with higher pain/disability levels. *Int J Prosthodont* 2020;33:9–13. doi: 10.11607/ijp.6223

Sleep disorders have been associated with temporomandibular disorders (TMD) in clinical populations and have also been shown to be both a risk factor for developing TMD (increasing the risk by 5 times) and a perpetuating factor (increasing the risk of treatment failure with conservative TMD treatments, such as bite splints or pain medication, by 3.1 times).<sup>1,2</sup>

In a recent systematic review, the prevalence of two or more sleep disorders has been shown to be as high as 43% in TMD patients, with insomnia (36%) and sleep apnea (28.4%) the most frequent. However, these studies were performed in clinical populations (ie, patients seeking treatment for TMD) and were not reported for different TMD diagnostic groups (ie, pain, disc displacements, or arthralgia/osteoarthritis/osteoarthrosis).<sup>3</sup>

Therefore, population studies on the prevalence and distribution of sleep disorders in TMD subjects in general and in different TMD diagnostic groups using valid methodologies are still missing.

#### Correspondence to:

Prof. M. L. Grossi  
Faculdade de Odontologia – PUCRS  
Avenida Ipiranga 6681 prédio 6,  
Porto Alegre RS 90619-900, Brazil  
Email: mlgrossi@pucrs.br

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## MATERIALS AND METHODS

### Research Design and Population

In this population-based cross-sectional study, sleep disorders in a TMD population not seeking treatment compared to controls without TMD were assessed. Participants were individuals (18 to 65 years of age, men and women) from the city of Maringá (357,077 inhabitants) registered in the Brazilian Public Health System (SUS). The Research Diagnostic Criteria for TMD (RDC/TMD) Axis I, applied by a single trained clinical examiner, (L.B.P.) was used for clinical diagnoses of TMD after the assessment of clinical history using the RDC/TMD Axis II and SUS medical records. Participants were excluded if they had a history of systemic diseases or disorders, chronic or acute pain conditions, or chronic use of medication affecting the central nervous system (CNS). The complete description of the inclusion/exclusion criteria can be found elsewhere.<sup>4</sup>

### Research Instruments for TMD and Sleep Assessment

For TMD diagnosis, the RDC/TMD, a clinical questionnaire developed with the objective of creating a set of diagnostic criteria for the classification of TMD, was employed. It allows a multidimensional evaluation of chronic TMD pain using a two-axis diagnostic system, including not only clinical variables measured by Axis I (ie, measurement of mandibular movement, muscle/TMJ pain on palpation, and auscultation of TMJ sounds, such as clicking and crepitus), but also social and economic factors (ie, education level, income, age, etc), psychosocial variables (ie, depression and somatization with or without pain), and chronic pain disability measured by Axis II. It is often used for standardizing data collection, for the replication of studies, and for the comparison of data from different studies.<sup>5</sup>

The RDC/TMD Axis I diagnostic criteria are based on a careful clinical examination for the traditional signs and symptoms of TMD and a structured diagnosis of the most common articular disorders and/or muscular disorders affecting the TMJ and/or masticatory muscles: Group I = myofascial pain; Group II = disc displacements, and Group III = arthralgia/osteoarthritis/osteoarthrosis. Those without a TMD diagnosis from Axis I were the controls for each diagnostic group.<sup>5</sup>

Axis II was used to assess social/demographic variables in both the TMD and control groups. In addition, Axis II classification of pain intensity and disability was assessed using the Graded Chronic Pain Severity (GCPS): Grade 0 = absence of pain in the last 6 months; Grade I = low-intensity pain, Grade II = high-intensity pain; Grade III = moderate functional limitation; and

Grade IV = severe functional limitation.<sup>5</sup> Subjects with a GCPS of I to IV were considered TMD patients, while those with a GCPS of 0 were considered controls.<sup>4</sup>

