



Brazilian Journal of  
OTORHINOLARYNGOLOGY

www.bjorl.org



ORIGINAL ARTICLE

Tinnitus prevalence in the city of São Paulo ☆,☆☆

Jeanne Oiticica\*, Roseli Saraiva Moreira Bittar

Department of Otorhinolaryngology, Hospital das Clínicas, Faculdade de Medicina, Universidade de São Paulo (USP), São Paulo, SP, Brazil

Received 16 November 2013; accepted 20 July 2014

KEYWORDS

Tinnitus;  
Epidemiology;  
Prevalence

Abstract

*Introduction:* The public and private health care in the city of São Paulo has no data on tinnitus prevalence.

*Objective:* Determine tinnitus prevalence in São Paulo city.

*Study design:* Series study.

*Methods:* Cross-sectional study by field questionnaire with 1960 interviews. Predictor variables included gender, age, tinnitus.

*Results:* The prevalence of tinnitus was 22%. It affects more women (26%) than men (17%) and increases with advancing age. Approximately one third of cases (32%) assert that they have constant tinnitus (*i.e.*, "ringing"), while most describe intermittent tinnitus (68%). The majority (64%) reported feeling annoyed, while others (36%) denied any annoyance. Among women, the occurrence of an annoying tinnitus was significantly higher (73%) than among men (50%). The percentages were: mildly annoying (11%), moderately annoying (55%), and severely annoying (34%). Tinnitus interferes with daily activities in 18% of those reporting to be annoyed.

*Conclusion:* The population in the city of São Paulo suffering from tinnitus was more prevalent than previously estimated. Generally, it affects more women and those without occupation, and increases significantly with age. Most respondents described the tinnitus as annoying, and this was more prevalent in females. The degree of discomfort measured by a Visual Analogue Scale showed moderate tinnitus, with responses averaging 6.3.

© 2014 Associação Brasileira de Otorrinolaringologia e Cirurgia Cérvico-Facial. Published by Elsevier Editora Ltda. All rights reserved.

☆ Please cite this article as: Oiticica J, Bittar RS. Tinnitus prevalence in the city of São Paulo. Braz J Otorhinolaryngol. 2014. <http://dx.doi.org/10.1016/j.bjorl.2014.12.004>

☆☆ Institution: Escola de Medicina, Universidade de São Paulo (USP), São Paulo, SP, Brazil.

\* Corresponding author.

E-mail: [jeanneoiticica@bioear.com.br](mailto:jeanneoiticica@bioear.com.br) (J. Oiticica).

<http://dx.doi.org/10.1016/j.bjorl.2014.12.004>

1808-8694/© 2014 Associação Brasileira de Otorrinolaringologia e Cirurgia Cérvico-Facial. Published by Elsevier Editora Ltda. All rights reserved.

**PALAVRAS-CHAVE**

Epidemiologia;  
Prevalência;  
Zumbido

**Prevalência do zumbido na cidade de São Paulo****Resumo**

*Introdução:* As redes pública e privada de saúde na cidade de São Paulo não possuem dados sobre a prevalência de zumbido.

*Objetivo:* Determinar a prevalência do zumbido na população paulistana.

*Desenho do estudo:* Estudo de Série.

*Método:* Estudo transversal por questionário de campo totalizando 1960 entrevistas.

*Resultados:* A prevalência de zumbido observada foi de 22%. Acomete mais mulheres (26%) do que homens (17%). Observou-se crescimento progressivo da prevalência com o aumento da idade. Cerca de 1/3 dos casos (32%) têm zumbido constante, enquanto a maioria refere zumbido intermitente (68%). A maioria (64%) declarou se sentir incomodada, os demais (36%) negaram qualquer incômodo; neste quesito o percentual de mulheres foi significativamente maior (73%) que o de homens (50%). Os percentuais observados foram: incômodo leve (11%), incômodo moderado (55%), e incômodo severo (34%). O zumbido interfere nas atividades diárias em 18% dos sujeitos.

*Conclusão:* O zumbido na cidade de São Paulo mostrou-se mais prevalente do que o previamente estimado. Acometem mais frequentemente mulheres e indivíduos sem ocupação, aumentando significativamente com a idade. A maioria refere se incomodar com o zumbido, sendo a queixa mais prevalente nas mulheres. O incômodo médio aferido pela escala visual analógica apontou zumbido moderado com nota de 6,3.

© 2014 Associação Brasileira de Otorrinolaringologia e Cirurgia Cérvico-Facial. Publicado por Elsevier Editora Ltda. Todos os direitos reservados.

