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The Influence of Degrees of Severity of Temporomandibular Dysfunction on Report of Vestibular Symptoms – A Cross-Sectional Study

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ABSTRACT

Introduction: Due to the anatomical proximity and functional connection, vestibular symptoms (VS) are common in temporomandibular disorders (TMD). However, it is not known whether the degree of severity of TMD affect the report of associated vestibular symptoms.
Objective: To evaluate associations of demographic, clinical and functional factors, as well as report of VS, with the severity of TMD.
Method: Cross-sectional study carried out at a higher education institution in Salvador, Bahia, Brazil. After approval by the Ethics Committee of Hospital Santo Antônio (CAAE 81517317.2.0000.0047), the collection team applied the Dizziness Handicap Inventory (DHI), the Fonseca Anamnestic Questionnaire (QAF) and the Research Diagnostic Criteria for Temporomandibular Disorders axis II questions (RDC/TMD) in employees, teachers and students. Statistical tests of association with the Chi-square, t test for independent samples and ANOVA (alpha 5% and 80% power) were performed.
Results: The sample of 623 participants identified 333 (63.7%) people with TMD and 418 (79.9%) with VS. Females were associated with both temporomandibular dysfunction and vestibular symptoms. The degree of severity of the TMD showed a strong correlation with VS ($p < 0.001$).
Conclusion: In the studied sample, it was observed that the greater the degree of severity of the TMD, the greater the VS, which confirms the need to evaluate both systems in symptomatic patients for each of the clinical conditions.

KEYWORDS
Vestibulopathies; temporomandibular disorders; prevalence; dizziness

Introduction

Temporomandibular disorder (TMD) designates a group of health conditions that affect the temporomandibular joint (TMJ), masticatory muscles and associated structures [1]. The prevalence of TMD in adults affects about 50% of the world population [2]. Its etiology is complex and multifactorial, and may be associated with a combination of psychological, physiological, structural, postural and genetic factors [3,4]; and with morphofunctional, neuromuscular, traumatic, degenerative and sociodemographic aspects.

Individuals with TMD may present orofacial pain in the preauricular region and masticatory muscles, in addition to headaches mostly classified as tension headaches, cervicogenic, and migraine [5,6]. Vestibular disorders are also prevalent in the general population, affecting 20–30% of adults [7]. Vestibular Symptoms (VS) include, vertigo, tinnitus and imbalance, ear pain or earache, a sensation of ear fullness, reduced hearing acuity or hearing loss, tinnitus, dizziness and vertigo [5]. These symptoms mentioned above are often related to disorders of the vestibular system, whose function is to promote spatial orientation and balance of the human body [5].

The prevalence of otologic symptoms in the world population ranges from 10 to 31%, but it increases to 85% in patients with TMD [8]. Due to the anatomical proximity and functional connection, some signs and symptoms are common in temporomandibular and vestibular disorders [6]. Both TMD and isolated VS generate symptoms that affect the quality of life of those affected [5,9]. The presence of both these conditions can, therefore, potentiate symptoms and have a more intense impact on quality of life [9].

Despite these epidemiological findings, it is not known whether the degree of TMD in persons influences the report of VS. Their identification can help create preventive, therapeutic and health rehabilitation strategies for people who suffer from these problems. Therefore, this study aimed to test the hypothesis that the greater the degree of severity of TMD, the greater the associated vestibular signs and symptoms.

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Methods

A cross-sectional observational study was conducted according to the STROBE checklist for sectional studies (available https://www.strobe-statement.org/checklists/) at a higher education institution in Salvador, Bahia, Brazil. It is a private institution with 3,100 university students, 322 professors and 259 technical-administrative employees.

The research was approved by the Research Ethics Committee of the Hospital Santo Antônio, Obras Sociales Irmã Dulce (CAAE 81517317.2.0000.0047; opinion 3,017,541), and followed all the recommendations of the National Health Council of Brazil and the Declaration of Helsinki for research involving beings humans.

Volunteers over 18 years of age, male and female gender, with a regular relationship with the institution (students with active enrollments and employees registered in the human resources department) and who signed an informed consent form, were included. Individuals with difficulties in understanding the instruments applied, expressed in more than 10% of the answers to the blank questionnaires, were excluded. Answers were left blank after repeating the same question three times by the examiner.

Between March and August 2018, the previously trained collection team applied a sociodemographic questionnaire developed by the authors, the Dizziness Handicap Inventory (DHI) (α = 0.89) [10], the Fonseca Anamnestic Questionnaire (QAF) and Axis II questions of the Research Diagnostic Criteria for Temporomandibular Disorders (DC/TMD).

