

Evaluation of factors related to the tinnitus disturbance

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Abstract

Introduction: The perception of tinnitus varies among individuals. The limitations caused by tinnitus are related to psychological factors, mood changes and psychiatric conditions, while other factors related to discomfort caused by tinnitus are being studied. Hearing loss is an important factor for the onset of tinnitus. **Objectives:** To evaluate the correlation between the degree of discomfort caused by tinnitus and the hearing loss level. **Materials and Methods:** A retrospective study of the patients treated at the Otolaryngology Service of the State University from Campinas for 15 months, using the Visual-Analogue Scale to classify the degree of discomfort by tinnitus. **Results:** 107 patients were studied and there was no correlation between the degree of annoyance of tinnitus with hearing loss, age, gender, presence of dizziness, of neck pain, headache, changes of the temporomandibular joint, the use of caffeine or excessive intake of carbohydrates. The discomfort was slightly higher in patients without hearing loss and in women. **Conclusion:** Dizziness, neck pain, headache and caffeine abuse are prevalent complaints in patients with tinnitus.

Keywords: dizziness, hearing loss, quality of life, tinnitus.

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INTRODUCTION

Tinnitus is a mysterious and complex disorder of hearing. The word “tinnitus” is derived from the Latin “tinnire” meaning “ring”. In its most common form, tinnitus is presented as a phantom sensation which is not associated with an external sound stimulus¹. The neurophysiological model proposed by Jastreboff still remains the most accepted^{2,3}. In that model, damage to peripheral organs act as triggers of tinnitus, and is supported by events that occur in the central auditory pathway, such as maladaptive neuroplastic processes and phenomena such as hyperactivity of the auditory cortex.

The perception of tinnitus varies among individuals. Some patients describe tinnitus as loud and intense, which may trigger psychosocial disorders and compromise their quality of life^{4,5}. Some studies show that the limitations caused by tinnitus are related to psychological factors, such as mood swings, irritability and psychiatric diseases^{6,7,8,9}.

Several methods have been used in an attempt to scale the discomfort of tinnitus: Visual-Analogue Scale (VAS), Tinnitus Handicap Inventory (THI), Tinnitus Handicap/Support Questionnaire, Tinnitus Effect Questionnaire, Tinnitus Severity Questionnaire and the Tinnitus Reaction Questionnaire^{10,11,12}. The THI is the most accepted method to evaluate tinnitus, because of its easy application, interpretation and the fact that it addresses several aspects of the patient’s quality of life^{13,14}. However, previous studies have shown that EVA, in which the patient classifies his discomfort related to tinnitus from 1 to 10, has a good correlation with the THI¹⁰⁻¹⁴.

In the literature, some factors possibly related to the nuisance caused by tinnitus have been tested, such as age, gender, presence of vestibular symptoms and hearing loss^{15,16,17,18}. In the genesis of tinnitus, the consensus is that hearing loss acts as one of the main triggers at the onset of tinnitus¹⁹, beyond a discussion of a common pathway that integrates all the central relationships of tinnitus^{20,21}. However, hearing loss and its relationship with the distress associated with tinnitus is still controversial. In 2004, Weisz showed that patients with hearing loss at high frequencies are more subject to tinnitus nuisance²². Sanchez et al. in 2005, using EVA to measure the degree of annoyance of tinnitus, found that patients with hearing loss and those with normal hearing have the same degree of discomfort, but patients without hearing loss had a greater impairment in concentration and emotional status, due to tinnitus²³. In 2010, the same author, using the THI, found no significant correlation between degree of hearing loss and discomfort related to tinnitus²⁴. There are authors who still relate hearing loss with worse quality of life²⁵.

Therefore, the main objective of our study was to evaluate the correlation of the degree of discomfort

caused by tinnitus with hearing loss. In addition, the presence of associated clinical symptoms and general data were also evaluated.

MATERIALS AND METHODS

We conducted a clinical epidemiological study with a retrospective analysis of medical records of patients seen at the Otolaryngology Service of the State University from Campinas, in the period from February 2009 to April 2010. This study was approved by the Ethics Committee in Research of the institution.