**Introduction**

Tinnitus is a common symptom in ENT outpatient clinics and can be defined as the perception of sound in the absence of any external sound stimulus. The presence of tinnitus may indicate that something is wrong somewhere in the auditory system. This symptom can also be the result of a number of health conditions, such as noise-induced hearing loss, acoustic trauma, presbycusis, metabolic disorders, use of medication, ear infections, somatosensory impairment and/or chronic co-morbidities. It may also be present in individuals with normal hearing.<sup>1</sup>

Despite its high prevalence, in Brazil and in São Paulo there are no epidemiologic studies of the general population to determine the frequency of tinnitus. Estimates of the prevalence of tinnitus vary among different existing epidemiological studies; but previously published results indicate a frequency of approximately 10–15% of the general adult population.<sup>2–8</sup> The difficulties in conducting this type of study and the source of uncertainty in epidemiological studies are based on two key facts: tinnitus severity can only be assessed by the patient, and there is no objective measure for the symptom.<sup>9</sup>

According to the literature, most individuals with tinnitus are not bothered by the symptom, with only 25% of those seeking professional help.<sup>10</sup> The degree of discomfort with the symptom often varies over time; and a small but significant number of patients report that tinnitus interferes directly in their daily activities, causes changes in quality of life and substantial changes in behavior, including anxiety, frustration, irritability, depression and sleep disorders.<sup>11</sup> In 1–2% of cases, tinnitus is bothersome enough to significantly affect daily activities.<sup>12</sup>

It is known that the prevalence of tinnitus is directly related to age and hearing loss;<sup>12</sup> however, the exposure to noise is also a well established and known risk factor, and one of the most common causes of tinnitus. Urban centers like São Paulo emerge as a concentration point for daily exposure to noise and environmental noise pollution. As examples, consider the excessive land and air traffic, overcrowded public spaces, shows, concerts and outdoor recreational activities, sports activities, and even the noise stemming from domestic leisure and safety equipment and household appliances. The expectation is that the prevalence of tinnitus will increase in the future, not only among adults and the elderly, as a consequence of increased longevity and chronic comorbidities; but also among teenagers and children, because of the greater noise exposure in schools, leisure environments, and in particular by the misuse of personal music listening devices. Therefore, it is reasonable to infer that auditory clinical complaints, such as tinnitus, should emerge as a public health problem.

According to the latest census of the IBGE (Instituto Brasileiro de Geografia e Estatística), 2010, the city of São Paulo has a population of 11,253,503 inhabitants, with a birth rate of 15.59/1000.<sup>13</sup> The elderly represent 12.5% of the population and illiterate persons 3.1%. The city of São Paulo has a *per capita* annual income of R\$ 39,445.20 and 58.4% of the population concluded secondary education. These socio-demographic characteristics of the city of São Paulo reveal a profile that is similar to that observed in most European countries. Demographic changes especially a decline in fertility and an increase in years of survival directly influences the age composition of the population, and we have witnessed a transfer of responsibility for the economic maintenance of the elderly.

Knowledge of information about the population profile of the city of São Paulo is of utmost importance, since it is critical to make sure that the final sample obtained after field collection and analysis of our results is actually sufficiently diversified, representative of all socioeconomic strata and major age groups and proportional to population size, keeping the equiprobability.

The social demands of those people living in the city of São Paulo have been changing, and it is necessary to have a better understanding of this population, so that appropriate health policies can be undertaken. Public and private healthcare network in the city of São Paulo have no data on the prevalence of tinnitus; actually, this information is unknown even for the Brazilian population, because of an absence of specific epidemiological studies. Thus, the compilation, analysis and dissemination of such information may help to delineate the precise profile of the population.

Our hypothesis is that tinnitus is a prevalent complaint in the city of São Paulo, with potential morbidity and impact on people's health, particularly in the elderly. Thus, additional information about the frequency, intensity of discomfort, impact on daily activities and associated risk factors, can improve primary care and the referral of patients to triage sectors. In addition, this information helps support public health policies and prevention campaigns. Moreover, risk factors collected from population samples may raise new pathophysiological hypotheses and contribute to advances in tinnitus therapy. Determining the prevalence of tinnitus will increase our knowledge about the symptom profile for this city, favoring the implementation of new public health policies. Without an accurate estimate, it is impossible to plan any kind of action, including obtaining resources or support for these projects.

## Objectives

This epidemiological study aimed to:

1. Determine the prevalence of tinnitus in the adult population of the city of São Paulo;
2. Describe the main clinical characteristics of tinnitus in this population;
3. Quantify the degree of tinnitus in the population.

## Methods

This observational cross-sectional epidemiological study was conducted between April and October 2012 in the city of São Paulo. The population-based survey to determine the prevalence of tinnitus in the city of São Paulo was accomplished through the application of a field survey questionnaire on this population, previously designed for this specific purpose and adapted and modified based on two original studies: the first, conducted to determine the prevalence of tinnitus in the US population<sup>8</sup> and the second to study Meniere's disease in southwestern Finland population<sup>14</sup>. In a previous publication, we determined that the prevalence of dizziness in the city of São Paulo was 42%, with the use of the same questionnaire.<sup>15</sup> The project was conducted in accordance with norms and guidelines established by ESOMAR's International Code of Practice for Social Research

and Marketing, and after approval by the Ethics Committee for Analysis of Research Projects (CAPPesq), Medicine School, Universidade de São Paulo (USP), research protocol No. 0970/09. The project was funded by Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP/Regular Research Support/Process No. 2011/10343-7).