Both Axes I and II of the Brazilian Portuguese version of the RDC/TMD were used, which has been tested for reproducibility (Cronbach's  $\alpha = .72$ ) and concurrent validity for part of the RDC/TMD Axis II (kappa values from 0.73 to 0.91).<sup>6</sup> The RDC/TMD was used over the Diagnostic Criteria for TMD (DC/TMD) because it was the only translated and validated questionnaire for TMD assessment and diagnosis in Brazilian Portuguese available during the time of the data collection, between August 2011 and July 2012.<sup>6</sup>

The Sleep Assessment Questionnaire (SAQ) was used for sleep disorder assessment, considering that it has been validated against polysomnography (Cronbach's  $\alpha = .71$ ). It has 17 items assessing the presence and frequency (ie, never, seldom, sometimes, always) of the following sleep disorders: insomnia; nonrestorative sleep; sleep schedule disorders; daytime sleepiness; sleep apnea; and restlessness. The higher the score, the worse the sleep quality. The overall (global) score can range from 0 to 68, with a positive diagnostic cutoff score of  $\geq 16$ .<sup>7,8</sup>

### Research Protocol: Pilot Study and Quality Control, History and Clinical Examination, and Blinding

For quality control, 10% of the total sample (random selection) underwent a phone interview with a few variables (questions 23 to 29) of the RDC/TMD Axis II in order to assess the accuracy and whether the actual research results remained with little variation over time.<sup>9</sup>

One experienced clinical examiner, trained following the RDC/TMD Axis I criteria, performed the clinical examination in the whole sample (L.B.P.). The intra-examiner kappa index has been shown to be similar or higher than the inter-examiner reliability for trained examiners.<sup>5</sup> A pilot study with 20 interviews and clinical examinations was carried out in Maringá's SUS-selected users in order to assess the clinical examination time and problems in the fieldwork.<sup>4</sup> A brief clinical examination (dichotomous diagnosis: presence or absence) was then performed prior to examination via Axis I to check for visible oral diseases in the oral mucosa and teeth (eg, ulcerations, oral lesions, caries, or periodontal disease). When positive, subjects were excluded from the study and referred to the Ingá Faculty of Dentistry.

Patients were contacted and handed the questionnaires by a second examiner, who was blinded to the self-completed questionnaires and instructed not to question patients about the research instruments. The database was created by a third examiner blinded to the patients' identities.

## Data Analysis and Sample Size Calculation

The estimated sample size for TMD prevalence and correlated variables was calculated from the total percentage of Maringá's SUS-registered and actual users ( $n = 132,620$ ) between 20 and 65 years of age. This yielded a partial sample size of 806 subjects (95% confidence interval [CI], 5% anticipated TMD prevalence, 1.5% of margin of error), which was increased to 1,365 for the case-control part of the study. The final calculated sample was 1,775 due to a 30% increase to compensate for recruitment loss and missing values.<sup>10</sup> Data analyses were performed with SPSS v. 18, and Student *t* test and Pearson chi-square test were used for continuous and categorical (dichotomous) data analyses, respectively.

## RESULTS

In the final sample, 1,643 individuals were selected (recruitment = 92.56%), as shown in Table 1. The majority of the sample were women (65.9%), young to middle-aged adults (84.7%), married or single (90.6%), Caucasian (70.1%), with a Brazilian medium income (75.1%) and high school education or higher (79.9%).

Tables 2 and 3 show cross-tabulations between sleep disorders and the RDC/TMD Axis II and I classifications, respectively. In Table 2, there was a high or very high statistically significant difference ( $P < .01$  or  $P < .001$ ) in the RDC/TMD Axis II scores between TMD subjects and controls, showing much worse levels of all sleep disorders in the TMD group, analyzed in both continuous and categorical analyses. TMD subjects had a high prevalence of sleep disorders in all SAQ diagnostic groups: 72.1% had global sleep disorders; 37.5% had insomnia; 47.2% had nonrestorative sleep; 60% had sleep schedule disorders; 26.6% had daytime sleepiness; 24.7% had sleep apnea; and 46.6% had restlessness.