The Brazilian version of the Dizziness Handicap Inventory (DHI) [11] aims to assess the influence of dizziness on the quality of life, considering the physical, functional and emotional aspects of each individual. In this instrument, the final score will be obtained by the sum of the points obtained in all aspects, with a minimum score of 0 and a maximum of 100 points. The option 'yes' (4 points) should be marked by the presence of severe symptoms and difficulties, while the options 'sometimes' (2 points) and 'no' (0 points) should be marked, respectively, by the occasional presence. and absence of these same symptoms and difficulties.

The QAF proposes to characterize the severity of TMD symptoms, classifying them into four categories: no TMD (0 to 15 points), mild TMD (20 to 40 points), moderate (45 to 65 points) or severe (70 to 100 points) [12]. The QAF was tested in patients with TMD, thoroughly and obtained a correlation of 95% with the clinical index of Helkimo, which was one of the pioneers in the evaluation of questionnaires for TMD. Questions number 23 to number 30 of the Brazilian version of the DC/TMD were used to indicate the presence of TMD signs and symptoms.

The criteria used to identify participants with vestibular symptoms were the presence of at least one symptom, such as dizziness, imbalance, tinnitus or nystagmus. Temporomandibular symptoms, on the other hand, were defined by the presence of at least two classic signs and/or symptoms of TMD, being essential the symptom of orofacial pain in the last month or the presence of a joint noise.

The data obtained with the applied instruments were tabulated and analyzed using the Statistical Package for Social Sciences (SPSS) version 26.0 for Windows. Statistical tests of association with the Chi-square, *t*-test for independent samples and ANOVA (alpha 5% and 80% power) were performed.

To examine the association between the sociodemographic profile of the sample regarding age, gender, marital status, self-reported skin color and function at the institution with the degrees of severity of the temporomandibular disorder (Fonseca anamnestic questionnaire), a chi-square test was used. To test the sociodemographic differences in total scores and physical, functional and emotional subscales obtained using the Brazilian version of the Dizziness Handicap Inventory (DHI), independent sample *t*-test or ANOVA (depending on groups size) were used. ANOVA was also used to compare the differences of the severity degrees of temporomandibular disorders (Fonseca anamnestic questionnaire) among the subscales of the Brazilian version of the Dizziness Handicap Inventory. Concerning missing values, pairwise deletion was chosen to handle missing data since its probability on the dependent variable is unrelated to other independent variables as well as the dependent variable itself [13].

The sample size was calculated using the Lee calculator (Epidemiology and Statistics Laboratory of the University of São Paulo) and determined a minimum number of 339 participants. For this, a study was used the whose prevalence of dizziness was 85% in a population of 20 university students with TMD [14], with a margin of error and absolute estimation precision of 5% and a confidence level of 99%.

Results

623 volunteers were interviewed, of which 267 (52.9%) were students, 87 (17.2%) were teachers, 93 (18.4%) were administrative staff and 58 (11.5%) were general service assistants. The average age of the sample was 28.6 ± 9.6 years in which women (61.7 %), brown (43.5%), black (36.9%) and single (76.3%) prevailed. The characterization of the sample is described in Table 1.

Of the 523 study participants, 332 (63.4%) were classified as having TMD by the QAF, most of them with light TMD (50.3%). As for vestibular signs and

Table 1. Characterization of the sample of a higher education institution in Salvador, Bahia, Brazil.

Sample Features N %			
Age range (n = 492)			
	18y to 21y	135	27.4
	22y to 25y	124	25.2
	26y to 34y	115	23.4
	35y to 65y	118	24.0
Gender (n = 509)			
	Male	195	38.3
	Feminine	314	61.7
Marital status (n = 502)			
	Not married	383	76.3
	Married	102	20.3
	Separated/Divorced	17	3.4
Skin Color (n = 501)			
	White	79	15.8
	Yellow	17	3.4
	Red	2	0.4
	Dun	218	43.5
	Black	185	36.9
University Function (n = 505)			
	Student	267	52.9
	Teacher	87	17.2
	Administrative Technician	93	18.4
	General Services	58	11.5
TMD* (n = 332)			
	Without TMJ	89	26.8
	Light TMJ	167	50.3
	Moderate TMJ	57	17.2
	Severe TMJ	19	5.7
DHI(n = 505)**		**Average**	**Standard deviation**
	Total	10.2	14.4
	Physical aspects	3.6	4.7
	Emotional aspects	4.0	6.3
	Functional aspects	2.0	4.0