## Sample

The sample size was calculated assuming an expected prevalence of tinnitus of 15% in the population, with an accuracy of 2%, confidence interval of 95%, design effect of two, and 10% increase for possible losses. The sample size was initially estimated as being 1901 inhabitants. Estimating 3–4 persons per household, it was calculated that 633 households would be visited. It was estimated that 40 of the 13,193 census sectors of the city of São Paulo would be selected: 8 in each of the first five areas of the city (north, south, east, west and center). The five regions were included to ensure some diversity to the sample, thus ensuring an estimate involving all major socioeconomic profiles and age groups. The draw of the census sector was proportional to the population size of the area, for maintenance of equiprobability.

## Data sampling

Cluster sampling among the various census sectors was used. For the selection of households to be visited for data collection, a random selection of census sectors was performed. Inside each of these sectors, one block and one corner of this block were drawn. From this allocated corner, the first 16 homes were visited consecutively. Every adaptation and codification of our structured population questionnaire, pre-test conduction, preparation of cards, field manuals and control supplies, staff training, census sector draws, field-work, interviews personally applied in household visits and statistical analysis of the collected results were executed by Analítica Pesquisas Mercadológicas, Sociais e Econômicas Ltda, a specialized company in field research, with long-term experience in that business.

## Inclusion criteria

Individuals over 18 years and of both genders were included. In the population-based survey sample, all residents in each selected household were interviewed. If in the same place two or more families cohabited, each was considered separately.

## Exclusion criteria

For the assorted residences, the exclusion criteria were: (1) residents absent at the time of the interview, and that after three rational attempts of visitation were not found; (2) sick and convalescent people; (3) people not living in the household who were being visited, including relatives and/or friends passing through the house and domestic employees not resident in the household; and (4) commercial houses with no resident people and uninhabited houses.

## Study variables

The measure of occurrence was evaluated by the ratio between the number of individuals with tinnitus complaint compared to the total number of respondents. The main predictor variables were gender, age, schooling, race, occupation, and their relationships with tinnitus, tinnitus characteristics (constant [not constant]; annoying [not annoying], interfering [not interfering] with daily activities), defined as qualitative variables. Quantitative variables included time of occurrence of tinnitus and level of discomfort of tinnitus measured by VAS (Visual Analogue Scale). The scale is graduated in colors ranging from white, through blue, green, yellow and orange tones, ending in the red color and numbered from 0 to 10. The subject was instructed to assign a score from zero to ten for the nuisance caused by his/her tinnitus, according to Figueiredo<sup>16</sup> and illustrated in Fig. 1. The respondent was requested to position him/herself in relation to the level of discomfort, *i.e.*, the closer to the white color zone, the lower the discomfort; and the closer to the red zone, the higher the discomfort. A score of zero corresponds to "no annoyance at all" and a score of ten corresponds to the "most uncomfortable" perception. The level of discomfort was classified as mild (1–3), moderate (4–7) or severe (8–10), according to the score given by the respondent to his/her symptom on a scale from 0 to 10.

## Statistical analysis

The variables investigated were subjected to descriptive analysis. The significance of the association between qualitative variables and the measure of occurrence, presence or absence of tinnitus was determined by the chi-squared ( $\chi^2$ ) test. For quantitative variables, the Student's *t*-test was applied. The variables showing a significant association with the measure of occurrence ( $p < 0.05$ ) were subjected to a logistic regression model to identify possible confounders of the association and also to identify those factors most strongly associated with the presence and degree of annoyance caused by tinnitus. Confidence intervals of 95% were also calculated for the estimates produced (*e.g.*, prevalence of tinnitus).

## Results

### Sample

The company responsible for our field research chose to expand the sample size originally calculated at the time of collection, to reduce possible losses. Therefore, our final sample consisted of 1960 individuals. To obtain this number, 1008 households, randomly assigned between 63 of 13,193 census sectors of the city of São Paulo, were visited, which accounted for an average of 2.2 adults per household (Table 1).

A descriptive analysis of the main predictor variables evaluated (gender, age, schooling, race) is discriminated in Table 2.

**Table 1** Sample size (*n*) and percentage (%) of households visited according to census sectors in the city of São Paulo.

Regions	Total	
	<i>n</i>	%
East	738	38
South	589	30
North	305	16
West	194	10
Center	134	7
Sample base	1960	100

*n*, sample size; %, sample percentage.

**Table 2** Descriptive analysis of the sample profile collected for the city of São Paulo.

	<i>n</i>	%
<i>Gender</i>		
Female	1046	53
Male	914	47
<i>Age (years)</i>		
18/25	278	14
26/35	404	21
36/45	349	18
46/55	325	17
56/65	273	14
66 and +	328	17
Refusal	3	*
<i>Schooling</i>		
Illiterate/incomplete primary school	292	15
Completed primary school/incomplete junior high school	484	25
Completed junior high school/incomplete Secondary studies	346	18
Completed secondary studies/incomplete university studies	620	32
Completed university studies	218	11
<i>Race (by observation)</i>		
White	1237	63
Black	167	9
Yellow	45	2
Mulatto	507	26
Indian	4	*
<i>Sample base</i>	1960	100

*n*, sample size; %, sample percentage.

