

The impact of tinnitus on the quality of life in patients with temporomandibular dysfunction

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Abstract

Introduction: The most common otological symptoms in patients with temporomandibular disorders (TMD) are ear fullness, tinnitus and ear pain. **Objective:** To evaluate the impact of tinnitus on the quality of life for patients with TMD. **Method:** This is a quantitative, cross-sectional retrospective study. The sample consisted of 19 individuals with TMD, 17 (89.47%) females and 2 (10.53%) male, mean age 53.5 years. Data collection consisted of: anamnesis, pure tone audiometry, acuphenometry and application of the Portuguese version of the Tinnitus Handicap Inventory (Brazilian THI). **Results:** 63.12% had had tinnitus for less than five years, and 15.79% had tinnitus that sounded like whistling, rain and/or a cricket. There was a predominance of laterality in the right ear (42.11%). 52.63% of the subjects reported that their tinnitus is continuous, while 31.58% stated that it lasts for days, and 47.37% report that it is common. The audiometry revealed mean audiometric thresholds above 25 dB HL in the high frequencies (3000, 4000, 6000 and 8000 Hz) bilaterally. In acuphenometry, the average loudness of the tinnitus was 21 dB SL the right ear and 17.85 dB SL in the left ear, and the average tinnitus pitch was 3775 Hz in the right ear and 3750 Hz in the left ear. The total THI score was 37.8 points. It appears that there is significant correlation between the THI scale, time of tinnitus duration and its occurrence. **Conclusion:** Tinnitus reported in patients with TMD caused moderate impact on quality of life and can be seen in the presence of background noise although daily activities can still be performed.

Keywords: temporomandibular joint dysfunction syndrome, tinnitus, pain clinics.

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INTRODUCTION

Tinnitus is the third worst problem that can affect human beings, which corresponds to 20% of cases, second only to pain and severe intractable dizziness^{1,2}. Questionnaires used to assess the impact of tinnitus show that it can represent a big nuisance for those who suffer from it and affect their quality of life²⁻⁴.

In the neurophysiological model⁵, tinnitus results from abnormal processing of sound generated in the auditory system. This erroneous processing occurs before the sound is perceived centrally. Tinnitus is the result of continuous firing of cochlear fibers to the brain due to hyperactivity of the hair cells, or permanent damage to these cells, which creates a phantom sound transmitted to the brain that is heard as a real sound.

Tinnitus is a subjective symptom and is characterized by the presence of one or more sounds perceived in the ears or head in the absence of corresponding external sound stimulus. It affects approximately 17% of the general population and 33% of the elderly population, being severe in 20% of cases. Tinnitus may affect, directly or indirectly, personal, professional and leisure activities, interfere in family and social relationships, and in extreme cases, even lead to suicide⁶⁻⁸.

The most important psychoacoustic characteristics of tinnitus are frequency (pitch) and intensity (loudness). Frequency is measured with respect to a range of frequencies (low, medium or high), while intensity corresponds to the volume of the tinnitus sound. Frequency and intensity for tinnitus can be studied by acuphenometry^{6,9}.

Tinnitus is a symptom that can accompany various diseases or disorders of the external, middle, or inner ear, brain stem, and cerebral cortex. More than one cause of tinnitus may be present in the same patient¹⁰. Diseases that are primarily otological, or diseases that secondarily affect the ear and have tinnitus as a symptom, are metabolic, cardiovascular, neurological, pharmacological, psychiatric and dental⁶⁻¹⁰.

Among the dental diseases, temporomandibular joint dysfunction (TMD) is a collective term covering a wide range of clinical joint and muscle problems in the orofacial area. These disorders are mainly characterized by pain in the joint, sounds, and irregular or unlimited mandibular function.¹¹ TMD can also generate secondary auditory symptoms such as earache, tinnitus, vertigo, dizziness, hearing loss, referred pain or headaches¹²⁻²⁸. Of the general population, 40-75% show signs of TMD, and 33% have at least one symptom. In addition, 10% have hearing loss and 7-15% complain of tinnitus²⁹.

Nerve compression is one of the causes of TMD; the chorda tympani is a branch of the seventh cranial

nerve (facial nerve) and the auricular nerve, a sensitive branch of the mandibular nerve, which in turn is a branch of the fifth cranial nerve (trigeminal nerve). Compression of these nerves can cause serious consequences³⁰.