In Table 3, in the RDC/TMD Axis I analysis, myofascial pain and arthralgia/osteoarthritis/osteoarthritis (Groups I and III, respectively) also had significantly ( $P < .01$  or  $P < .001$ ) worse levels of sleep disorders than asymptomatic controls. In contrast, subjects with disc displacements (Group II) showed no significant difference in most sleep disorders analyzed compared to controls, except for nonrestorative sleep and restlessness, where marginal significant differences were found ( $P < .05$ ). These results were identical in both the continuous and categorical analyses of all variables analyzed, with the exception of restlessness in Group II. The prevalence range of sleep disorders was also high for all three Axis I diagnostic groups: 57.9% to 73.1% had global sleep disorders; 23.8% to 40.9% had insomnia; 37.3% to 51.2% had nonrestorative sleep; 57.9% to 62.6% had sleep schedule disorders; 25.4% to 29.1% had daytime sleepiness; 19.8% to 24.2% had sleep apnea; and 42.9% to 46.7% had restlessness.

**Table 1** Social and Demographic Description of the Sample Extracted from the Population of the City of Maringá, Users of the Brazilian Public Health System (N = 1,643)

Variables	No.	(%)
<b>Gender</b>		
Male	561	34.1
Female	1,082	65.9
<b>Age groups</b>		
< 20 y	137	8.3
20–29 y	620	37.7
30–39 y	493	30.0
40–49 y	280	17.0
50–59 y	106	6.5
≥ 60 y	7	0.4
<b>Marital status</b>		
Married	795	48.4
Single	693	42.2
Divorced/widowed	155	9.4
<b>Ethnicity</b>		
Caucasian	1,152	70.1
Black/black mixed	387	23.6
Asian or native	104	6.3
<b>Monthly family income (Brazilian reais)*</b>		
High (≥ 3,000.00)	208	12.7
High medium (1,000.00 – 2,999.00)	576	35.1
Low medium (500.00 – 999.00)	658	40.0
Low (< 500.00)	201	12.2
<b>Education level</b>		
Complete postsecondary certificate/diploma	405	24.7
Incomplete postsecondary certificate/diploma	398	24.2
Complete high school	509	31.0
Incomplete high school	170	10.3
Elementary school	161	9.8

\*Based on the Brazilian Institute of Geography and Statistics exchange rate with the US dollar = 3.94 (19 April, 2019).

## DISCUSSION

Subjects with TMD diagnosed by the RDC/TMD in both Axes I and II had significantly worse levels and higher prevalence of sleep disorders measured by the SAQ than asymptomatic controls. Sleep disorders were directly related to the higher pain intensity found in TMD subjects with myofascial pain and arthralgia/osteoarthritis/osteoarthritis, as compared to subjects with lower pain intensity found in disc displacements, where no difference was found between TMD subjects and asymptomatic controls in most sleep disorders.

This is in line with the current literature. A longitudinal, multi-center study has also found that in subjects reporting subjective fairly or very bad sleep quality as measured by the Pittsburgh Sleep Quality Index, the risk of developing TMD was increased by 2.11 times. In addition, in subjects with a high likelihood of having obstructive sleep apnea, the risk of TMD development was increased by 2.29 times.<sup>11</sup> However, most studies reported in the literature neither used the RDC/TMD