\* Percent value <0.003%.

## Prevalence of symptoms in the population of the city of São Paulo

### Presence of tinnitus

The prevalence of the reported symptom "tinnitus" in the population of the city of São Paulo was 22% (430



**Table 4** Time of duration of reported tinnitus, according to the different age groups in the population of the city of São Paulo.

How long have you been experiencing this ringing in your ears?	Total		Age											
	n	%	18–25 years		26–35 years		36–45 years		46–55 years		56–65 years		>65 years	
			n	%	n	%	n	%	n	%	n	%	n	%
Up to 1 year	84	20	7	21	19	35	17	28	20	23	13	16	8	7
>1 and ≤3 years	86	20	12	36	11	20	11	18	21	24	9	11	22	19
>3 and ≤5 years	62	14	3	9	9	17	14	23	8	9	11	14	17	15
>5 and ≤10 years	100	23	8	24	9	17	7	12	22	26	22	28	32	27
>10 and ≤20 years	54	13	3	9	3	6	5	8	10	12	13	16	19	16
>20 and ≤30 years	28	7	–	–	3	6	4	7	1	1	8	10	12	10
>30 years	10	2	–	–	–	–	2	3	4	5	3	4	1	1
Refused	1	*	–	–	–	–	–	–	–	–	–	–	1	1
Do not know/do not remember	5	1	–	–	–	–	–	–	–	–	–	–	5	4
Reduced base	430		33		54		60		86		79		117	

n, sample size; %, sample percentage.

\* Percentage value <0.003%.

respectively. Their responses were: mean,  $6.3 \pm 2.3$  points, and median, 6 points.

#### Interference of tinnitus in daily activities

Despite the high prevalence of respondents who reported annoyance with tinnitus when asked, “Does your ringing interfere with your daily activities?”, 82% answered “no”, while 18% answered “yes.” With respect to those 18% who reported that tinnitus interferes with their daily activities, no differences were observed between the categorical variables surveyed.

#### Discussion

Our field study was intended to estimate the prevalence of the symptom “tinnitus” in the adult population of the city of São Paulo. This is the first study of this kind to be held in Brazil. This is an expensive project, since the interviews were conducted in person in the households of the interviewees; and the execution of our study was only possible because of the financial support of FAPESP. We used the field research as a tool – the investigator went to the investigated person’s home and directly addressed the questionnaire. Considering that tinnitus is subjective and

**Table 5** Prevalence of constant/intermittent tinnitus, according to the different age groups in the population of the city of São Paulo.

Is this ringing constant, <i>i.e.</i> , do you perceive it every day?	Total		Age											
	n	%	18–25 years		26–35 years		36–45 years		46–55 years		56–65 years		>65 years	
			n	%	n	%	n	%	n	%	n	%	n	%
Yes	136	32	5	15	7	13	8	13	34	40	33	42	48	41
No	294	68	28	85	47	87	52	87	52	60	46	58	69	59
Reduced base*	430		33		54		60		86		79		117	

#### Qui-squared tests

	Value	df	p
Pearson’s chi-squared	35.315 <sup>a</sup>	6	0.000
Likelihood ratio	38.621	6	0.000
Linear by Linear Association	25.957	1	0.000

n, sample size; %, sample percentage; \*, mentioned tinnitus in their ears; df, difference; p, statistical significance (two-tailed).

<sup>a</sup> Two cells (14.3%) wait for a score <5. The minimum expected count is 66.

a difficult symptom to measure, we insisted on intensive training of all interviewers on the application of the questionnaire so that we could characterize as best as possible the symptom mentioned. Therefore, it must be considered that the subjectivity of the respondents' judgment, as well as the temporal nature of the reported complaints, can be considered as potential elements of bias.

An affirmative answer to the question: Heading 3 was given by 22% (430 individuals) *versus* 78% (1530 individuals) of respondents who denied the complaint. Despite the clinical relevance of the symptom, no epidemiological study determining the prevalence of tinnitus in the population was published in Brazil, and this prevalence was estimated based on the results from population-based surveys in other countries. Even considering these data, studies that estimated the prevalence of tinnitus in adult populations (over 18 years old) are limited, since they differ from each other in many aspects, making it difficult to compare our results with those of other authors in the literature. In general, these epidemiological studies estimate that the prevalence of tinnitus is around 10–15% of the adult general population.<sup>3,9,12,17,18</sup>

The percentage observed in our study is remarkable, since this value is well above that estimated for the national population, and is still high compared to most other published surveys. Axelsson and Ringdahl observed in 1989 a prevalence of 14.2%, with the occurrence being more frequent in men *versus* women).<sup>12</sup> In 2.4% of cases, tinnitus was reported as a disabling condition. In 1996, in an epidemiological study of adult hearing problems in Italy, Quaranta et al. found that the prevalence of prolonged spontaneous tinnitus was 14.5%.<sup>18</sup> In an epidemiological study on hearing loss in the United States assessing individuals between 48 and 92 years old and published in 2002, Nondahl et al. noted a prevalence of tinnitus of 8.2%.<sup>9</sup> In 2011, Fujii conducted a Japanese population-based study of adults aged 45–79 years.<sup>3</sup> The prevalence was 11.9%, occurring more frequently in men (13.2%) than women (10.8%); the author also noted that the frequency of this symptom increased with age.

