

# Sensação subjetiva do zumbido pré e pós intervenção nutricional em alterações metabólicas\*\*\*\*\*

## Tinnitus sensation pre and post nutritional intervention in metabolic disorders

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### Abstract

Background: different etiologies are related to tinnitus including metabolic disorders (blood glucose and lipids). Aim: the aim of this study was compare tinnitus severity by self-report measures pre and post nutritional intervention, using the Tinnitus Handicap Inventory. Method: participants of this study were twenty one male and female subjects, with ages ranging from 40 to 82 years. Inclusion criteria involved the presence of tinnitus and metabolic disorder diagnosed by laboratory exams. All subjects were submitted to a nutritional intervention program. Audiological evaluation and the Tinnitus Handicap Inventory were applied pre and post intervention. Results: when comparing the presence of tinnitus pre and post intervention, data analysis indicates statistical difference concerning tinnitus sensation - 71.5% of the individuals referred less impact of tinnitus in daily activities. Conclusion: an important difference was observed concerning tinnitus influence in subject's life by self-report measures. A direct relation between tinnitus and metabolic disorders in cases related with this symptom was verified.

**Key Words:** Tinnitus; Hyperglycemia; Hypertriglyceridemia; Hypercholesterolemia.

### Resumo

Tema: diferentes etiologias estão relacionadas com a presença de zumbido, incluindo doenças metabólicas (glicêmicas e lipídicas). Objetivo: comparar o grau de severidade do zumbido por meio de medidas de auto-análise em sujeitos com alterações metabólicas pré e pós-intervenção nutricional, utilizando o Questionário de Gravidade do Zumbido. Método: vinte e um sujeitos, homens e mulheres, com idade entre 40 e 82 anos, participaram deste estudo. Critérios de inclusão abrangeram a presença de zumbido e de alteração metabólica diagnosticada por meio de exames laboratoriais. Todos os sujeitos foram submetidos a um programa de intervenção nutricional. A avaliação audiológica e o questionário de gravidade de zumbido foram aplicados pré e pós-intervenção. Resultados: comparando os resultados pré e pós-intervenção os dados mostram uma diferença estatisticamente significativa com relação à sensação do zumbido em 71,5% dos sujeitos, os quais referiram menor impacto do zumbido nas atividades diárias. Conclusão: uma importante diferença foi observada com relação à influência do zumbido na vida do sujeito quando utilizadas as medidas de auto-análise. Verificou-se uma relação direta entre zumbido e alterações metabólicas em casos relacionados a estes sintomas.

**Palavras-Chave:** Zumbido; Hiperglicemia; Hipertrigliceridemia; Hipercolesterolemia.

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## Introduction

Tinnitus is a symptom that presents high prevalence (approximately 15% of population) and causes an important morbidity, interfering on health and life of patient (1-5). Different etiologies are ascribed to tinnitus including metabolic or endocrines disorders (hyperlipidemy, deficiency in B vitamin or zinc, anemia, hyperthyroidism, or hypothyroidism, glycemc /insulinemic alterations) (2, 6-8).

Ear metabolism directly depends on oxygen and glucose supply originated by blood circulation. Thus, modifications on blood flow or metabolites may cause damage in normal functioning of inner ear, bringing adverse consequences to auditory system. Many studies related these metabolic alterations with auditory disorders, including tinnitus (6, 9-14).

Hence, the aim of this study was to compare the severity of tinnitus, pre and pos nutritional intervention, in subjects with metabolic disorders, by using Tinnitus Handicap Inventory (THI).

## Method

The present study was approved by The Ethics Committee of the Institution (Guarulhos University nº 115/2007). All participants agreed on participated in this study and on disseminated all the results by signing Free and Informed Consent Form, in which all performed procedures were described.

### Subjects

Participants were referred to Speech, Language and Hearing Sciences Course of The Guarulhos University. Seven male and fourteen female, from 40 to 82 years old, participated on this study. Inclusion criteria included tinnitus and metabolic disorder (as fast glucose levels, cholesterol, triglycerides, diagnosed by laboratory exams).

### Procedures

First steep: audiological and tinnitus evaluation.

1. Health history and tinnitus investigation data collection: aiming providing information about hearing sensation, tinnitus complaints and health history.