The study included patients over 18 years who had unilateral or bilateral tinnitus with normal hearing or sensorineural hearing loss.

Patients with pulsatile tinnitus or infectious disease of the external and middle ear were excluded.

A protocol was used for the evaluation of all patients with tinnitus. For the analysis epidemiological data such as gender and age; and clinical features like the presence of unilateral or bilateral tinnitus, dizziness, headache, neck pain, temporomandibular joint disorder (TMJD) and abuse of caffeine or carbohydrates were used. All patients underwent complete ENT examination and pure tone audiometry, testing the following frequencies: 250, 500, 1,000, 2,000, 3,000, 4,000, 6,000 and 8,000 Hz.

To measure the degree of discomfort caused by tinnitus, the patients were evaluated by visual-analogue scale (VAS), graduated from zero to ten. In cases of bilateral tinnitus the worst side was considered (the most uncomfortable). They were classified in three degrees of discomfort: mild (0-3), moderate (4-7) and severe (8-10).

In order to evaluate the value of the nuisance caused by tinnitus and hearing loss, patients were divided into three groups:

- Group I: Patients without hearing loss (hearing thresholds less than 25 dB at all frequencies).
- Group II: Patients with high frequency hearing loss (thresholds higher than 25 dB at frequencies of 4000, 6000 and/or 8000 Hz).
- Group III: Patients with overall hearing loss (patients with hearing loss who do not fit the criteria of group II).

Statistical analysis was performed on the Statistical Analysis System - SAS, version 9.1. For correlation of the data we used chi-square’s and Fischer’s tests. *P*-values below 0.05 were considered significant.

RESULTS

107 patients were included in the study. Twenty three (21.5%) belonged to Group I with normal hearing, 38 (35.51%) to Group II, with high frequency hearing loss and 46 (42.99%) Group III, with overall hearing loss (Figure 1). No patient was excluded from the study.

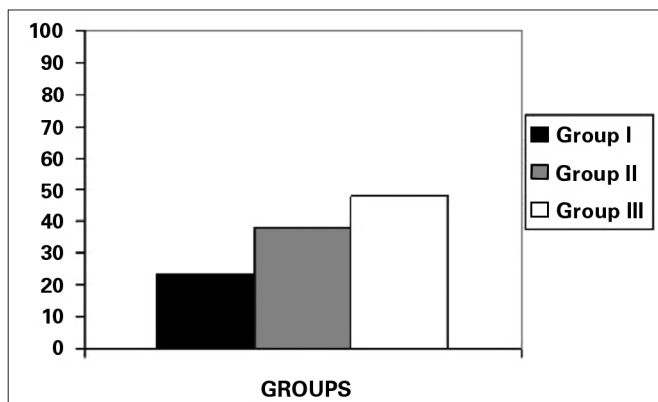


Figure 1. Distribution of population (n = 107) in the groups classified according to hearing loss group I (n = 23), Group II (n = 38) and Group III (n = 46).

With regard to their ages, 57 (53%) patients were between 45 and 65 years old. In group I, 48% of patients had less than 45 years old. In group III, 32% of patients were aged over 65 years old. As for their gender, 72% of patients were women, with similar distribution among the three groups (Figures 2 and 3). As for a correlation between age and gender with a degree of discomfort caused by tinnitus through the EVA, there was no significant difference (Table 1).