In a population-based field study conducted in Australia by Sindhusake et al. in 2003, 2015 individuals aged between 55 and 99 years were included. Similar to our series, to determine its prevalence the authors focused only on the presence of tinnitus by their patients, without focusing on factors such as time, frequency and/or severity of symptoms. The prevalence of tinnitus was 30.3%.<sup>11</sup> This is one of the few published studies in the literature indicating a high prevalence of the symptom, and one of the few whose results resemble those of our survey. The main difference is that, in their analysis, Sindhusake et al. considered only elderly individuals, whereas in our study we chose to include a sample with an age group (18–80 years) more representative of the population.

The use of different criteria for the definition of tinnitus (ringing in the last year, persistent tinnitus for at least three months, prolonged tinnitus, tinnitus often or always present, tinnitus for a few years, frequent and bothersome tinnitus in recent years, at least moderate tinnitus that interferes with sleep). The study of different age groups (elderly, adolescents), characteristics (workers and non-workers, workers exposed and unexposed to noise), and methods used for data

collection (mailed questionnaires, a retrospective analysis of data from population-based studies) among the various existing studies in the literature complicates the comparison of prevalence among populations. The higher prevalence in our study may have been influenced by the fact that we did not restrict our question to a specific time, frequency and severity patterns of tinnitus during the interview, when we simply asked about the presence of the symptom. Among respondents, tinnitus occurred intermittently in two thirds of the sample who reported the symptom. This finding can be supported by a population-based field research conducted with 14,178 US adults between 1999 and 2004, with the aim to determine the prevalence of tinnitus in the United States. The study was published by Shargorodsky et al. in 2010, after an analysis of the national database, and included individuals aged 30–80 years.<sup>8</sup> The prevalence of tinnitus among US adults was 25.3% for the presence of tinnitus, regardless of frequency or measure of occurrence, a finding very similar to ours; and 7.9% when considering only the cases of frequent tinnitus in the last year. That is, the prevalence changes drastically depending on the criteria used to consider the occurrence of tinnitus.

With respect to gender, among those who answered "yes" to the question: "Do you have ringing in your ears?" (22% – 430 individuals), a higher percentage of women (26%) *versus* men (17%) was observed, when compared to respondents who answered "no" to the same question (78% – 1530 individuals). Population studies are discrepant when considering the gender among individuals who reported tinnitus. Some studies show a higher prevalence among men *versus* women,<sup>7,19–21</sup> but not all studies.<sup>9,11,12,22,23</sup> Few articles in the literature were similar to ours as to the sample chosen (adult individuals in the population). In 2004, Fujii et al., while investigating the prevalence of tinnitus in the Japanese population, observed higher prevalence of this complaint in men (13.2%) than in women (10.8%). The authors used as their study platform an old database from 31,552 residents over 35 years of age in the town of Takayama, interviewed in 1992 on demographic issues. In 2002, after excluding those deceased and those who had moved, the authors sent questionnaires asking about tinnitus, so that one of three possible answers was marked: (1) "I never had tinnitus," (2) "I have tinnitus," (3) "I've had tinnitus." The bias is that new residents or those who have completed 35 years old during the gap of 10 years of the study were not included in the sample.<sup>3</sup> And when those who responded "I've had tinnitus" were considered, the prevalence was higher among females (5.1%) than in males (3.1%). Baigi et al. (2011) randomly selected 20,100 inhabitants from the national registry of the entire Swedish population (6,891,560 inhabitants), limited to the age of 18–84 years, among which 12,166 individuals responded to the proposed questionnaire. The question asked was "Do you have ringing in your ears?" With three possible answers: (1) "No," (2) "Yes, with a mild discomfort," and (3) "Yes, with an intense discomfort." Logistic regression was performed to estimate the probability of tinnitus related to stress and noise level. According to the authors, women have 40% less risk to develop tinnitus than men (Odds Ratio = 0.60); this chance was observed for all age groups.<sup>2</sup> In 2010, in the United States, after an analysis of the national database (1999–2004) for adults (>20 years old), Shargorod-

sky et al. observed similar results. The presence of tinnitus was considered based on an answer "Yes" to the question "In the last 12 months did you have tinnitus in your ears?", followed by the question "How often?". The tinnitus was considered as being frequent when this symptom was usually present, or occurring at least once a day. The prevalence of tinnitus was higher among men (26.1%) versus women (24.6%). However, as the national database intentionally contained an overrepresentation of elderly people and of Mexican-American and black subjects, this simply cannot be considered a sample of the US population. After a multivariate adjustment to turn this sample to a representative basis for generalizing the results to the population, it was found that the prevalence of tinnitus was higher in women, when only the presence of this symptom was considered, irrespective of whether or not this be a frequent symptom (OR 1.28). Thus, after this adjustment, women are 28% more likely to have tinnitus than men.<sup>8</sup> In 2005, Hannaford et al., using a questionnaire mailed to 12,100 households in Scotland, conducted a survey that included 15,788 respondents over 14 years. The percentage of response to the questionnaires was 64.2%. The prevalence of tinnitus (lasting longer than 5 min) was 17%. The authors found that, in individuals under 45 years, the prevalence was higher among women (13.3%), reaching a value almost twice that observed among males (7.1%); and that a gradual reversion of this situation occurs for people over 45 years.<sup>23</sup>