Compressions in the bilaminar zone can lead to auditory symptoms commonly observed in patients with TMD (muscle and/or joint origin) and may be related to pressure on the auricular region. The main causes of auricular nerve and chorda tympani compression are poor dental occlusion and craniocervical posture alterations.³⁰ However, there is no evidence that shows involvement only between TMD and otological symptoms²⁸. A predisposition of the association between TMD and otological symptoms in females has been observed^{7,9,15,30}. Many reports of relief from or improvement in otological symptoms occur after treatment for TMD^{7,11}.

Studies of TMD patients show some psychological involvement with symptoms often interfering with daily activities³¹. The same can be said for tinnitus^{3,4,6,7}. Tinnitus and TMD are considered to be somatic syndromes and both are influenced by psychological disorders, depression, and anxiety³².

Thus, this study aims to assess the impact of tinnitus on quality of life for patients with TMD through the application of the Brazilian Portuguese version of the Tinnitus Handicap Inventory (Brazilian THI), with a view to promoting health in this population.

METHODS

This is a cross-sectional, quantitative study conducted with TMD patients, and approved by opinion number 1.180.334 of the Research Ethics Committee from a public hospital in the city of Curitiba.

The sample consisted of 19 patients in a Brazilian university, evaluated by the Research Diagnostic Criteria/ Temporomandibular Disorders (RDC/TMD). The 19 cases of tinnitus symptoms were referred to the Speech Therapy Clinic of the same university where anamnesis, pure tone audiometry, acuphenometry were performed and the Brazilian THI questionnaire was given⁴.

The anamnesis focused on tinnitus characteristics. Pure tone audiometry was performed using a MADSEN ltera II audiometer in a soundproof booth.

Acuphenometry evaluated the sensation of tinnitus frequency (pitch), through pure tone or narrowband noise at frequencies from 125 Hz to 8000 Hz, presented initially at 5-10 dB SL (loudness), i.e., above audiometric thresholds, and performed on each ear.

The signal was increased in steps of 5 dB HL until the patient stated that it was equivalent to the tinnitus sound. This procedure was performed on each ear.

The THI is an assessment tool with 25 questions³ and has been translated and adapted to Brazilian Portuguese⁴. Each response is scored respecting the

following values: yes (4 points), sometimes (2 points) and no (0 points). The maximum sum achieved is 100 points, and, depending on the result, can show the degree of severity of tinnitus associated with the individual's quality of life. For the analysis, the THI authors⁴ suggest the following scoring ranges:

- 0-16: Slight - barely audible in quiet environments;
- 18-36: Mild - masked by ambient noise, no audible sounds during routine activities;
- 38-56: Moderate - present, even with ambient noise, but not normally interfering with daily activities;
- 58-76: Severe - almost always present, sleep disturbances, can interfere with daily activities;
- 78-100: Catastrophic - always present, sleep disturbances, difficulty in carrying out any activity.

The questionnaire is grouped into three sub-scales. The functional sub-scale is comprised of eleven questions (1, 2, 4, 7, 9, 12, 13, 15, 18, 20 and 24) and evaluates the limitations that tinnitus causes in: the mental area ("Because of tinnitus do you have trouble concentrating?"); in the social/occupational area ("Because of tinnitus do you not enjoy social activities such as going out to dinner or to the movies?"); and in the physical area ("Because of tinnitus do you have trouble sleeping at night?"). There are nine questions (3, 6, 10, 14, 16, 17, 21, 22 and 25) for the emotional subscale, including a wide range of emotional responses for tinnitus, such as anger, frustration, irritability and depression. And finally there are five questions for the catastrophic subscale (5, 8, 11, 19 and 23) to survey the most severe reactions resulting from tinnitus, such as despair, loss of control, inability to face problems, inability to escape the tinnitus, and fear of having a serious illness^{26,28}.

Statistical analysis of this research was conducted with the use of descriptive methods (tables with absolute and relative frequencies) and inferential methods (Student's t-test) at the 0.05 significance level. Spearman correlation tests were used to compare the duration of tinnitus with quality of life.

RESULTS

There was a predominance of females in the sample (89.47%). The average age of the sample was 53.5 years (range 26-72 years). One can observe a frequency of 42.11% of the sample for patients age 60 years or older, and also of 31.58% age between 40 and 49 years old.