**Table 2** Continuous and Categorical Data Analyses of TMD Subjects<sup>a</sup> Based on the RDC/TMD Axis II

SAQ scores (continuous and categorical analyses)	TMD, Axis II (n = 595)	Controls, Axis II (n = 1,048)	P
<b>Global score (0–68)</b>			
Mean (SD)	21.82 (9.95)	15.62 (8.32)	< .001 <sup>b</sup>
<b>Global score (0–68), %</b>			
Absent (< 16)	27.9	51.8	< .001 <sup>c</sup>
Present (≥ 16)	72.1	48.2	
<b>Insomnia (0–20)</b>			
Mean (SD)	7.93 (3.92)	5.56 (3.48)	< .001 <sup>b</sup>
<b>Insomnia (0–20), %</b>			
Absent (< 10)	62.5	85.3	< .001 <sup>c</sup>
Present (≥ 10)	37.5	14.7	
<b>Nonrestorative sleep (0–12)</b>			
Mean (SD)	4.53 (2.59)	2.72 (2.25)	< .001 <sup>b</sup>
<b>Nonrestorative sleep (0–12), %</b>			
Absent (< 5)	52.8	81.8	< .001 <sup>c</sup>
Present (≥ 5)	47.2	18.2	
<b>Schedule disorders (0–12)</b>			
Mean (SD)	3.73 (2.90)	3.28 (2.74)	< .01 <sup>b</sup>
<b>Schedule disorders (0–12), %</b>			
Absent (< 3)	40.0	47.2	< .01 <sup>c</sup>
Present (≥ 3)	60.0	52.8	
<b>Daytime sleepiness (0–8)</b>			
Mean (SD)	1.68 (1.80)	1.16 (1.41)	< .001 <sup>b</sup>
<b>Daytime sleepiness (0–8), %</b>			
Absent (< 3)	73.4	83.8	< .001 <sup>c</sup>
Present (≥ 3)	26.6	16.2	
<b>Sleep apnea (0–8)</b>			
Mean (SD)	1.46 (1.80)	1.16 (1.60)	< .01 <sup>b</sup>
<b>Sleep apnea (0–8), %</b>			
Absent (< 2)	75.3	82.6	< .001 <sup>c</sup>
Present (≥ 2)	24.7	17.4	
<b>Restlessness (0–8)</b>			
Mean (SD)	2.47 (1.90)	1.71 (1.58)	< .001 <sup>b</sup>
<b>Restlessness (0–8), %</b>			
Absent (< 2)	53.4	72.9	< .001 <sup>c</sup>
Present (≥ 2)	46.6	27.1	

Axis II is in cross-tabulation with the Sleep Assessment Questionnaire (SAQ) in the following sleep disorders: global score; insomnia; nonrestorative sleep; sleep schedule disorders; daytime sleepiness; sleep apnea; and restlessness. SD = standard deviation.

<sup>a</sup>TMD cases = Graded Chronic Pain Severity (GCPS) of I, II, III, or IV; Controls = GCPS of 0.

<sup>b</sup>Student *t* test.

<sup>c</sup>Linear-by-linear association.

nor the DC/TMD as diagnostic tools for TMD, or when they were used, did not employ both Axes I and II; therefore, longitudinal studies from the general population using both Axes I and II are still needed in order to confirm these findings.<sup>3</sup>

## CONCLUSIONS

Subjects with TMD had worse sleep disorders, particularly in diagnostic groups with higher pain/disability levels.

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**Table 3** Continuous and Categorical Data Analyses of TMD Subjects Based on the RDC/TMD Axis I<sup>a</sup>