**Temporomandibular Dysfunction; **Dizziness Handicap Inventory; Legend: Physical aspects – questions 1, 4, 8, 11, 13, 17 and 25; Functional aspects – questions 3, 5, 6, 7, 12, 14, 16, 19 and 24; Emotional aspects – questions 2, 9, 10, 15, 18, 20, 21, 22 and 23.*

symptoms, 418 (79.9%) participants reported dizziness, tinnitus or nystagmus, alone or in the association. The association between VS and QoL was then analyzed, with no significant association ($p > 0.05$) according to the DHI. Crossing sociodemographic variables with VS, using the Chi-square test (bivariate analysis), associations were identified between VS of head movement with female gender ($p < 0.001$), with young adults aged between 18 and 25 years ($p < 0.001$) and in students ($p < 0.001$). The presence of tinnitus was associated with singles and separated ($p < 0.001$).

When performing an analysis on the association between degrees of TMD and sociodemographic variables (Table 2), an association with gender ($p = 0.002$) and with brown and black skin color ($p = 0.006$) was confirmed.

When comparing the DHI scores with the sociodemographic variables, associations of the total score and the physical and functional domains with female gender were identified; in addition to the teaching function with all domains (physical, functional and emotional) and with the total score (Table 3).

When comparing TMD degrees by QAF with DHI scores, it was found that all domains were significantly associated with TMD severity (Figure 1).

Discussion

This cross-sectional study confirmed the hypothesis that the greater the degree of TMD severity, the greater the number of reported VS. In a sample of adults from a higher education institution, it was found that both in students, as well as in professors and employees who attend TMD, symptoms of dizziness, vertigo, tinnitus and balance problems are found, and vice versa.

The prevalence of TMD (63.7%) and VS (79.9%) can be considered high in this sample. This result is similar to that found in the study by Machado et al. [14] who observed a prevalence of 85% of TMD and 75% of otological symptoms in a sample of 20 women. Corroborating the conclusions of Silveira et al. [15], our findings confirm that more than 50% of the population has at least one sign and/or symptom of TMD.

Table 2. Analysis of the association of sociodemographic variables (age group, gender, marital status, skin color and function) (%) with the degrees of severity of the temporomandibular disorder (N = 333).

		Without TMD	Light TMJ	Moderate TMJ	Severe TMJ	p^a
Gender	Male	49.4	32.9	28.1	10.5	**0.002**
	Feminine	50.6	67.1	71.8	89.5	
Age Range	18–21	20.7	34.0	30.2	33.3	0.251
	22–25	23.0	27.2	32.1	38.9	
	26–34	32.2	20.4	22.6	16.7	
	35–65	24.1	18.5	15.1	11.1	
Marital status	Not married	75.9	83.6	82.5	72.2	0.172
	Married	20.7	16.4	14.0	27.8	
	Divorced	3.4	0.0	3.5	0.0	
Skin Color	White	10.2	12.8	10.7	22.2	**0.006**
	Yellow	2.3	3.0	8.9	5.6	
	Dun	52.3	43.3	35.7	44.4	
	Black	35.2	40.9	44.6	22.2	
	Red	0.0	0.0	0.0	5.6	
Occupation	Student	43.8	61.2	66.1	63.2	0.175
	Teacher	9.0	5.5	5.4	10.5	
	Administrative	32.6	20.6	21.4	10.5	
	General Services	14.6	12.7	7.1	15.8	

a = chi-square test; TMD = temporomandibular disorder

Table 3. Analysis of the association of independent variables (age group, gender, marital status, skin color, function) through mean values, the standard deviation of total scores and physical, functional and emotional subscales obtained using the Brazilian version of the Dizziness Handicap Inventory (DHI).