Table 1. Results related to tinnitus characteristics according to length of time, description, location, type, duration and frequency.

Time (Years)	Absolute frequency (n)	Relative frequency (%)
Less than 5	12	63.16
More than 5	7	36.84
Total	19	100.00
DESCRIPTION		
Buzzing	2	10.53
Whistle	3	15.79
Ocean sounds	1	5.26
Metallic	1	5.26
Waterfall	1	5.26
Doorbell	1	5.26
Rain	3	15.79
Cicada	1	5.26
Cricket	3	15.79
Teapot	2	10.53
Airplane engine	1	5.26
Total	19	100.00
LOCATION		
Right ear	8	42.11
Left ear	7	36.84
Right and Left ears	4	21.05
Total	19	100.00
TYPE		
Constant	3	15.79
Continuous	10	52.63
Pulsing	3	15.79
Sudden/Intermittent	3	15.79
Total	19	100.00
DURATION		
Days	6	31.58
Hours	2	10.53
Minutes	3	15.79
Seconds	4	21.05
Other	1	5.26
No answer	3	15.79
Total	19	100.00
FREQUENCY		
Sporadic	5	26.32
Frequent	9	47.37
Very frequent	5	26.32
Total	19	100.00

The results related to tinnitus according to the time since onset of tinnitus, description of sound, location,

type, duration and frequency are shown in Table 1. 63.12% of the subjects had had tinnitus for less than five years, and 15.79% described their tinnitus as a whistle, rain, or cricket sound. There was a predominance of laterality in the right ear (42.11%). 52.63% of subjects reported that their tinnitus is continuous, and as to the duration of tinnitus sounds, 31.58% stated that the noise lasts days, and 47.37% report that tinnitus is frequent.

Table 2 shows bilateral hearing thresholds. The audiometry revealed a predominance of audiometric average thresholds above 25 dB HL at high frequencies (3000, 4000, 6000, and 8000 Hz) bilaterally.

Table 2. Descriptive statistics of audiometric thresholds (mean, minimum, maximum, and standard deviation) for right and left ears.

FREQUENCIES (Hz) & EAR	MEAN	MIN.	MAX.	SD
250 RE	23.4	10.0	65.0	13.8
500 RE	23.4	5.0	65.0	16.2
1000 RE	19.7	0.0	50.0	13.5
2000 RE	23.2	5.0	50.0	15.0
3000 RE	26.5	0.0	70.0	20.4
4000 RE	29.7	0.0	85.0	22.3
6000 RE	39.2	5.0	90.0	23.5
8000 RE	40.5	5.0	95.0	24.8
250 LE	28.7	5.0	95.0	21.4
500 LE	27.4	5.0	80.0	20.2
1000 LE	24.2	0.0	80.0	20.6
2000 LE	25.8	5.0	70.0	18.5
3000 LE	30.6	5.0	90.0	24.0
4000 LE	28.9	0.0	90.0	25.4
6000 LE	39.7	5.0	95.0	26.1
8000 LE	40.3	0.0	95.0	27.6

Hz = Hertz; MIN = minimum; MAX = maximum; SD = standard deviation; RE = right ear; LE = left ear.

Table 3 shows the result of acuphenometry according to the intensity (dB SL) and frequency (kHz) in the right and left ears. In acuphenometry, the average tinnitus intensity (loudness) was 21 dB SL in the right ear and 17.85 dB SL in the left ear. The average of tinnitus pitch was 3775 Hz in the right ear and 3750 Hz in the left ear.

Table 4 shows the results of THI scale scores by size and total. The total score of THI was found to be 37.8 points, which shows a moderate impact on quality of life, where the tinnitus can be noticed in the presence of background noise, although daily activities can still be carried out.

Table 5 shows the correlation between THI scores with the duration and frequency of tinnitus. Using the Spearman correlation coefficient, at a significance level of 0.05, there is a significant correlation between THI scores, duration, and frequency.

Table 3. Descriptive measures according to the intensity (dB SL) and frequency (kHz) in right and left ears

ACUPHENOMETRY	INTENSITY (dB SL)		FREQUENCY (kHz)	
	RE	LE	RE	LE
Mean	21.0	17.5	3.775	3.750
Minimum	0	0	0.25	1
Maximum	70	90	6	6
n	10	9	10	9

RE = right ear; LE = left ear.

