

## Prevalence of Idiopathic Tinnitus in Patients with Hypertension and its Impact on Quality of Life

Nabil Abdulghany Sarhan<sup>1</sup>, Abdulsalam Mahmoud Algamal<sup>2</sup> and Eman Mahmoud Abdelsalam<sup>3</sup>

<sup>1</sup> Department of Otorhinolaryngology, Al-Azhar University, Egypt.

<sup>2</sup> Department of Cardiology, Mansoura University, Egypt.

<sup>3</sup> Department of Internal Medicine, Al-Azhar University for Girls, Egypt.

[abdo75gamal@gmail.com](mailto:abdo75gamal@gmail.com)

**Abstract: Background:** Tinnitus is a major clinical problem and can significantly impair the quality of life (QOL). The available data on the rate of tinnitus in the hypertensive population are still controversial. **Objective:** The aim of our study is to evaluate the prevalence of idiopathic tinnitus in patients with hypertension and its effect on their QOL, also to evaluate the severity of tinnitus in these patients. **Methods:** A total of 586 patients with hypertension were divided into two groups. Group A: consisted of 67 patients giving the history of tinnitus. Group B: consisted of 519 patients without history of tinnitus (control group). Abbreviated version of the World Health Organization Quality of Life questionnaire (WHOQOL-BREF) was used to assess all patients. The Klockhoff-Lindblom tinnitus-grading system was used to assess severity of tinnitus. **Results:** The prevalence of tinnitus in hypertensive patients in our study was 11.43 % with no significant difference between males and females. Age was significantly higher in patients with tinnitus. The QOL was significantly worse in patients with tinnitus, the severity of tinnitus did not differ with age and was similar in both males and females, also, QOL was significantly worse with increasing the grade of tinnitus. **Conclusion:** The prevalence of idiopathic tinnitus in patients with hypertension is 11.43 %. The QOL was significantly worse in patients with tinnitus and further worsened with increasing the grade of tinnitus. [Nabil Abdulghany Sarhan, Abdulsalam Mahmoud Algamal and Eman Mahmoud Abdelsalam. **Prevalence of Idiopathic Tinnitus in Patients with Hypertension and its Impact on Quality of Life.** *Life Sci J* 2016;13(1):9-15]. (ISSN:1097-8135). <http://www.lifesciencesite.com>. 2. doi:[10.7537/marslsj130116.02](https://doi.org/10.7537/marslsj130116.02).

**Key words:** Hypertension, Tinnitus, Quality of life, WHOQOL-BREF.

### 1.Introduction

Derived from the Latin verb *tinnire* (to ring), the term tinnitus describes the conscious perception of an auditory sensation in the absence of a corresponding external stimulus. Tinnitus can be subjective, when the experience is of the individual alone, or, less commonly, objective, when an observer can hear the tinnitus. The onset of tinnitus can be abrupt, but it is insidious in most cases. The sensation is generally of an elementary nature, descriptions of hissing, sizzling, and ringing are common, although, in some cases, more complex sounds such as voices or music are perceived. Tinnitus can sometimes be a rhythmic or pulsatile sound (1), pulsatile tinnitus (2) can be synchronous with the heartbeat, in which case a vascular origin is likely, or asynchronous, in which case myoclonus of middle-ear or palatal muscles is probable (3). Tinnitus can be constant or intermittent, and many patients experience more than one sound. It can be localized to one or both ears, or centrally within the head (1).

The prevalence of troublesome tinnitus increases with age, prevalence in men and women is similar (4). Studies indicated that the prevalence of tinnitus in adults lies in the range of 10–15% (5).

The extent to which tinnitus impairs quality of life (QOL) is highly variable, various questionnaires have been developed to assess tinnitus severity or

tinnitus-related impairment (6). About 80% of the people with chronic tinnitus suffer little or no treatment-seeking effects from their tinnitus, whereas about 20% manifest a clinically significant condition (4). Patients who experience tinnitus often report significant associated morbidities. Lifestyle detriment, emotional difficulties, sleep deprivation, work hindrance, interference with social interaction, and decreased overall health have been attributed to tinnitus, although causative relations are yet unknown, patients with tinnitus can have increased risk for depression, anxiety, and insomnia (7).

The World Health Organization (WHO) defines QOL as ‘an individual’s perception of their position in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards and concerns’ (8).