		DHI score	Physical DHI	Functional DHI	Emotional DHI
		M± DP	**M± DP**	**M± DP**	**M± DP**
Gender	**Male**	7.64 ± 12.0	2.47 ± 4.09	3.21 ± 5.35	1.23 ± 0.92
	Feminine	11.8 ± 15.6	4.30 ± 4.84	4.45 ± 6.79	2.40 ± 0.83
	p^a	**0.001**	**<0.001**	**0.032**	0.372
Marital status	**Not married**	7.90 ± 8.91	3.80 ± 3.32	4.20 ± 5.61	2.20 ± 3.58
	Married	6.74 ± 7.76	2.75 ± 2.61	1.75 ± 2.49	1.14 ± 2.69
	Divorced	11.25 ± 10.99	2.33 ± 3.20	5.00 ± 7.56	1.47 ± 3.03
	p^b	0.221	0.615	0.493	0.793
Skin Color	**White**	7.80 ± 8.05	3.64 ± 3.56	4.91 ± 6.22	1.64 ± 2.34
	Yellow	5.25 ± 5.43	4.00 ± 1.74	4.00 ± 1.12	6.00 ± 1.42
	Dun	7.65 ± 8.80	2.89 ± 2.84	3.11 ± 5.11	1.75 ± 4.20
	Black	8.13 ± 9.44	1.33 ± 1.16	NA	0.67 ± 1.16
	Red	11.00 ± 4.24	NA	NA	NA
	p^b	0.764	0.705	0.579	0.530
Occupation	**Student**	12.1 ± 15.4	4.39 ± 4.91	4.56 ± 6.74	2.32 ± 4.20
	Teacher	5.52 ± 10.1	2.21 ± 3.59	2.02 ± 4.52	0.92 ± 2.35
	Administrative	8.61 ± 13.1	3.00 ± 4.50	3.23 ± 5.35	1.89 ± 3.91
	General Services	10.5 ± 15.9	2.85 ± 4.47	5.26 ± 7.37	2.59 ± 5.25
	p^b	**0.002**	**<0.001**	**0.003**	**.0.028**

a = t-test for independent samples; b = Anova; NA = not applicable since there was no response to these items; DHI = Dizziness Handicap Inventory.

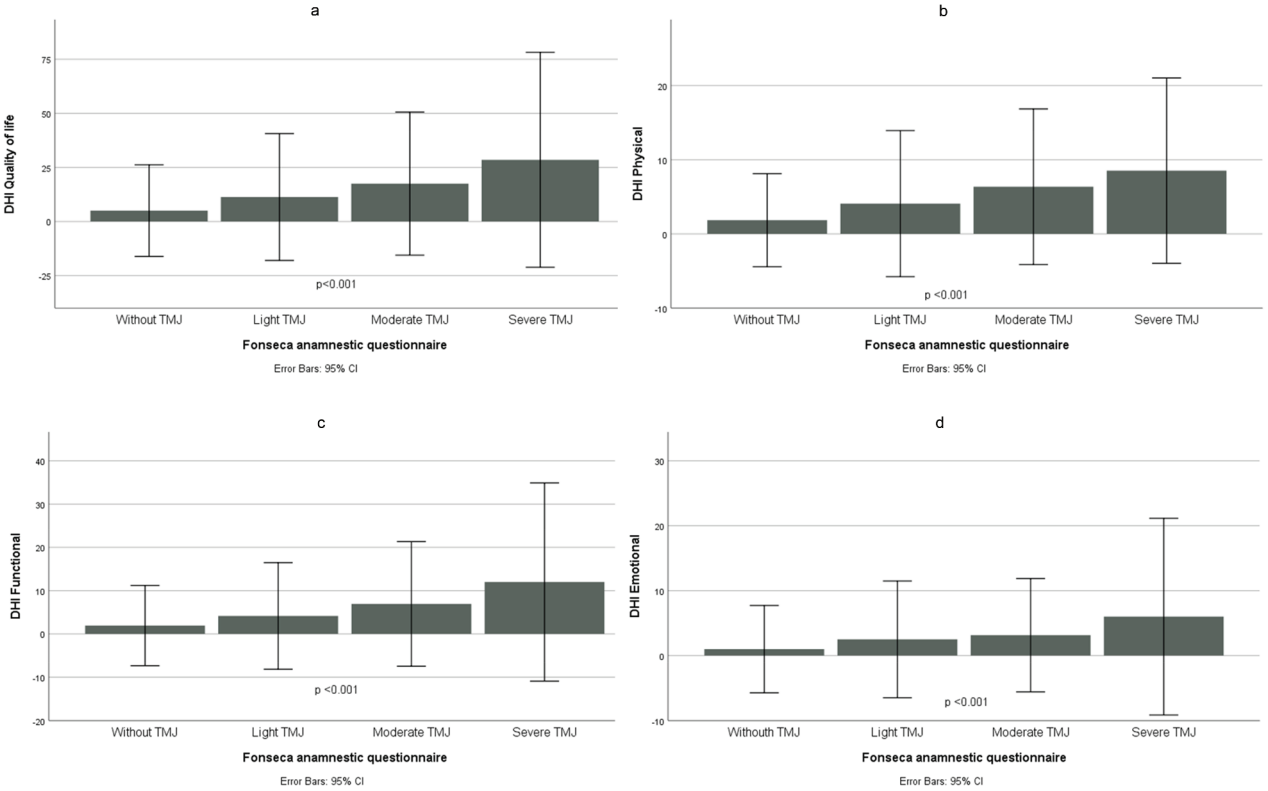

Figure 1. Comparison of the severity degrees of temporomandibular disorders (Fonseca anamnestic questionnaire), with the Brazilian version of the Dizziness Handicap Inventory (n = 418) in quality of life (A), physical (B), functional (C) and emotional (D) dimensions.