Table 4. Results from THI scores, by sub-scale (functional, emotional, and catastrophic) and total score.

SUB-SCALE	MEAN	MIN.	MAX.	SD
Functional	14.9	0.0	40.0	11.1
Emotional	13.5	0.0	32.0	10.4
Catastrophic	9.4	0.0	16.0	4.5
Total	37.8	4.0	76.0	23.4

MIN = minimum; MAX = maximum; SD = standard deviation.

Table 5. Correlation between THI score, length of time since onset, and frequency of tinnitus.

CORRELATION	SPEARMAN CORRELATION COEFFICIENT (R)	P
Functional and length of time	0.5354	0.0182*
Emotional and length of time	0.5088	0.0261*
Catastrophic and length of time	0.1223	0.6168
Total score and length of time	0.5702	0.0108*
Functional and frequency	0.2396	0.3232
Emotional and frequency	0.1466	0.5492
Catastrophic and frequency	0.4719	0.0414*
Total score and frequency	0.3248	0.1749

* P < 0.05%

DISCUSSION

Regarding the profile of the sample, one can verify the predominance of females, something also reported by different authors^{9,25}. In relation to age, it was found that the average age of the subjects in this study was 53.5 years old - consistent with results from a study³ that indicated that 30% of adult patients with tinnitus have an average age equal to or greater than 50. However, in other studies^{9,13}, the average age of participants was less than 50 years old.

As to the length of time since onset of tinnitus shown in Table 1, 63.16% had had tinnitus for less than five years. These findings are in agreement with the studies presented by different authors^{2,33} which reported the time since onset of tinnitus as less than five years.

Regarding the description of tinnitus sounds (Table 1), whistle, rain and cricket sounds (15.79%) were the most commonly reported, followed by buzzing and teapot sounds (10.53%), which differs from a study³³ that showed that wheezing (40%) was the most reported tinnitus sound description. The findings of another study⁹ showed high-pitched tinnitus was the most reported, with 75%, versus 25% for low-pitched.

With regard to the laterality of tinnitus (Table 1), there was a prevalence of tinnitus in the right ear (42.11%) which differs from a study³³ found that showed a higher prevalence of bilateral tinnitus (46%), probably because study participants were occupationally exposed to noise. Another study⁹ showed that bilateral tinnitus was the most frequent in normal hearing patients with TMD. However, in yet another study³⁴, there was no significant difference between hearing thresholds for high frequencies in the right and left ears of the individuals in the group with tinnitus when compared to the control group, as well as no significant difference regarding the location of the tinnitus³⁴.

The findings relating to the type of tinnitus (Table 1) show that more than half of participants report the tinnitus as being constant, in line with the findings of another study⁹. Episodes that last several days were the most reported (31.58%) and these results are in agreement with the findings of one study³³ which showed that a weeklong duration for tinnitus was the most reported (41%).

The findings related to the frequency of tinnitus symptoms (Table 1) showed that 47.37% of respondents report that their tinnitus is frequent. Regarding the intensity of tinnitus, high intensity (42.10%) was the most reported.

It is known that the pathophysiology of tinnitus remains unknown³⁵ and its relationship to TMD also is not clear. However, high frequency, moderate, oscillating, and sporadic intensities are usually associated with TMD^{12,36}.

As to the audiometric findings (Table 2), involvement of high frequencies bilaterally from 3 kHz corroborates one study³⁷, which found a lowering of thresholds in the airways at frequencies of 6 and 8 kHz. However, other studies^{7,37,38} showed audiometric thresholds within normal limits. In this sense, the hearing findings in patients with TMD are unclear and need to be better examined.

Regarding acuphenometry results (Table 3), the findings of this study are similar to the literature, which

reports high-pitch tinnitus as being most reported by patients^{9,39-41}.

With respect to the questionnaire THI (Table 4), it can be seen that the average was 37.8%, which indicates a moderate impact on quality of life. This finding is in agreement with studies^{42,43} reporting a higher incidence of moderate impacts (average THI 45.5 and 39 respectively), using the same evaluation tool. This differs from one study⁹ that found the nuisance caused by tinnitus classified as mild. Another study⁷ showed no significant statistical difference between the results of THI in TMD patients compared to the control group, and also showed no statistically significant correlation between THI and length of time with tinnitus⁷.