Similar to other systematic reports in the literature describing age as a well-defined risk factor for the development of tinnitus,<sup>2,3,8,9</sup> we also observed a progressive increase in the prevalence of this symptom with increasing age. The peak of the complaint occurs at 65 years of age, and is three times higher than the prevalence observed in younger subjects. This can be easily explained by the noise exposure over a lifetime and the own auditory system aging process, with consequent increase of complaints related to the inner ear. According Baigi et al. (2011), with each additional year of age, the risk of tinnitus increases by 3%, despite the risk observed in our study is alarmingly higher than that reported by these authors.<sup>2</sup>

Another important feature observed in our study related to employment. The prevalence of tinnitus among individuals without an occupation was almost two times higher than that observed among those with an occupation. A similar result was observed by Hasson et al. in 2010, when describing the prevalence of communication disorders in the Swedish general population (both employed and unemployed); and correlations with gender, age, socioeconomic status (SES) and noise.<sup>6</sup> The authors demonstrated a significant association between SES and prevalence of hearing problems, including tinnitus. We can infer that individuals with no occupation should be those with lower SES; and, therefore, those more susceptible to noise exposure (mechanical stress to the inner ear), because these people assume unhealthy habits regarding hearing protection in noisy environments, or expose themselves to excessive noise for long periods. These people are also clinically more vulnerable, thanks to the high level of stress associated with their condition (emotional stress). Recently, it was shown that poor health is directly related to higher prevalence of tinnitus; and that the emotional state can act as a modulator of the auditory system.<sup>5</sup> The processes of emotional stress

involve both the activation of the sympathetic system with stimulation of  $\alpha$ -adrenergic receptors in the cochlea,<sup>24,25</sup> and the primary neuroendocrine response aimed at establishing the hypothalamic-pituitary-adrenal (HPA) axis.<sup>26</sup> Current research suggests that acute stress protects the cochlea,<sup>27-29</sup> while chronic stress is damaging to hearing.<sup>30</sup> The importance of HPA axis in hearing preservation is supported by clinical studies showing that patients with tinnitus show signs of commitment associated with a high degree of perceived stress, compared to patients without tinnitus.<sup>31-33</sup> One must keep in mind that the elderly comprise a significant segment of the unemployed population, and tinnitus is three times more common in this age group.

When asked about the characteristics of the symptom mentioned, "Is this ringing constant, *i.e.*, is it perceived every day?"; one-third of individuals experienced steady tinnitus, while the remaining two-thirds had intermittent tinnitus. Surprisingly, the constant tinnitus was more prevalent among men than in women. This finding was also noted by Shargorodsky et al. in 2010<sup>8</sup> who observed the occurrence of frequent tinnitus (ringing usually present, or at least once a day) with a higher prevalence in men versus women (OR 0.92).

When asked about the annoyance caused by the symptom, "Is this ringing bothersome to you?"; we found that two-thirds of the population who mentioned tinnitus, whether constant or not, were bothered by the symptom. Until then, it was estimated that this percentage was far lower, because according to Jastreboff, only 25% of individuals who have tinnitus do seek medical attention<sup>10</sup> and as such, the percentage observed in our series (64%) was totally unexpected. This percentage was significantly higher in women compared to men, indicating greater sensitivity in the female gender.

To those who answered "Yes" to the above question, we took care to quantify that level of discomfort using VAS ("Point on the card how much your tinnitus is bothersome") – a rapid and easily understood method for the large-scale assessment of subjective symptoms. And it was surprising to realize that the vast majority (89%) had a moderate to severe degree of discomfort. The mean for the responses obtained using VAS was 6.3. We are not aware of another field study in the literature that has conducted this type of measurement to characterize tinnitus in the population, but this seems to us a very high value, based on expectations and estimates for the level of discomfort of the symptom.

We also asked, "Does this ringing interfere with your daily activities?"; and almost 20% of the population with an annoying tinnitus answered "Yes". We found no studies in the literature that support these numbers. In 2011, when considering this symptom in the Japanese population, Fujii et al. found that 20–30% reported tinnitus perception during waking hours, and that approximately 0.4% of the total population refers that tinnitus severely affects their ability to lead a normal life.<sup>3</sup> In 2010, Gopinath reported that the incidence of tinnitus during a 5-year observation period in the Australian population was 18%. Tinnitus was mentioned as slightly uncomfortable in 55.5% of new cases, as moderately uncomfortable in 6.5%, and as severely uncomfortable in 1.3%; five years later, this profile has changed in those individuals with persistent tinnitus: 39.6% mentioned a moderate discomfort and 5.9% reported a severe discomfort.<sup>4</sup>

Notwithstanding the inability to directly compare the results of Gopinath in 2010, since the study designs are different, these figures are well below those observed in our study.