SAQ scores (continuous and categorical analyses)	Group I			Group II			Group III		
	TMD Axis I (n = 484)	Control Axis I (n = 1,159)	P	TMD Axis I (n = 126)	Control Axis I (n = 1,517)	P	TMD Axis I (n = 470)	Control Axis I (n = 1,173)	P
<b>Global score (0–68)</b>									
Mean (SD)	22.38 (10.45)	15.98 (8.27)	< .001 <sup>b</sup>	18.66 (9.71)	17.80 (9.40)	NS <sup>b</sup>	21.52 (10.63)	16.40 (8.47)	< .001 <sup>b</sup>
<b>Global score (0–68), %</b>									
Absent (< 16)	26.9	50.0	< .001 <sup>c</sup>	42.1	43.2	NS <sup>c</sup>	31.1	48.0	< .001 <sup>c</sup>
Present (≥ 16)	73.1	50.0		57.9	56.8		68.9	52.0	
<b>Insomnia (0–20), %</b>									
Mean (SD)	7.94 (3.99)	5.78 (3.56)	< .001 <sup>b</sup>	6.47 (3.89)	6.41 (3.82)	NS <sup>b</sup>	7.62 (4.01)	5.93 (3.64)	< .001 <sup>b</sup>
<b>Insomnia (0–20), %</b>									
Absent (< 10)	59.1	84.6	< .001 <sup>c</sup>	76.2	77.1	NS <sup>c</sup>	64.3	82.2	< .001 <sup>c</sup>
Present (≥ 10)	40.9	15.4		23.8	22.9		35.7	17.8	
<b>Nonrestorative sleep (0–12)</b>									
Mean (SD)	4.74 (2.78)	2.80 (2.19)	< .001 <sup>b</sup>	3.80 (2.62)	3.34 (2.53)	< .05 <sup>b</sup>	4.40 (2.78)	2.96 (2.31)	< .001 <sup>b</sup>
<b>Nonrestorative sleep (0–12), %</b>									
Absent (< 5)	48.8	80.7	< .001 <sup>c</sup>	62.7	72.0	< .05 <sup>c</sup>	53.6	78.3	< .001 <sup>c</sup>
Present (≥ 5)	51.2	19.3		37.3	28.0		46.4	21.7	
<b>Schedule disorders (0–12)</b>									
Mean (SD)	3.96 (2.94)	3.23 (2.72)	< .001 <sup>b</sup>	3.50 (2.86)	3.44 (2.80)	NS <sup>b</sup>	3.88 (2.89)	3.27 (2.75)	< .001 <sup>b</sup>
<b>Schedule disorders (0–12), %</b>									
Absent (< 3)	37.4	47.6	< .001 <sup>c</sup>	42.1	44.8	NS <sup>c</sup>	38.1	47.2	< .01 <sup>c</sup>
Present (≥ 3)	62.6	52.4		57.9	55.2		61.9	52.8	
<b>Daytime sleepiness (0–8)</b>									
Mean (SD)	1.80 (1.88)	1.16 (1.40)	< .001 <sup>b</sup>	1.50 (1.63)	1.34 (1.58)	NS <sup>b</sup>	1.75 (1.82)	1.19 (1.44)	< .001 <sup>b</sup>
<b>Daytime sleepiness (0–8), %</b>									
Absent (< 3)	70.9	83.9	< .001 <sup>c</sup>	74.6	80.5	NS <sup>c</sup>	71.5	83.5	< .001 <sup>c</sup>
Present (≥ 3)	29.1	16.1		25.4	19.5		28.5	16.5	
<b>Sleep apnea (0–8)</b>									
Mean (SD)	1.46 (1.82)	1.19 (1.62)	< .01 <sup>b</sup>	1.19 (1.52)	1.28 (1.70)	NS <sup>b</sup>	1.48 (1.84)	1.19 (1.61)	< .01 <sup>b</sup>
<b>Sleep apnea (0–8), %</b>									
Absent (< 2)	75.8	81.7	< .01 <sup>c</sup>	80.2	80.0	NS <sup>c</sup>	76.0	81.6	< .05 <sup>c</sup>
Present (≥ 2)	24.2	18.3		19.8	20.0		24.0	18.4	
<b>Restlessness (0–8)</b>									
Mean (SD)	2.45 (1.87)	1.79 (1.64)	< .001 <sup>b</sup>	2.18 (1.55)	1.97 (1.75)	NS <sup>b</sup>	2.35 (1.84)	1.84 (1.67)	< .001 <sup>b</sup>
<b>Restlessness (0–8), %</b>									
Absent (< 2)	53.3	71.1	< .001 <sup>c</sup>	57.1	66.6	< .05 <sup>c</sup>	56.2	69.7	< .001 <sup>c</sup>
Present (≥ 2)	46.7	28.9		42.9	33.4		43.8	30.3	

Axis I groups are in cross-tabulation with the Sleep Assessment Questionnaire (SAQ) in the following sleep disorders: global score; insomnia; nonrestorative sleep; sleep schedule disorders; daytime sleepiness; sleep apnea; and restlessness. NS = nonsignificant; SD = standard deviation.

<sup>a</sup>TMD groups: Group I = myofascial pain; Group II = disc displacements; Group III = arthralgia/osteoarthritis/osteoarthritis;

Controls = without the respective group TMD diagnosis.

<sup>b</sup>Student *t* test.

<sup>c</sup>Linear-by-linear association.

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