Hypertension is increasing in prevalence in Saudi Arabia affecting more than one fourth of the adult Saudi population (9). The involvement of hypertension in the genesis of tinnitus remains controversial (10). The onset or the enhanced intensity of tinnitus could result from a decrease in cochlear blood flow when BP decreases and vasomotor autoregulation is impaired, as occurs in patients with hypertension (11). This negative mechanism might be dramatically enhanced by the concomitant activation of the sympathetic nervous system elicited by stressful

situations or by the administration of vasodilatory drugs, which could further reduce the autoregulatory mechanisms at the level of cochlear microcirculation, tinnitus might be related to an imbalance between the systemic and cochlear circulation, which in turn might be related to underlying pathophysiologic conditions and drug treatment (12).

Hypertension may induce or aggravate pre-existent tinnitus through two, principle mechanisms: damage to the cochlear microcirculation; and to ototoxicity caused by diverse antihypertensive drugs, such as furosemide and beta-blockers, an electron microscope study revealed that the primary site of cochlear involvement in patients with hypertension is the stria vascularis, followed by the Corti organ (13). Other authors speculated about an increase in perilymphatic pressure due to the increase of extracellular volume generally associated with high sodium retention in hypertension (14).

The aim of our study is to evaluate the prevalence of idiopathic tinnitus in patients with hypertension and its effect on their quality of life, also to evaluate the severity of tinnitus in these patients.

## 2. Patients and methods

This is a prospective observational study conducted in Olaya Medical Center (Riyadh) during the period from May 2013 to April 2015. The study protocol was approved by the center's ethics committee.

All patients with hypertension older than 18 years presented to cardiology and internal medicine clinics were enrolled in the study after a written consent to participate in the study (number = 615). All patients were asked to complete a standardized questionnaire to assess the presence, frequency, severity and duration of tinnitus, duration of hypertension and the antihypertensive(s) used. All patients giving the history of tinnitus (number = 96) were referred to ear, nose and throat (ENT) clinic, full history was taken, otoscopic examination and audiological evaluation for all patients including Pure Tone Audiometry and speech audiometry using Interacoustics Diagnostic Audiometer AD25, tympanometry using GSI 38 AUTO TYMP and Auditory brainstem response (ABR) using Path Senterio Advance to exclude patients with otogenic cause of tinnitus. All patients with local ear cause of tinnitus (number = 29) as hearing loss, perforation, cholesteatoma, ear wax etc. were excluded from the study. The remaining 67 patients with idiopathic tinnitus were included as the patients group and the hypertensive patients without history of tinnitus were included as control group (number = 519).

### 2.1, BP measurement:

The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC VII) identifies hypertension if blood pressure is  $\geq 140/90$  mmhg (15), or use of antihypertensive medications.

The patient was rested and then BP was measured by the authors using a mercuric manometer in supine position. The mean of three readings of BP taken 20 minutes apart was used as the final BP reading.

### 2.2, WHOQOL-BREF:

The abbreviated version of the World Health Organization Quality of Life (WHOQOL-BREF) questionnaire was used to assess all patients included in the study after approval from the World Health Organization. This questionnaire has 26 items on a five-point Likert scale, which includes two global items about QOL and health, respectively, and 24 items relating to four domains calculated as the sum of seven items for physical, six for psychological, three for social and eight for environmental QOL (16). The WHOQOL-BREF was self-administered by respondents but exceptionally, the authors assisted administration by reading items aloud where self-completion was not possible, usually for reasons of literacy or disability.

### 2.3, Tinnitus grading:

*Klockhoff and Lindblom 1967* (17) devised a classification system that can distinguish degrees of tinnitus distress, it consists of seven grades, from 0 to 3, differing from one another with respect to prevalence or intensity (or both; Table 1). The Klockhoff-Lindblom (KL) tinnitus-grading system has been shown to demonstrate good inter-rater reliability (18) and was selected for use in this study by asking patients about the severity, loudness and persistency of tinnitus.

### 2.4, Statistical Analysis:

Data was analyzed using SPSS (Statistical Package for Social Sciences) version 15. Qualitative data was presented as number and percent. Comparison between groups was done by Chi-Square test. Quantitative data was presented as mean  $\pm$  SD. F-test (One Way Anova) was used to compare between more than two groups. Pearson's correlation coefficient was used to test correlation between variables.  $P < 0.05$  was considered to be statistically significant.