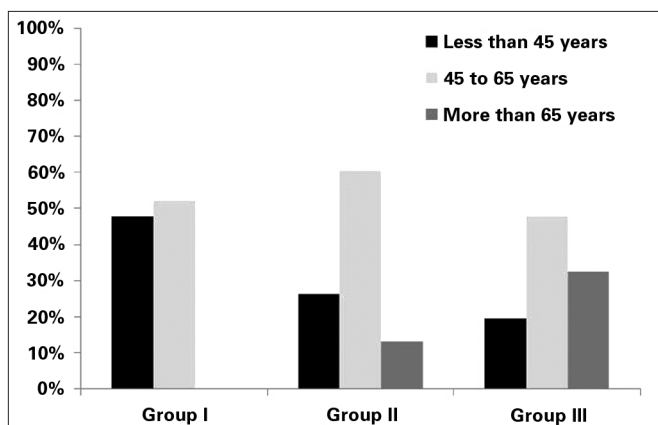


Figure 2. Distribution of age groups classified according to the hearing loss, Group I (n = 23), Group II (n = 38) and Group III (n = 46).

For associated clinical symptoms, there was a high prevalence of patients with dizziness, neck pain and headache. Some authors also demonstrated the great value of associated symptoms like those described above²⁶. When compared to the level of discomfort related to tinnitus (VAS), none of the factors evaluated showed statistically significant results. There was no difference in the distribution among the three groups (Table 2).

The correlation between the degrees of discomfort related to the tinnitus and the three groups separately showed that 48% of the patients in group I (normal he-

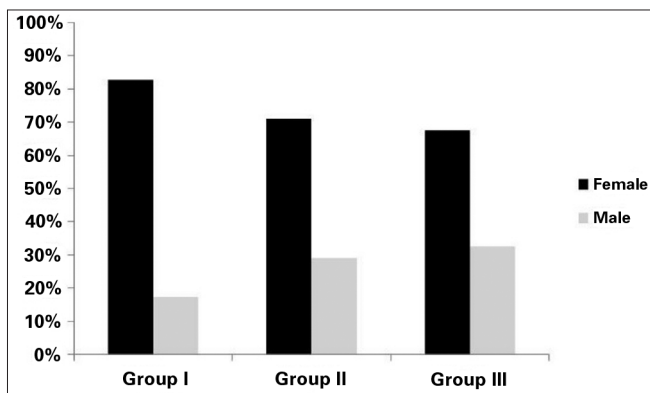


Figure 3. Distribution of patients according to gender in the groups classified according to the hearing loss, Group I (n = 23), Group II (n = 38) and Group III (n = 46).

Table 1. Correlation between the degrees of discomfort related to tinnitus (VAS) and the variables age and sex.

VAS (107)	Age			Gender	
	< 45 y	45 to 65 y	> 65 y	F	M
Mild/Moderate(70)	18	37	15	47	23
Severe (37)	12	20	5	29	8
	$p = 0.54$			$p = 0.11$	

aring) rated their tinnitus as severe. In groups II and III, this percentage was 27% and 30% respectively. However, there was no statistically significant difference between the three groups (Table 3). Comparing the buzzing nuisance related to the presence or absence of hearing loss (Group I x II + III) no statistically significant difference was observed. Finally, comparing groups II and III (respectively loss in patients with high frequency and loss in patients in general), no difference was found. The p values for these correlations are showed in the Table 4.

Discussion

Tinnitus is a symptom of high prevalence. Epidemiological studies show that one third of the population has experienced the sensation of tinnitus at least once in life. Of these, around 1% to 5% develop psychosocial complications²⁷.

Most studies in the literature show that the prevalence of patients with tinnitus and normal hearing is around 8% to 10%²⁸. In the present study there was a slightly higher prevalence (21.5%). A possible explanation for this finding might be the fact that the work has been performed in Otoneurology, in which the main complaint is tinnitus and not hearing loss. In this study, 72% of patients were female. Previous studies have shown that tinnitus is more prevalent in women^{29,30}. This can be explained by the increased demand of women to medical services, or the greater prevalence of psychological disorders in this group, such as anxiety and

Table 2. Distribution of clinical factors associated according to the groups.