Regarding dizziness, the results of several studies reveal a high prevalence in the world population, which agrees with our findings [16–18]. Also, Paulino et al. [19] found, in a sample similar to the present study, that 89.8% of the participants presents some level of TDM, of which 50.2% had mild TMD, 33.0% moderate and only 6.6% severe.

Despite being highly prevalent, vestibular symptoms did not significantly affect the quality of life of the participants. It worth to remark that dizziness can be a symptom of vestibular dysfunction as well as many other conditions However, the literature describes that many people with dizziness restrict their daily and leisure activities, to reduce the risk of

this unpleasant and frightening symptom, as well as to avoid the social embarrassment and stigma they can cause [20]. In addition, it generates physical and emotional problems, which can cause an incapacity to perform professional, social and domestic activities [20,21]. A sample with so many university students may have influenced this result, demanding caution in its interpretation.

The highest prevalence of TMD in females found in the present study coincides with previous data [1,22–24]. This finding can be explained by the sum of anatomical and psychosomatic factors [23]. Still, on sociodemographic data, the mean age of participants with TMD was 28.6 years and agrees with authors who reported that the prevalence of TMD is higher between 20 and 45 years, that is, among young people and adults [17,23].

VS in this sample, although more present in women, in agreement with previous data [25,26], affected more young adults. It is noteworthy that the convenience sample of a population involving university students limits the extrapolation of results, requiring that future population-based studies confirm this finding.

The greater the degree of severity of the TMD, both assessed by the QAF and by the RDC/TMD questions, the more symptoms of involvement of the vestibular system were found, which is aligned with a recent review conducted by Hernández-Nuño de la Rosa et al. [27]. This finding confirms several results of previous studies that reveal that patients with pathognomonic signs of TMD are at increased risk of hearing complaints [15,28,29]. However, Machado et al. [14] bring results that do not show statistical correlations between VS and TMD. The exclusive sample of 20 women with otoneurological symptoms likely failed to reveal this association that our findings and other previous studies have revealed.

Considering the social and functional limitations that can be caused by VS, with unpleasant debilitating sensations and causes of social isolation [18], it is possible that living with TMD can potentiate the symptoms and make the therapeutic approach difficult. Since there is no specific treatment, a review shows that conservative or reversible TMD therapy can provide relief, but with low evidence. However, the close relationship of a multi-professional team is essential to achieve the best recovery of the patient [30,31]. For this reason, it is necessary to investigate these symptoms from an early and insignificant stage.

Limitations of the study

These results demonstrate important findings for clinical practice and research, confirming that VS and TMD can coexist. However, the nonuse of a validated questionnaire for the diagnosis of TMD, such as the RDC/TMD, but only some of its questions, made it impossible to obtain a score for analysis and may have been a limiting factor for this work. When data were collected, this instrument was not used, as it is an extensive questionnaire that would make the application even more difficult, prolonging the response time, and increasing the risk of fatigue and indisposition for the participants. However, as a review of an existing database was carried out, it was not possible to have access to individuals to apply the questionnaire in full and perform a physical analysis.

Another point was to use the Fonseca Anamnestic Index, which has only been validated in Brazil but is a simple, easy-to-understand questionnaire, which favors its use in studies, especially in population epidemiological studies, to classify the degree of severity of the disease, signs and symptoms of TMD, but not the diagnosis of this dysfunction. In addition, there are not many questionnaires that assess the impact of TMD severity on patients' complaints.

Additional research is needed to further study the otological symptoms in patients with TMD, to assess the specific etiology of the combination of vestibular and temporomandibular symptoms, encompassing the probable causes of each condition, which may be isolated or simultaneously.

Conclusion

It can be concluded from the results of this study that the greater the degree of severity of the TMD, the greater number of reported VS. This underscores the importance of adding examination of the vestibular system in patients with TMD, as well as the examination of the temporomandibular function in people with vestibular disorders. This also points to the need for multidimensional prevention, treatment and rehabilitation. Observational population-based studies and clinical trials are necessary to strengthen the conclusion of these results. In addition, it is essential to empower the population about signs and symptoms of TMD and vestibular disorders.

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