2. Tinnitus Handicap Inventory (THI) (15) - Brazilian Portuguese version (16-18). The Tinnitus Handicap Inventory (THI) consists on a self-report measure that has been validated to quantifying the impact of tinnitus on daily living. The questionnaire

comprises 25 questions distributed in three subscale categories: (1) functional, (2) emotional, and (3) catastrophic. Answers are in the form of "yes, sometimes, or no," with corresponding scores of 4 points, 2 points, or 0 points, respectively. A grading system has been suggested: grade 1-slight (THI 0 to 16); grade 2-mild (THI 18 to 36); grade 3-moderate (THI 38 to 56); grade 4-severe (THI 58 to 76); and grade 5-catastrophic (THI 78 to 100).

3. Audiological Evaluation: each individual was submitted to external ear canal inspection by using a Heine otoscope in order to assess the conditions for conventional audiological assessment. Pure tone audiometry was performed in a soundproof booth with pulsate stimuli. The frequencies tested ranged from 250 to 8000 Hz (air conduction) and 500 to 4000 Hz (bone conduction), when necessary. The logoaudiometry was performed by means of the Speech Reception Threshold (SRT) and the Speech Recognition Index (SRI). For both procedures an audiometer from Interacoustic, Model AD 28, was used. The acoustic immittance measures were composed by tympanometry with probe tone of 226 Hz, and by the acoustic reflex of the stapedius muscle (ipsilateral and contralateral) at frequencies of 500, 1000, 2000 and 4000Hz, performed with a middle ear analyzer from Interacoustic, Model AZ 7.

4. Laboratory exams and nutritional intervention: after auditory evaluation, patients were submitted to laboratory exams (complete blood cell count, cholesterol levels and fractions, triglycerides and fasting glucose test) aiming to investigate metabolic alterations and then, they were sent to nutritional intervention in Nutritional Clinic of Guarulhos University.

Second step: Nutritional Intervention Program to Tinnitus (NIPT).

Patients were submitted on a diet-nutritional monitoring to reach better indices at cholesterol, triglycerides and glucose levels, measured by laboratory exams. This monitoring program occurred approximately during seven months, and it included the following procedures: nutritional obstacle delimitation, individual energy-needs protocol; food frequency questionnaire; diet plan guide; adherence to diet check; laboratory exams results pos nutritional intervention.

Third step: audiological evaluation and tinnitus inventory pos nutritional intervention, following the same procedures described on first step.

### Result Analysis

The comparative result analysis of assessments before and after nutritional intervention was performed based on qualitative and quantitative data. Statistical analysis was performed using the t-paired test and McNemar test. The significance level was of 5%.

### Results

#### Gender and age

Data indicated a major percentage of women (66,7%) as gender. Regarding age, there was a higher occurrence of subjects between 51 to 60 age (47,7%), followed by 61 to 70 (19%) and by 71 to 82 (19%) and finally by 40 to 50 years old (14,3%). The average age was 60 years old (Standard deviation = 10,8 years old).

#### Audiological evaluation

There was a major of individuals with mild to bilaterally moderate sensorineural hearing loss (66,7%), followed by individuals with bilateral normal hearing (19%) and by unilateral mild sensorineural hearing loss (14,3%).

#### THI

There was only one subject belonging to "catastrophic" category pre nutritional intervention. Therefore, to allow THI comparison, "severe" and "catastrophic" categories were grouped.

Regarding grading of tinnitus severity (Table 1) pre nutritional intervention, there was a predominance of moderate tinnitus, followed by mild and severe/catastrophic tinnitus. In post nutritional intervention assessment, there was a predominance of slight tinnitus, followed by mild.

Thus, comparing pre and post intervention, there was a decrease on tinnitus impact - 71,5% of subjects (Table 1 - dark gray). Also an improvement pre and post nutritional intervention statistically significant (p=0,020) was observed.

#### Metabolic assessment

Table 2 presents laboratory exam results. Most of metabolic alterations (both pre and post nutritional intervention) concerns hypercholesterolemia, followed by hypertriglyceridemia and by hyperglycemia. One subject also presented hypothyroidism.

Present analysis revealed that there was a slight improvement (in percentage) on amount of alterations presented pre and post nutritional intervention, both in comparison regarding 21 subjects and in comparison regarding 16 subjects (Table 2). However, this improvement didn't statistically significant and for cholesterol there wasn't a reduction on post mean value, how described in Table 3.