Clinical features	Dizziness	Neck pain	Headache	TMJ	Caffeine	Carbohydrates
Total	45 (42%)	36 (33%)	44 (41%)	23 (21%)	38 (35%)	14 (13%)
Group I	10 (43%)	11 (47%)	11 (47%)	8 (34%)	8 (35%)	3 (13%)
Group II	15 (39%)	15 (39%)	16 (42%)	7 (18%)	14 (37%)	6 (15%)
Group III	20 (43%)	10 (21%)	17 (37%)	8 (17%)	16 (34%)	5 (11%)

Table 3. Value of the degree of discomfort related to tinnitus and hearing loss (groups I, II and III).

	VAS	
	Mild/Moderate	Severe
Total	72	35
Group I	12	11
Group II	28	10
Group III	32	14

$p = 0.20$

Table 4. Comparison of the degree of discomfort related to the tinnitus among the groups.

Studied groups	VAS
Without Hearing loss (Group I) x Hearing Loss (groups II e III)	$p = 0.13$
Group II x Group III	$p = 0.86$

depression^{31,32}. On the other hand, when the risk factor under study is the exposure to noise, there is a higher prevalence of the male sex³³. Despite of this prevalence among women, our work suggests that tinnitus-related annoyance is similar in both groups.

Regarding age, 57 (53%) patients were within the age group 45 to 65 years. Concerning the three groups separately, it was observed that in group I (normal hearing) there was a higher prevalence of patients below 45 years old. Sanchez in 2005 also observed that the average age of patients with tinnitus and normal audiometry was lower compared to patients with hearing loss²³.

We know there is a close relationship between tinnitus and audiometric conditions and also in situations of normal hearing²². Heller and Bergman in 1953 showed that 94% of normal hearing patients reported sensation of tinnitus in completely quiet environments³⁴. Riga in 2007, by testing for suppression of otoacoustic emission distortion products, suggested that patients with normal hearing may have a dysfunction of the cochlear efferent system, specifically the medial olivocochlear bundle³⁵.

In the literature, most studies suggest that hearing loss, regardless of its degree, is related to greater inconvenience caused by tinnitus^{8,29,36,37}.

In our study 48% of patients with normal hearing rated their tinnitus as severe. Considering the patients

with hearing loss (groups II and III), this percentage was 28%, suggesting that patients with tinnitus and normal hearing are more related to tinnitus annoyance. Savastano in 2008, using the THI, found a higher number of patients who rated the annoyance by tinnitus in the group with moderate normal audiometry³⁸.

Specifically evaluating patients in group I, a high prevalence of psychoaffective disturbs such as depression and anxiety disorder was found. Several studies indicate that these disturbances are mainly involved in the genesis and perpetuation of tinnitus³⁹. Another hypothesis that could explain a greater discomfort in patients with normal hearing would be the impossibility of adaptation of a hearing aid in these patients.

In this study we found no difference within the group of patients with hearing loss (groups II and III), consistent with several other studies which have been published^{39,40,41}.

Concerning the related clinical symptoms, a high prevalence of patients with dizziness, neck pain, headache and abuse of caffeine was found, which could be acting as triggering factors or worsening of tinnitus. There was no statistically significant difference among the three groups. It is noteworthy that the diagnostic accuracy is essential to any attempt to relieve tinnitus⁴².

CONCLUSION

In this study it was concluded that the degree of annoyance of tinnitus, using the visual analogue scale, was higher in patients without hearing loss and in females, but there was no statistical significance. Dizziness, neck pain, headache and caffeine abuse are prevalent complaints in patients with tinnitus.

REFERENCES

1. Eggermont JJ. Pathophysiology of tinnitus. *Prog Brain Res.* 2007;166:19-36.
2. Jastreboff PJ, Hazell JWP. A neurophysiological approach to tinnitus: clinical implications. *Br J Audiol.* 1993;27(1):7-17.
3. Jastreboff PJ. Phantom auditory perception (tinnitus): Mechanisms of generation and perception. *Neurosci Res.* 1990;8:221-54.
4. Sanchez, TG. Reabilitação do paciente com zumbido. In: *Tratado de Otorrinolaringologia.* Campos CA, Costa HO. Ed, São Paulo: Roca; 2002. (2), p. 311-24.
5. Sanchez TG (2003). Zumbido: Análise crítica de uma experiência de pesquisa. Tese de Pós Graduação - Livre-Docência. Faculdade de Medicina da Universidade de São Paulo. São Paulo.