**Table (1).** Klockhoff and Lindblom Classification System for Distinguishing Levels of Tinnitus Distress:

Grade	Description
0	None
0.5	Slight <sup>*</sup> , periodic
1.0	Slight, continuous or moderate <sup>**</sup> , periodic
1.5	Continuous, fluctuating from slight to moderate
2.0	Continuous, moderate or fluctuating from slight to severe <sup>***</sup> , intermittent, severe
2.5	Continuous, fluctuating from moderate to severe
3.0	Continuous, severe

\* Audible only in a quiet environment.

\*\* Audible in an ordinarily noisy environment but divertible (i.e., not observed when attention is focused on work, etc.).

\*\*\* Constantly noticed in all ordinary acoustic environments, even when concentrating on work, etc.

### 3.Results

We screened 615 patients with hypertension for the presence of tinnitus, we found 96 patients with tinnitus who were referred to ENT clinic to exclude those with local ear cause of tinnitus (29 patients). We enrolled 586 hypertensive patients with mean  $\pm$  SD age of  $49.56 \pm 13.373$  years, they were 349 males (59.6 %) and 237 females (40.4 %). Patients were divided into 2 groups: patients group with idiopathic tinnitus (67) and control group without history of tinnitus (519).

The prevalence of idiopathic tinnitus in hypertensive patients in our study was 11.43 % including 40 males (59.7 %) and 27 females (40.3 %). The prevalence in males was 11.46 % and in females was 11.39 % with no significant difference (Table 2).

Age was significantly higher in patients with tinnitus than control group (Table 2) and 35.82 % of cases of tinnitus occurred in elderly (above the age of 60 years), in elderly, the prevalence of tinnitus is 15.48 % which is significantly higher than that in patients < 60 years (9.97 %) (Table 2).

Both systolic and diastolic BP readings were significantly lower in patients with tinnitus than control group. The duration of hypertension was significantly longer in patients with tinnitus than control group (Table 2).

The use of antihypertensive drugs was similar in patients with tinnitus and control groups regarding beta blockers, calcium channel blockers (CCB) and angiotensin converting enzyme inhibitors (ACEI), whereas, the use of diuretics was significantly higher in patients with tinnitus and the use of angiotensin

receptor blockers (ARB) was significantly higher in control patients. The use of monotherapy or combination antihypertensives was not different between the two groups (Table 4). The rate of tinnitus was significantly lower in patients with uncontrolled hypertension (systolic BP  $\geq$  140 mmhg and/or diastolic BP  $\geq$  90 mmhg) (Table 5).

The physical, psychological, social and environmental QOL assessed by WHOQOL-BREF questionnaire was significantly worse in patients with tinnitus than the control groups (Table 2).

Continuous severe tinnitus (KL grade 3) occurred only in 2 patients (2.98 %), continuous moderate to severe tinnitus (KL grade 2.5) occurred only in 3 patients (4.47 %), continuous moderate, slight to severe or intermittent severe tinnitus (KL grade 2) occurred in 9 patients (13.43 %), continuous slight to moderate tinnitus (KL grade 1.5) occurred in 15 patients (22.38 %), slight continuous or moderate periodic (KL grade 1) was the most common and occurred in 21 patients (31.34 %) and slight periodic (KL grade 0.5) occurred in 17 patients (25.37 %). Totally severe tinnitus occurred in 6 patients (8.95 %), moderate tinnitus occurred in 18 patients (26.86 %) and mild tinnitus was the most common and occurred in 43 patients (64.19 %), continuous tinnitus occurred in 20 patients (29.85 %) and intermittent tinnitus occurred in 47 patients (70.15 %) (Table 3).

The severity of tinnitus, assessed by KL grade, did not differ with age and was similar in both males and females, also, QOL was significantly worse with increasing the grade of tinnitus (Table 3).