When analyzed by sub-scale alone, the functional subscale average of 14.9%, indicated a mild impact on quality of life, affecting the mental, social and physical areas. The emotional subscale had an average of 13.5%, which is also considered to be a mild impact on quality of life, affecting emotional areas, such as feelings of anger, frustration, irritability, and depression that tinnitus can cause. The catastrophic subscale found an average of 9.4%, considered to indicate a mild impact on quality of life for this population, which means an interference of tinnitus with regard to despair, intolerance to tinnitus, and a loss of control in situations that tinnitus can produce. One author⁴⁴ found an association of light and mild degrees of tinnitus in individuals who had hearing loss, and mild to catastrophic levels associated with subjects without hearing loss, which was not observed in this study.

There is the existence of a significant correlation between the THI score, length of time since onset, and the frequency of tinnitus. As in all significant cases, R correlations are positive, meaning that the higher the score, the longer the time since onset, the more frequent the episodes of tinnitus, the worse the quality of life for the patient. One author⁷ already showed no statistically significant correlation between THI and the length of time since onset.

This study had some limitations when considering the sample size and the lack of comparison of cases with a control group. But it is known that one of the greatest difficulties in conducting research in the area of TMD and orofacial pain is the selection of a homogeneous sample and the standardization of results⁷. Due to the subjective nature of tinnitus and TMD, we opted for a cross-sectional study. However, prospective studies are needed to establish a cause-effect relationship between them and associate the characteristics of patients with tinnitus and TMD as a way of assisting the diagnosis and guiding more specific treatments.

The findings of this study reinforce the need for evaluation and multidisciplinary conduct involving ENT

surgeons, dentists, and speech-language therapists in the differential diagnosis and treatment of TMD and otological symptoms.

CONCLUSION

Tinnitus reported in patients with TMD caused a moderate impact on quality of life and can be seen in the presence of background noise, but daily activities can still be performed. It has been found that there is significant correlation between the THI score, length of time since onset, and frequency of tinnitus.