This study assessed the prevalence of tinnitus in the adult population of the city of São Paulo. This is the first and largest study of its kind ever done in Brazil, and considering that most other reports in the international literature were based on mailed questionnaires, we believe that our population-based sample is more reliable and representative. The high prevalence of tinnitus observed in our patients, together with the alarming predictions of WHO<sup>34,35</sup> with respect to an increase of hearing problems in the short term, signals the seriousness of the problem. Part of this exponential growth can be explained by the aging population, as well as by the increasing noise exposure in countries with middle and high income,<sup>35</sup> as is the case of the city of São Paulo. In order to revert this negative trend in our community, it is necessary that preventive interventions are implemented and adjusted, both at the individual and organizational level, making more pressing the development of strategies and campaigns to prevent, delay or minimize its current and future impact on the community.

## Conclusion

Tinnitus in the population of the city of São Paulo was more prevalent than previously estimated. Generally, this symptom more frequently affects women and those unemployed, and increases significantly with advancing age. Most respondents mentioned annoyance with tinnitus, and this finding is more prevalent in females. The degree of discomfort measured by the Visual Analogue Scale showed moderate tinnitus, with an average of 6.3 for the responses.

## Conflicts of interest

The authors declare no conflicts of interest.

## Acknowledgements

Associação Brasileira de Otorrinolaringologia e Cirurgia Cérvico-Facial (ABORL-CCF), under Direction of Prof. Dr. Ricardo Ferreira Bento – Public Notice for Scholarship Support to Epidemiological Projects; and Fundação de Amparo a Pesquisa do Estado de São Paulo (FAPESP)/Regular Research Support/Process No. 2011/10343-7.

## References

- Sanchez TG, Medeiros IR, Levy CP, Ramalho Jda R, Bento RF. Tinnitus in normally hearing patients: clinical aspects and repercussions. *Braz J Otorhinolaryngol.* 2005;71:427–31. PubMed PMID: 16446955.
- Baigi A, Oden A, Almlid-Larsen V, Barrenas ML, Holgers KM. Tinnitus in the general population with a focus on noise and stress: a public health study. *Ear Hear.* 2011;32:787–9. PubMed PMID: 21716113.
- Fujii K, Nagata C, Nakamura K, Kawachi T, Takatsuka N, Oba S, et al. Prevalence of tinnitus in community-dwelling Japanese adults. *J Epidemiol.* 2011;21:299–304. PubMed PMID: 21646745.
- Gopinath B, McMahon CM, Rochtchina E, Karpa MJ, Mitchell P. Incidence, persistence, and progression of tinnitus symptoms in older adults: the Blue Mountains Hearing Study. *Ear Hear.* 2010;31:407–12. PubMed PMID: 20124901.
- Hasson D, Theorell T, Wallen MB, Leineweber C, Canlon B. Stress and prevalence of hearing problems in the Swedish working population. *BMC Public Health.* 2011;11:130. PubMed PMID: 21345187, PubMed Central PMCID: 3056746.
- Hasson D, Theorell T, Westerlund H, Canlon B. Prevalence and characteristics of hearing problems in a working and non-working Swedish population. *J Epidemiol Community Health.* 2010;64:453–60. PubMed PMID: 19692714.
- Michikawa T, Nishiwaki Y, Kikuchi Y, Saito H, Mizutani K, Okamoto M, et al. Prevalence and factors associated with tinnitus: a community-based study of Japanese elders. *J Epidemiol.* 2010;20:271–6. PubMed PMID: 20501961.
- Shargorodsky J, Curhan GC, Farwell WR. Prevalence and characteristics of tinnitus among US adults. *Am J Med.* 2010;123:711–8. PubMed PMID: 20670725.
- Nondahl DM, Cruickshanks KJ, Wiley TL, Klein R, Klein BE, Tweed TS. Prevalence and 5-year incidence of tinnitus among older adults: the epidemiology of hearing loss study. *J Am Acad Audiol.* 2002;13:323–31. PubMed PMID: 12141389.
- Jastreboff PJ, Gray WC, Gold SL. Neurophysiological approach to tinnitus patients. *Am J Otol.* 1996;17:236–40. PubMed PMID: 8723954.
- Sindhusake D, Mitchell P, Newall P, Golding M, Rochtchina E, Rubin G. Prevalence and characteristics of tinnitus in older adults: the Blue Mountains Hearing Study. *Int J Audiol.* 2003;42:289–94. PubMed PMID: 12916702.
- Axelsson A, Ringdahl A. Tinnitus – a study of its prevalence and characteristics. *Br J Audiol.* 1989;23:53–62. PubMed PMID: 2784987.
- IBGE. Censo Demográfico da População da Cidade de São Paulo; 2010. Available from: [http://www.ibge.gov.br/home/presidencia/noticias/noticia\\_visualiza.php?id\\_noticia=2204&id\\_pagina=1](http://www.ibge.gov.br/home/presidencia/noticias/noticia_visualiza.php?id_noticia=2204&id_pagina=1)
- Havia M, Kentala E, Pyykko I. Prevalence of Meniere's disease in general population of Southern Finland. *Otolaryngology.* 2005;133:762–8. PubMed PMID: 16274806.
- Bittar RSM, Oiticica J, Bottino MA, Ganança FF, Dimitrov R. Population epidemiological study on the prevalence of dizziness in the city of São Paulo. *Braz J Otorhinolaryngol.* 2013;79:688–98.
- Figueiredo RF, Azevedo AA, Oliveira PM. Análise da correlação entre a escala visual-análoga e o Tinnitus Handicap Inventory na avaliação de pacientes com zumbido. *Rev Bras Otorrinolaryngol.* 2009;75:76–9.
- Anonymous. Population study of hearing disorders in adults: preliminary communication. *J R Soc Med.* 1981;74:819–27. PubMed PMID: 7299784, PubMed Central PMCID: 1439358.
- Quaranta A, Assennato G, Sallustio V. Epidemiology of hearing problems among adults in Italy. *Scand Audiol Suppl.* 1996;42:9–13. PubMed PMID: 8668911.
- Leske MC. Prevalence estimates of communicative disorders in the U.S. Language, hearing and vestibular disorders. *Asha.* 1981;23:229–37. PubMed PMID: 6972221.
- Cooper JC Jr. Health and Nutrition Examination Survey of 1971–75: Part II. Tinnitus, subjective hearing loss, and well-being. *J Am Acad Audiol.* 1994;5:37–43. PubMed PMID: 8155893.
- Hoffman HJ, Reed GW. Epidemiology of tinnitus. In: Snow JB Jr, editor. *Tinnitus: theory and management* New York: Lewiston; 2004. p. 16–41.
- Gates GA, Cooper JC Jr, Kannel WB, Miller NJ. Hearing in the elderly: the Framingham cohort, 1983–1985. Part I. Basic audiometric test results. *Ear Hear.* 1990;11:247–56. PubMed PMID: 2210098.