**Table (2):** clinical data of patients and control groups.

		Tinnitus group (67)	Control group (519)	P value
<b>Age (years)</b>		52.72 ± 12.97	49.16 ± 13.38	0.04
<b>Elderly (&gt; 60 years)</b>		24 (15.48 %)	131 (84.52 %)	0.047
<b>Sex</b>	male	40 (59.7%)	309 (59.5%)	0.545
	female	27 (40.3%)	210 (40.5%)	
<b>sBP (mmhg)</b>		133.48 ± 17.02	140.69 ± 17.57	0.002
<b>dBP (mmhg)</b>		81.54 ± 10.7	86.87 ± 10.71	< 0.0001
<b>HTN duration (years)</b>		9.34 ± 6.57	7.09 ± 5.5	0.009
<b>Physical domain</b>		13.39 ± 1.5	14.73 ± 1.26	< 0.0001
<b>Psychological domain</b>		11.77 ± 1.95	14.07 ± 1.53	< 0.0001
<b>Social domain</b>		10.03 ± 1.71	11.19 ± 1.09	< 0.0001
<b>Environmental domain</b>		10.91 ± 1.51	12.67 ± 1.31	< 0.0001

sBP = systolic blood pressure, dBP = diastolic blood pressure, HTN = hypertension.

**Table (3):** Severity of tinnitus by KL grade.

		0.5 (17)	1.0 (21)	1.5 (15)	2.0 (9)	2.5 (3)	3.0 (2)	P value
<b>Age (years)</b>		52.18 ± 14.44	52.57 ± 12.4	52.67 ± 13.82	51.33 ± 12.74	63.33 ± 7.64	49.5 ± 14.85	0.823
<b>Elderly (&gt; 60 years)</b>		5 (20.8 %)	8 (33.3 %)	5 (20.8 %)	3 (12.5 %)	2 (8.3 %)	1 (4.2 %)	0.872
<b>Sex</b>	male	6 (35.3%)	15 (71.4%)	10 (66.7%)	7 (77.8%)	1 (33.3%)	1 (50.0%)	0.163
	female	11 (64.7%)	6 (28.6%)	5 (33.3%)	2 (22.2%)	2 (66.7%)	1 (50.0%)	
<b>sBP (mmhg)</b>		138.47 ± 18.9	130.52 ± 17.86	131.4 ± 18.44	131.22 ± 11.48	141.33 ± 12.06	136 ± 0.0	0.69
<b>dBP (mmhg)</b>		84.06 ± 10.87	79.67 ± 11.89	80.87 ± 11.24	81.67 ± 8.44	87.33 ± 7.57	75.5 ± 4.95	0.69
<b>HTN duration (years)</b>		9.82 ± 6.82	7.67 ± 5.7	9.0 ± 6.75	10.0 ± 6.12	19.67 ± 6.03	7.0 ± 7.07	0.094
<b>Physical domain</b>		15.1 ± 0.53	13.6 ± 0.85	12.93 ± 0.82	12.03 ± 0.89	10.94 ± 0.57	10.04 ± 1.73	< 0.0001
<b>Psychological domain</b>		13.73 ± 1.07	12.57 ± 0.67	10.96 ± 0.85	9.44 ± 1.24	8.89 ± 0.56	7.5 ± 1.18	< 0.0001
<b>Social domain</b>		11.76 ± 0.86	10.5 ± 0.72	9.42 ± 1.05	8.79 ± 0.69	6.81 ± 0.51	5.33 ± 0.0	< 0.0001
<b>Environmental domain</b>		12.33 ± 0.81	11.23 ± 0.57	10.68 ± 1.18	10.25 ± 1.01	7.88 ± 1.13	6.75 ± 0.53	< 0.0001

sBP = systolic blood pressure, dBP = diastolic blood pressure, HTN = hypertension.

**Table (4):** antihypertensives used.

drug used	tinnitus(67)	no tinnitus(519)	P value
ACEI	15 (22.38 %)	105	0.681
ARB	28 (41.79 %)	147	0.023
CCB	26 (38.8 %)	209	0.818
Diuretics	26 (38.8 %)	78	<0.001
Beta blockers	5 (7.46 %)	34	0.778
monotherapy	38	253	0.220
combination	29	266	0.220

ACEI = angiotensin converting enzyme inhibitors, ARB = angiotensin receptor blockers, CCB = calcium channel blockers

**Table (5):** uncontrolled hypertension.

	tinnitus(67)	no tinnitus (519)	P value
<b>Uncontrolled sBP</b>	24 (35.82 %)	270 (52.02 %)	0.013
<b>Uncontrolled dBP</b>	21 (31.34 %)	239 (46.05 %)	0.023

sBP = systolic blood pressure, dBP = diastolic blood pressure.

#### 4. Discussion

Tinnitus is a major clinical problem because it involves a large proportion of the general population and can significantly impair the quality of life and

working attitude of affected individuals. The available data on the rate of tinnitus in the hypertensive population are still controversial (12).