TABLE 1. Distribution of 21 subjects according severity grade of tinnitus (THI pre and post nutritional intervention).

		Post								Total	
		1. slight		2. mild		3. moderate		4. severe/ catastrophic			
		N	%	N	%	N	%	N	%	N	%
Pre	1. slight	2	9,5	0	0,0	0	0,0	0	0,0	2	9,5
	2. mild	3	14,3	3	14,3	0	0,0	0	0,0	6	28,6
	3. moderate	4	19,0	3	14,3	0	0,0	0	0,0	7	33,3
	4. severe/ catastrophic	1	4,8	3	14,3	1	4,8	1	4,8	6	28,6
	Total	10	47,6	9	42,9	1	4,8	1	4,8	21	100,0

Legend: Dark gray – people with less impact of tinnitus (severity grade pre > severity grade pos). Intermediate gray – people with same impact of tinnitus (severity grade pre = severity grade pos). Gray – people with worse impact of tinnitus (severity grade pre < severity grade pos). McNemar test: p = 0,020\*.

TABLE 2. Distribution of subjects according metabolic changes pre and post nutritional intervention.

Types of alterations	Pre nutritional intervention (A)		Pre nutritional intervention (B)		Post nutritional intervention	
	(n = 21)		(n = 16)		(n = 16)	
	N	% regarding 21 subjects	N	% regarding 16 subjects	N	% regarding 16 subjects
<b>Hypercholesterolemia</b>	14	66,7	11	68,75	10	62,5
(>200 mg/dl)						p=1,000
<b>Hyperglycemia</b>	8	38,1	5	31,25	4	25
(>99 mg/dl)						p=1,000
<b>Hypertriglyceridemia</b>	6	28,6	4	25	2	12,5
(>170 mg/dl)						p=0,5000

Legend: Data pre intervention (A) are regarding 21 subjects and pre intervention (B) are regarding 16 subjects that participated until last step of study, because 5 quit of investigation at laboratory reevaluation; data post intervention are regarding at same 16 subjects, as well as the p-value (McNemar test).

TABLE 3. Mean standard deviation and p-value regarding 16 subjects in pre and post nutritional intervention for cholesterol, glucose and triglycerides.

	Cholesterol pre	Cholesterol post	Glucose pre	Glucose post	Triglycerides pre	Triglycerides post
<b>Mean</b>	225,18	229,25	98,87	97,5	165,43	145,93
<b>Standard deviation</b>	32,46	57,67	11,82	8,06	84,33	98,92
<b>p</b>	0,759		0,457		0,201	

Legend: t-paired test.

## Discussion

Present study had a predominance of females between subjects that participated; such finding is in accordance with some previous studies (3,6), although prevalence of tinnitus is greater in males (19). Investigation about this theme (6) presented statistic regarding metabolic alterations, showing a greater amount of females that affected by hyperglycemia and hypertriglyceridemia, which may explain why there were more women in a study that related tinnitus and metabolic alterations.

Regarding age, observed results showed a major occurrence of individuals between 51 and 60 years old, followed by 61 to 70 years old group. It is notorious that tinnitus incidence increases with age and about 70 years old, at least 25 to 30% of population has this symptom (20). Prevalence of tinnitus reaches 1% to people below 45 years old and 9% to people over 65 years old (19), emphasizing that age group of present investigation is most affected by this symptom.

Concerning audiological evaluation, 81% of subjects had uni or bilateral sensorineural hearing loss and only 19% had normal hearing thresholds. Such findings are in accordance with others of literacy (17) that found only 10% of patients with normal hearing and tinnitus, as well as corroborate another investigation (12) that verified 72,2% of sensorineural hearing loss in patients with tinnitus and glycemical alterations.

Many authors related auditory disorders, including tinnitus, to metabolic alterations (6, 9-14). Among the problems related to lipid metabolism, increasing levels of blood cholesterol and triglycerides have been described. These alterations could be related to peripheral resistance to insulin and hyperinsulinemia, which may be responsible for increasing in the rate of production of triglycerides. On the other hand, a hyperlipidic diet could cause damage on hair cells, impairing normal functioning of inner ear (10).