6. Langguth B, Kleinjung T, Fischer G, Hajak P, Eichhammer P, Sand PG. Tinnitus severity, depression and the big five personality traits. *Prog Brain Res*. 2007;166:221-7.
7. Tyler RS, Baker LJ. Difficulties experienced by tinnitus sufferers. *J Speech Hear Disord*. 1983; 48(2):150-4.
8. Holgers KM, Zoger S, Svedlund K. Predictive factors for development of severe tinnitus suffering further characterization. *Int J Audiol*. 2005;44(10):584-92.
9. McKenna L, Hallam RS, Hinchcliff R. The prevalence of psychological disturbance in neurotology patients. *Clin Otolaryngol Allied Sci*. 1991;16:452-6.
10. Hallam RS, Jakes SC, Chambers C, Hinchcliff R. A comparison of different methods for assessing the intensity of tinnitus. *Acta Otolaryngol*. 1985; 99(5-6):501-8.
11. Kuk FK, Tyler RS, Russel D, Jordan H. The psychometric properties of a tinnitus handicap questionnaire. *Ear Hear*. 1990; 11(6):434-45.
12. Jr FMB, Venosa AR, Oliveira CA. Benzodiazepines and GABAergics in Treating Severe Disabling Tinnitus of Predominantly Cochlear Origin. *Int Tinnitus J*. 2006; 12(2):140-144.
13. Ferreira PEA, Cunha F, Onishi ET, Branco-Barreiro FCA, Ganança, FF. Tinnitus Handicap Inventory: adaptação cultural para o português brasileiro. *Pro-Fono*. 2005; 17(3):303-10.
14. Schmidt LP, Teixeira VN, Dall Ígna C, Dalagnol D, Smith MM. Adaptação para a língua portuguesa do questionário Tinnitus Handicap Inventory: validade e reprodutibilidade. *Braz J Otorrinolaringol*. 2006;72:808-10.
15. Holgers KM, Erlandsson SI, Barreñas ML. Predictive factors for the severity of tinnitus. *Audiology*. 2000;39(5):284-91.
16. Hiller W, Goebel G. Factors influencing tinnitus loudness and annoyance. *Arch Otolaryngol Head Neck Surg*. 2006;132(12):1323-9.
17. Unterrainer J, Greimel KV, Leibetseder M, Koler T. Experiencing tinnitus: which factors are important for perceived severity of the symptom? *Int Tinnitus J*. 2003; 9(2):130-3.
18. Raymundo IT, Bahmad F Jr, Barros Filho J, Pinheiro TG, Maia NA, Oliveira CA. Intratympanic methyl prednisolone rescue therapy in sudden sensorineural hearing loss. *Braz J Otorrinolaringol*. 2010; 76(4):499-509.
19. Searchfield GD, Jerram C, Wise K, Raymond S. The impact of hearing loss on tinnitus severity. *The Australian and New Zealand J Audiol*. 2007;29(2):67-76.
20. Shulman, A, Goldstein, B, Strashun AM. Final Common Pathway for Tinnitus: Theoretical and Clinical Implications of Neuroanatomical Substrates. *Int Tinnitus J*. 2009; 15(1):5-50
21. Lenhardt ML. Tinnitus: A Philosophical Problem. *Int Tinnitus J*. 2008;14(1):37-41
22. Weisz N, Voss S, Berg P, Elbert T. Abnormal auditory mismatch response in tinnitus sufferers with high-frequency hearing loss is associated with subjective distress level. *BMC Neurosci*. 2004;5:8-16.
23. Sanchez TG, Mak MP, Pedalini MEB. Evolução do zumbido e da audição em pacientes com audiometria tonal normal. *Arq Int Otorrinolaringol*. 2005;9(3):220-27.
24. Pinto PCL, Sanchez TG, Tomita S. Avaliação da relação entre severidade do zumbido e perda auditiva, sexo e idade do paciente. *Braz J Otorrinolaringol*. 2010;76(1):18-24.