Our study was designed to evaluate the prevalence of idiopathic tinnitus in patients with hypertension and its effect on their quality of life, also to evaluate the severity of tinnitus in these patients. All hypertensive patients presented to the cardiology clinic in Olaya Medical Center were evaluated by thorough ENT assessment to rule out local otologic causes of tinnitus. The study included 586 patients who were divided into two groups. Group A: consisted of 67 patients giving the history of tinnitus. Group B: consisted of the remaining 519 patients without history of tinnitus who served as a control group.

The prevalence of idiopathic tinnitus in hypertensive patients in our study was 11.43 % including 40 males (59.7 %) and 27 females (40.3 %). **Borghi et al., 2005** (12) found that 17.6 % of hypertensive patients reported occasional or prolonged spontaneous tinnitus. **Fasce et al., 2002** (19) found an incidence of 9.1 % of tinnitus in hypertensive patients which was not significantly different from that in non hypertensive patients (9.4%).

The prevalence of tinnitus in adults lies in the range of 10–15% (5), the prevalence of tinnitus is much higher than the number of patients who seek treatment (20).

There was no difference in the incidence of tinnitus in hypertensive patients between males and females, this is in agreement with **Davis & El Rafaie 2000** (4) and **Khedr et al., 2010** (5) and in contrast to **Borghi et al., 2005** (12) who found that tinnitus was significantly higher in women compared with men, also, **Fujii et al., 2011** (21) found that tinnitus was somewhat higher among men (13.2%) than women (10.8%).

The prevalence of tinnitus in hypertensive patients increased with age and was significantly higher in elderly > 60 years (15.48 %), no data are available about the prevalence of tinnitus in hypertensive elderly and this may be the first study to address that, the prevalence of tinnitus in elderly in general was reported to be 42.77 % by **Gibrin et al., 2013** (22), 24.2 % by **Negrila-Mezei et al., 2011** (23), 18.6 % by **Michikawa et al., 2010** (24) and 14.1 % by **Lasisi et al., 2010** (25). The high prevalence of tinnitus in elderly can be explained by increasing the prevalence of other medical conditions with age that are considered as potential causes of tinnitus such as vascular disease, diabetes, hypertension, autoimmune and degenerative disorders (26). Furthermore, these medical conditions are accompanied by increasing use of medications, which may exacerbate tinnitus (27). However, **McFadden 1982** (28) reported that age-related tinnitus exists as a distinct pathology and is related to degeneration at all levels of the auditory system.

In our study, both systolic and diastolic BP readings were significantly lower in hypertensive patients with tinnitus than control group, this may be related to hypotension followed by an abnormal vasomotor regulation that could generate a transient ischemia and a consequent sufferance of the inner ear, also, impaired vasomotor regulation of the peripheral vascular tree might be responsible for intermittent labyrinthine functional damage in response to systemic BP decrease (29). This is in agreement with **Borghi et al., 2005** (12) who found that the prevalence of tinnitus in hypertensive patients was significantly higher in patients with lower office and ambulatory BP monitoring systolic values. The duration of hypertension was significantly longer in patients with tinnitus than control group, also, the rate of tinnitus was significantly lower in patients with uncontrolled hypertension. This is contradictory to **Borghi et al., 2005** (12) who concluded that the prevalence of tinnitus was significantly higher in patients with uncontrolled BP compared with patients with adequate BP control.

The use of beta blockers, CCB and ACEI was similar in patients with tinnitus and control groups, whereas, the use of diuretics was significantly higher in patients with tinnitus and the use of ARB was significantly higher in control patients, these findings support the possible role of renin-angiotensin system activation of the sympathetic nervous system in the pathogenesis of tinnitus (12). This is in agreement with **Borghi et al., 2005** (12) who concluded that the prevalence of tinnitus was significantly lower in patients treated with ARBs and was more prevalent in the patients treated with a diuretic.