23. Hannaford PC, Simpson JA, Bisset AF, Davis A, McKerrow W, Mills R. The prevalence of ear, nose and throat problems in the community: results from a national cross-sectional postal survey in Scotland. *Family Pract.* 2005;22:227–33. PubMed PMID: 15772117.
24. Bielefeld EC, Henderson D. Influence of sympathetic fibers on noise-induced hearing loss in the chinchilla. *Hear Res.* 2007;223:11–9. PubMed PMID: 17092669.
25. Horner KC, Giraudet F, Lucciano M, Cazals Y. Sympathectomy improves the ear's resistance to acoustic trauma – could stress render the ear more sensitive? *Eur J Neurosci.* 2001;13:405–8. PubMed PMID: 11168546.
26. Canlon B, Meltser I, Johansson P, Tahera Y. Glucocorticoid receptors modulate auditory sensitivity to acoustic trauma. *Hear Res.* 2007;226:61–9. PubMed PMID: 16843624.
27. Tahera Y, Meltser I, Johansson P, Salman H, Canlon B. Sound conditioning protects hearing by activating the hypothalamic–pituitary–adrenal axis. *Neurobiol Dis.* 2007;25:189–97. PubMed PMID: 17056263.
28. Wang Y, Liberman MC. Restraint stress and protection from acoustic injury in mice. *Hear Res.* 2002;165:96–102. PubMed PMID: 12031519.
29. Rarey KE, Gerhardt KJ, Curtis LM, ten Cate WJ. Effect of stress on cochlear glucocorticoid protein: acoustic stress. *Hear Res.* 1995;82:135–8. PubMed PMID: 7775279.
30. Horner KC. The emotional ear in stress. *Neurosci Biobehav Rev.* 2003;27:437–46. PubMed PMID: 14505685.
31. Hebert S, Lupien SJ. The sound of stress: blunted cortisol reactivity to psychosocial stress in tinnitus sufferers. *Neurosci Lett.* 2007;411:138–42. PubMed PMID: 17084027.
32. Hebert S, Lupien SJ. Salivary cortisol levels, subjective stress, and tinnitus intensity in tinnitus sufferers during noise exposure in the laboratory. *Int J Hyg Environ Health.* 2009;212:37–44. PubMed PMID: 18243788.
33. Hebert S, Paiement P, Lupien SJ. A physiological correlate for the intolerance to both internal and external sounds. *Hear Res.* 2004;190:1–9. PubMed PMID: 15051125.
34. Mathers C, Smith A, Concha M, editors. *Global burden of hearing loss in the year 2000.* Geneva: World Health Organisation; 2000.
35. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. *PLoS Med.* 2006;3:e442. PubMed PMID: 17132052, PubMed Central PMCID: 1664601.