REFERENCES

1. American Tinnitus Association ATA - Information about Tinnitus, Portland. 2015 [cited 2015 Dez 8]. Available from: <http://www.ata.org>
2. Sanchez TG, Bento RF, Minti A, Câmara J. Zumbido: características e epidemiologia: experiência do Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo. *Rev Bras Otorrinolaringol.* 1997;63(3):229-35.
3. Newall P, Mitchell P, Sindhusake D, Golding M, Wigney D, Hartley D, et al. Tinnitus in older people: It is widespread problem. *Hear J.* 2001;54(11):14-8. DOI: <http://dx.doi.org/10.1097/01.HJ.0000293149.86219.30>
4. Ferreira PGA, Cunha F, Onishi ET, Branco-Barreiro FCA, Ganança FF. Tinnitus handicap inventory: adaptação cultural para o português brasileiro. *Pró-Fono.* 2005;17(3):303-10. DOI: <http://dx.doi.org/10.1590/S0104-56872005000300004>
5. Jastreboff PJ. Clinical Implication of the neurophysiological model of tinnitus. *Proceedings of the 5th International Tinnitus Seminar*; 1996; Portland, Oregon, USA.
6. Sameli AG. Zumbido: avaliação, diagnóstico e reabilitação: abordagens atuais. São Paulo: Lovise; 2004.
7. Hilgenberg PB. Estudo da participação de sinais sintomas de Disfunção Temporomandibular (DTM) e sintomas otológicos em pacientes portadores de zumbido subjetivo. [Dissertação de Mestrado]. Escola de Odontologia de Bauru, Área Ciências da Saúde: Universidade de São Paulo; 2009.
8. Steinmetz LG, Zeigelboim BS, Lacerda AB, Morata TC, Marques JM. Evaluating tinnitus in industrial hearing loss prevention programs. *Int Tinnitus J.* 2008;14(2):152-8.
9. Morais AA, Gil D. Tinnitus in individuals without hearing loss and its relationship with temporomandibular dysfunction. *Braz J Otorhinolaryngol.* 2012;78(2):59-65. PMID: 22499371
10. Saches TG. Quem disse que o zumbido não tem cura? 1ª ed. São Paulo: H Máxima; 2006.
11. Carlsson GE, Magnusson T, Guimarães AS. Tratamento das disfunções temporomandibulares na clínica odontológica. São Paulo: Quintessence; 2006.
12. Felício CM, Faria TG, Silva MANR, Aquino AMCM, Junqueira CA. Desordem temporomandibular: relações entre sintomas otológicos e orofaciais. *Rev Bras Otorrinolaringol.* 2004;70(6):786-93. DOI: <http://dx.doi.org/10.1590/S0034-72992004000600014>
13. Martins-Basseto J, Klagenberg KF, Zeigelboim BS, Jurkiewicz AL, Jacob LCB. Sinais e sintomas otoneurológicos na disfunção temporomandibular. *Distúrb Comun.* 2004;16(2):167-73.
14. Zeigelboim BS, Jurkiewicz AL, Martins-Basseto J, Klagenberg KF. Avaliação vestibular em mulheres com disfunção temporomandibular. *Rev CEFAAC.* 2007;9(2):255-62. DOI: <http://dx.doi.org/10.1590/S1516-18462007000200015>
15. Shargorodsky J, Curhan GC, Farwell WR. Prevalence and characteristics of tinnitus among US adults. *Am J Med.* 2010;123(8):711-8. DOI: <http://dx.doi.org/10.1016/j.amjmed.2010.02.015>
16. Costa JRL. Estudo da função do sistema vestibular em mulheres com disfunção temporomandibular. [Dissertação de Mestrado]. Departamento de Odontologia: Universidade de Taubaté; 2010.
17. Tuz HH, Onder EM, Kisnisci RS. Prevalence of otologic complaints in patients with temporomandibular disorder. *Am J Orthod Dentofacial Orthop.* 2003;123(6):620-3. PMID: 12806339 DOI: [http://dx.doi.org/10.1016/S0889-5406\(03\)00153-7](http://dx.doi.org/10.1016/S0889-5406(03)00153-7)
18. Ash CM, Pinto OF. The TMJ and the middle ear: structural and functional correlates for aural symptoms associated with temporomandibular joint dysfunction. *Int J Prosthodont.* 1991;4(1):51-7.
19. Chan SW, Reade PC. Tinnitus and temporomandibular pain-dysfunction disorder. *Clin Otolaryngol Allied Sci.* 1994;19(5):370-80. DOI: <http://dx.doi.org/10.1111/j.1365-2273.1994.tb01251.x>
20. Keersmaekers K, De Boever JA, Van der Berghe L. Otolgia in patients with temporomandibular joint disorders. *J Prosthet Dent.* 1996;75(1):72-6. DOI: [http://dx.doi.org/10.1016/S0022-3913\(96\)90421-7](http://dx.doi.org/10.1016/S0022-3913(96)90421-7)
21. Lam DK, Lawrence HP, Tenenbaum HC. Aural symptoms in temporomandibular disorder patients attending a craniofacial pain unit. *J Orofac Pain.* 2001;15(2):146-57.
22. Koskinen J, Paavolainen M, Ravio M, Roschier J. Otological manifestations in temporomandibular joint dysfunction. *J Oral Rehabil.* 1980;7(3):249-54. DOI: <http://dx.doi.org/10.1111/j.1365-2842.1980.tb00442.x>
23. Torii K, Chiwata I. Occlusal management for a patient with aural symptoms of unknown etiology: a case report. *J Med Case Rep.* 2007;1:85. DOI: <http://dx.doi.org/10.1186/1752-1947-1-85>
24. Pita MS, Ribeiro AD, Zuim PRJ, Garcia AR. Hearing symptoms and temporomandibular disorders. *Rev Odontol Araçatuba.* 2010;31(1):38-45.
25. Zocoli R, Mota EM, Somavilla A, Perin RL. Manifestações otológicas nos distúrbios da articulação temporomandibular. *ACM Arq Catarin Med.* 2007;36(1):91-5.
26. Bove SRK, Guimarães AS, Smith LR. Caracterização dos pacientes de um ambulatório de disfunção temporomandibular e dor orofacial. *Rev Latinoam Enferm.* 2005;13(5):686-91.
27. Vernon J, Griest S, Press L. Attributes of tinnitus associated with the temporomandibular joint syndrome. *Eur Arch Otorhinolaryngol.* 1992;249(2):93-4. PMID: 1581053 DOI: <http://dx.doi.org/10.1007/BF00186455>
28. Vielsmeier V, Kleinjung T, Strutz J, Bürgers R, Kreuzer PM, Langguth B. Tinnitus with temporomandibular joint disorders: a specific entity of tinnitus patients. *Otolaryngol Head Neck Surg.* 2011;145(5):748-52.
29. De Leeuw R, Klasser GD. Orofacial pain: guidelines for assessment, diagnosis and management. 4th ed. Hanover Park: Quintessence; 2008.
30. Biasotto-Gonzalez DA. Abordagem interdisciplinar das disfunções temporomandibulares. Barueri: Manole; 2005.
31. Carlson CR. Psychological factors associated with orofacial pains. *Dent Clin North Am.* 2007;51(1):145-60, vii. DOI: <http://dx.doi.org/10.1016/j.cden.2006.09.001>
32. Auvenshine RC. Temporomandibular disorders: associated features. *Dent Clin North Am.* 2007;51(1):105-27, vi. DOI: <http://dx.doi.org/10.1016/j.cden.2006.10.005>
33. Steinmetz LG, Zeigelboim BS, Lacerda ABM, Morata TC, Marques JM. The characteristics of tinnitus in workers exposed to noise. *Braz J Otorhinolaryngol.* 2009;75(1):7-14. DOI: [http://dx.doi.org/10.1016/S1808-8694\(15\)30825-9](http://dx.doi.org/10.1016/S1808-8694(15)30825-9)
34. Figueredo RBS, Corona AP. Influência do zumbido nos limiares auditivos de altas frequências. *Rev Soc Bras Fonoaudiol.* 2007;12(1):29-33. DOI: <http://dx.doi.org/10.1590/S1516-80342007000100007>
35. Bernhardt O, Gesch D, Schwahn C, Bitter K, Mundt T, Mack F, et al. Signs of temporomandibular disorders in tinnitus patients and in a population-based group of volunteers: results of the Study of Health in Pomerania. *J Oral Rehabil.* 2004;31(4):311-9. DOI: <http://dx.doi.org/10.1046/j.1365-2842.2003.01249.x>