The effects of tinnitus on quality of life are highly individualized, and personality characteristics may predispose a person to experience tinnitus as a 'distressing' symptom (30). The severity of tinnitus, assessed by KL grade, did not differ with age and was similar in both males and females. The physical, psychological, social and environmental QOL assessed by WHOQOL-BREF questionnaire was significantly worse in patients with tinnitus than the control group, also, QOL was significantly worse with increasing the grade of tinnitus, our study may be the first to address the effect of tinnitus on QOL in hypertensive population, however, tinnitus generally impaired QOL as shown by **Kennedy et al., 2004** (31) and **Erlandsson & Holgers 2001** (32). Also, tinnitus impaired QOL in some special groups as elderly as shown by **Negrila-Mezei et al., 2011** (23) and **Lasisi et al., 2010** (25). Also, **Nondahl et al., 2007** (33) found clear associations between tinnitus and reduced quality of life in a large cohort of older adults (ages 53-97 years). Similarly, **Prestes and Gil 2009** (34) concluded that the handicap caused by tinnitus is

moderate among individuals with hearing impairment and in older individuals with normal hearing, whereas this handicap is mild among younger individuals with normal hearing. Also, *Zeman et al., 2014* (6) confirmed the strong and consistent relationships between self-reported tinnitus burden and both quality of life, and depression.

### 5. Conclusions

In our study, the prevalence of idiopathic tinnitus in patients with hypertension is 11.43 % with no difference between males and females, the prevalence increased with age and was significantly higher in elderly (15.48 %).

Both systolic and diastolic BP were significantly lower in hypertensive patients with tinnitus than control group. The duration of hypertension was significantly longer in patients with tinnitus than control group, also, the rate of tinnitus was significantly lower in patients with uncontrolled hypertension, the prevalence of idiopathic tinnitus in patients with hypertension was significantly higher in patients using diuretics and significantly lower in patients using ARB.

The severity of tinnitus did not differ with age and was similar in both males and females. The QOL was significantly worse in patients with tinnitus, also, QOL was significantly worse with increasing the grade of tinnitus.

### Conflict of interest

The authors declare no conflict of interest.

### References

1. Baguley D, McFerran D, Hall D. Tinnitus. *Lancet* 2013; 382: 1600–07.
2. Stouffer JL, Tyler RS. Characterization of tinnitus by tinnitus patients. *J Speech Lang Hear Res* 1990; 55:493–553.
3. Bhimrao SK, Masterson L, Baguley DM. Systematic review of management strategies for middle ear myoclonus. *Otolaryngol Head Neck Surg* 2012; 146:698–706.
4. Davis A, El Rafaie A. Epidemiology of tinnitus. In: Tyler RS, ed. *Tinnitus handbook*. San Diego, CA: Singular, Thomson Learning, 2000: 1–23.
5. Khedr EM, Ahmed MA, Shawky OA, Mohamed ES, El Attar GS, Mohammad KA. Epidemiological Study of Chronic Tinnitus in Assiut, Egypt. *Neuroepidemiology* 2010;35:45–52.
6. Zeman F, Koller M, Langguth B, Landgrebe M and Tinnitus Research Initiative database study group. Which tinnitus-related aspects are relevant for quality of life and depression: results from a large international multicenter sample. *Health and Quality of Life Outcomes* 2014; 12: 7.
7. Folmer RL, Griest SE. Tinnitus and insomnia. *Am J Otolaryngol* 2000; 21: 287- 293.
8. WHOQOL Group. Development of the WHOQOL: Rationale and current status. *Int J Mental Health* 1994; 23: 24–56.
9. Al-Nozha MM, Abdullah M, Arafa MR, Khalil MZ, Khan NB, Al-Mazrou YY *et al.* Hypertension in Saudi Arabia. *Saudi M J* 2007; Vol. 28 (1): 77-84.
10. Ferreira LMB, Júnior ANR, Mendes EP. Characterization of Tinnitus in the Elderly and its Possible Related Disorders. *Braz J Otorhinolaryngol.* 2009; 75(2):249-55.
11. Izzard AS, Rizzoni D, Agabiti-Rosei E, Heagerty AM. Small artery structure and hypertension: Adaptive changes and target organ damage. *J Hypertens.* 2005 ;23:247-250.
12. Borghi C, Brandolini C, Prandin MG, Dormi A, Modugno GC and Pirodda A. Prevalence of Tinnitus in Patients with Hypertension and the Impact of Different Antihypertensive Drugs on the Incidence of Tinnitus: A Prospective, Single-Blind, Observational Study. *Current Therapeutic Research* 2005; VOLUME 66, NUMBER 5.
13. Tachibana M, Yamamichi I, Nakae S (1984) The site of involvement of hypertension within the cochlea. *Acta Otolaryngol* 97(3–4):257–265
14. Markova M (1990) The cochlea vestibular syndrome in hypertension. *Cesk Otolaryngol* 39(2):80–97.
15. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, *et al.* The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. *JAMA* 2003; 289(19): 2560-2572.
16. Krägeloh CU, Henning MA, Hawken SJ, Zhao Y, Shepherd D, Billington R. Validation of the WHOQOL-BREF Quality of Life Questionnaire for Use with Medical Students. *Education for Health* 2011; 24(2):545.
17. Klockhoff I, Lindblom U. Ménière's disease and hydrochlorothiazide (Dichlotride): A critical analysis of symptoms and therapeutic effects. *Acta Otolaryngol (Stockh)* 63: 347-365,1967.
18. Andersson G, Lyttkens L, Larsen HC. Distinguishing levels of tinnitus distress. *Clin Otolaryngol* 24: 404-410, 1999.
19. Fasce E, Flores M, Fasce F. Prevalence of symptoms associated with blood pressure in normal and hypertensive population. *Rev Med Chil* 2002; 130(2): 160–166.
20. Brown SC: Older Americans and Tinnitus: A Demographic Study and Chart Book. GRI