Cholesterol can impair cochlear microcirculation by diminishing the release of the potent vasodilator (nitric oxide), as well as can have a direct action at the outer hair cell membrane, diminishing its motility probably because of increased stiffness caused by integration of cholesterol molecules into the lateral wall membrane, impairing normal functioning of inner ear (13).

Patients suffering metabolic alterations of glucose could be present auditory and/or vestibular symptoms, including tinnitus. Vestibular structures, principally vascular stria, present intense metabolic activity, being sensitive to oxygen and glucose

levels, and to ATP availability to maintenance of endocochlear potential. Glucose metabolism greatly influences inner ear and both hypoglycemia and hyperglycemia could alter its normal functioning (9, 12). Such changes may modify cochlear homeostase and, so could rise symptoms like tinnitus, hearing loss and vestibular balance disorders (11, 12, 14).

The THI assess the relation between tinnitus and stress manifestation, irritation, depression and difficulties with family and friends relationship (emotional category); identify interference of tinnitus on activities that require concentration, sleep, diary activities, fatigue caused by this symptom and worsening of tinnitus with stress (functional category); and recognize sensations like despair, intolerance to tinnitus and loss of situation control (catastrophic category). This toll is indicated not only for use in initial consultations of patients with tinnitus, but mainly as parameter of clinic evolution on therapeutic management (16-18).

Regarding grading of tinnitus severity measured by THI pre nutritional intervention, most of patients reported that this symptom had a moderate interference on daily living, followed by mild interference and by severe/catastrophic interference. On the other hand, in post nutritional intervention period, most of individuals reported slight interference of tinnitus on daily living, followed by mild interference. Therefore, pre and post nutritional intervention comparison evidenced statistically significant improvement on degree of tinnitus discomfort for 71,5% of subjects.

These findings emphasizes a possible relationship between tinnitus and metabolic alterations, which already was pointed by many investigations (6, 9, 11-13, 21), since degree of tinnitus impact seems to be influenced by diet because there was improvement on discomfort caused by tinnitus, after nutritional control.

Concerning laboratory assessment, there was a predominance of metabolic alterations on hypercholesterolemia, fact also reported in another study (6), that found 56,91% of patients with tinnitus and this metabolic alteration, being that percentage of hypercholesterolemia higher than in the general population, which is around 42%. The referred investigation (6) also found 17,49% of patients with tinnitus and hyperglycemia, which presented higher prevalence when compared to general population too. Percentage verified by present study is greater than the previous study, indicating that patients evaluated have more hyperglycemia than general population.

The relation between dizziness and glucose alterations was studied by some investigations. In one of them (22), 65% of patients with dizziness had glucose alterations, which also is above population media. On the other hand, another authors (12) found fasting glucose levels changes in 7,6% of tinnitus patients. Regarding triglycerides, same study (12) observed 15,58% of tinnitus patients with changed levels, while present study found greater percentages, although it was similar to those expected for the general population (around 27 to 30%).

In addition to the metabolic changes, one patient (4,7%) also presented hypothyroidism, which is within the expected percentage for the general population (10%) (6).

Analysis that assessments evolution on amount of metabolic changes pre and post nutritional intervention revealed that it was a slight improvement, but this improvement is not statistically significant. However, despite this slight improvement metabolic, was noted a big progress regarding impact of tinnitus on daily living, how commented previously. This fact probably has relationship with diet modification, which altered flow and/or metabolism blood that provided improvement on homeostasis of inner ear, resulting in decrease at the sensation of tinnitus (6, 12).

Efficiency of atorvastatin, used for high cholesterol treatment, was tested in slow down the progression of presbycusis. It was a double-blind study, where patients were randomly assigned to treatment with either atorvastatin or placebo. After 7 and 13 months, patients were reevaluated and it wasn't observe significant difference between two groups, regarding hearing thresholds; however, there was a tendency of statistic significance regarding tinnitus relief on atorvastatin group, just as there was a significant decrease in cholesterol levels, suggesting influence of cholesterol above tinnitus (13).

The significance of improved dietary habits, regarding glucose and fat is empathized on literacy (6), since it is a simple behavior, without collateral effects and that may help on improvement of inner ear conditions in general and of tinnitus particularly, fact that is probably what happened with the patients evaluated in this study.

## Conclusion

Present findings indicated a major relation between tinnitus and metabolic variation, confirmed by statistically significant tinnitus severity improvement by those who participated on nutritional intervention.

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