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36. Tullberg M, Emberg M. Long-term effect on tinnitus by treatment of temporomandibular disorders: a two-year follow-up by questionnaire. *Acta Odontol Scand.* 2006;64(2):89-96. DOI: <http://dx.doi.org/10.1080/00016350500377842>
 37. Mota LAA, de Albuquerque KMG, Santos MHP, Travassos RO. Sinais e sintomas associados à otalgia na disfunção temporomandibular. *Arq Int Otorrinolaringol.* 2007;11(4):411-5.
 38. Tota T, Santiago G, Gonçalves ES, Saes AO, Berretin-Felix G. Características auditivas de indivíduos com disfunção temporomandibular e deformidades dentofaciais. *Dental Press J Orthod.* 2013;18(5):70-7.
 39. Azevedo AA, Oliveira PM, Siqueira AG, Figueiredo RR. Diagnosis routine and approach in genetic sensorineural hearing loss. *Braz J Otorhinolaryngol.* 2007;73(3):418-23.
 40. Fernandes LC, Santos TMM. Tinnitus and normal hearing: a study on the transient otoacoustic emissions suppression. *Braz J Otorhinolaryngol.* 2009;75(3):414-9. DOI: [http://dx.doi.org/10.1016/S1808-8694\(15\)30660-1](http://dx.doi.org/10.1016/S1808-8694(15)30660-1)
 41. Martinez Devesa P, Waddell A, Perera R, Thedoulou M. Cognitive behavioural therapy for tinnitus (Review). *Cochrane Database Syst Rev.* 2007;(1):CD005233.
 42. Figueiredo VMG, Cavalcanti AL, Farias ABL, Nascimento SR. Prevalência de sinais, sintomas e fatores associados em portadores de disfunção temporomandibular. *Acta Sci., Health Sci.* 2009;31(2):159-63.
 43. Pinto PCL, Sanchez TG, Tomita S. The impact of gender, age and hearing loss on tinnitus severity. *Braz J Otorhinolaryngol.* 2010;76(1):18-24.
 44. Savastano M. Tinnitus with or without hearing loss: are its characteristics different? *Eur Arch Otorhinolaryngol.* 2004;265(11):1295-300. PMID: 18317787