- Monogr 1990; Ser A, No 2. Washington, Gallaudet Research Institute, Gallaudet University.
21. Fujii K, Nagata C, Nakamura K, Kawachi T, Takatsuka N, Oba S, Shimizu H. Prevalence of Tinnitus in Community-Dwelling Japanese Adults. *J Epidemiol* 2011; 21(4):299-304.
  22. Gibrin PCD, Melo JJ, Marchiori LLM. Prevalence of tinnitus complaints and probable association with hearing loss, diabetes mellitus and hypertension in elderly. *CoDAS* 2013; 25(2): 176-80.
  23. Negrila-Mezei A, Enache R, Sarafoleanu C. Tinnitus in elderly population – clinic correlations and impact upon QoL. *Journal of Medicine and Life* 2011; Vol. 4, Issue 4, 412-416.
  24. Michikawa T, Nishiwaki Y, Kikuchi Y, Saito H, Mizutani K, Okamoto M, Takebayashi T. Prevalence and Factors Associated with Tinnitus: A Community-Based Study of Japanese Elders. *J Epidemiol* 2010; 20(4):271-276.
  25. Lasisi AO, Abiona T, Gureje O. Tinnitus in the elderly: Profile, correlates, and impact in the Nigerian Study of Ageing. *Otolaryngology - Head and Neck Surgery* 2010; 143, Issue 4, 510–515.
  26. Perry BP, Gantz BJ. Medical and surgical evaluation and management of tinnitus; in Tyler RS (ed): *Tinnitus Handbook*. San Diego, Singular, 2000, pp 221–241.
  27. Meikle MB, Creedon TA, Griest SE: *Tinnitus archive*, ed 2. <http://www.tinnitusarchive.org/> (accessed April 29, 2004).
  28. McFadden D: *Tinnitus – Facts, Theories and Treatments*. Washington, National Academy Press, 1982.
  29. Pirodda, A.; Saggese, D.; Ferri, G.G.; Giausa, G.; Grippo, M.C.; Gaddi, A. The role of hypotension in the pathogenesis of sudden hearing loss. *Audiology* 1997, 36, 98-108.
  30. Henry JL, Wilson PH: *The Psychological Management of Chronic Tinnitus*. Needham Heights, Allyn & Bacon, 2001.
  31. Kennedy V, Wilson C, Stephens D. Quality of life and tinnitus. *Audiological Medicine*, 2004, Vol. 2, No. 1: Pages 29-40.
  32. Erlandsson SI, Holgers KM. The impact of perceived tinnitus severity on health-related quality of life with aspects of gender. *Noise Health* 2001;3:39-51.
  33. Nondahl DM, Cruickshanks KJ, Dalton DS, Klein BE, Klein R, Schubert CR, Tweed TS, Wiley TL. The impact of tinnitus on quality of life in older adults. *J Am Acad Audiol*. 2007; 18(3):257-66.
  34. Prestes R & Gil D. Impact of Tinnitus on Quality of Life, Loudness and Pitch Match, and High-Frequency Audiometry. *International Tinnitus Journal* 2009; Vol. 15, No. 2, 134–138.