25. Prestes R, Gil D. Impact of Tinnitus on Quality of Life, Loudness and Pitch Match, and High-Frequency Audiometry. *Int Tinnitus J*. 2009;15(2):134-38.
26. Claussen C, Pandey A. Neurootological Differentiations in Endogenous Tinnitus. *Int Tinnitus J*. 2009;15(2):174-84.
27. Seidmann MD, Jacobson GP. Update on tinnitus. *Otolaryngol Clin North Am* 1996;29:455-65.
28. Barnea G, Attias J, Gold S, Shahar A. Tinnitus with normal hearing sensitivity: extended high-frequency audiometry and auditory nerve brain-stem-evoked responses. *Audiology* 1990;29:36-45.
29. Coelho CCB, Sanchez TG, Bento RF. Características do zumbido em pacientes atendidos em serviço de referência. *Arq Int Otorrinolaringol*. 2004;8(3):284-92.
30. Axelsson A, Ringdahl A. Tinnitus: a study of its prevalence and characteristics. *Br J Audiol*. 1989;23(1):53-62.
31. Davis AC. Hearing disorders in the population: first phase findings of the MRC national study of hearing. In: *Hearing Science and Hearing Disorders*. Lutman, ME, Haggard MP. Ed, London: Churchill Livingstone; 1983. p. 35-60.
32. Dobie RA, Sullivan MD. Antidepressant drugs and tinnitus. In: *Tinnitus Treatment and Relief*. Vernon JA, editor. Ed, Boston: Allyn and Bacon; 1998. (1)p. 43-51.
33. McCombe A, Baguley D, Coles R, McKenna L, McKinney C, Windle-Taylor P. Guidelines for the grading of tinnitus severity: the results of a working group commissioned by the British Association of Otolaryngologists, Head and Neck Surgeons, 1999. *Clin Otolaryngol Allied Sci*. 2001;26(5):388-93.
34. Heller MM, Bergman M. Tinnitus aurium in normally hearing persons. *Annual Otology*. 1953;62:73-83.
35. Riga M, Papadas T, Werner JA, Dalchow CV. A Clinical Study of the Efferent Auditory System in Patients With Normal Hearing Who Have Acute Tinnitus. *Otology & Neurotology* 2007;28:185-90.
36. Coles RRA. Epidemiology of tinnitus: prevalence. *J Laryngol Otol*. 1984; Suppl 9:7-15.
37. Mondelli MFCG, Rocha AB. Correlation Between the Audiologic Findings and Tinnitus Disorder. *Arq. Int. Otorrinolaringol*. 2011;15(2):172-80.
38. Savastano M. Tinnitus with and without hearing loss: are its characteristics different? *Eur Arch Otorhinolaryngol*. 2008;265(11):1295-300.
39. McKinney CJ, Hazell JWP, Graham RL. An evaluation of the TRT method. In: *Proceedings of the Sixth International Tinnitus Seminar - The Tinnitus and Hyperacusis Center*. Ed, London: Cambridge; 1999. p.9-105.
40. Baskill JL, Coles RRA. Relationship between tinnitus loudness and severity. In: *Proceedings of the Sixth International Tinnitus Seminar - The Tinnitus and Hyperacusis Center*. Ed, London: Cambridge; 1999. p. 424-8.
41. Davis A. The aetiology of tinnitus: risk factors for tinnitus in the UK population-a possible role for conductive pathologies. In: *Proceedings of the Fifth International Tinnitus Seminars The Tinnitus and Hyperacusis Center*. Reich GE, Vernon JA. Ed, London: Cambridge; 1996. p. 38-45.
42. Shulman A, Goldstein B. Principles of Tinnitusology: Tinnitus Diagnosis and Treatment A Tinnitus-Targeted Therapy. *Int Tinnitus J*. 2010;16(1):73-85.