ECRONICON OPEN ACCESS

EC MICROBIOLOGY
Review Article

Epidemiology of Tinnitus in Elderly

Nisreen Omar Asraf[1]*, Ahmed Habib Alshaikh[2], Orjuwan Abdulbari Mazi[3], Zainab Abdulrahman Sairafi[4], Khalid Abdulaziz Alzahrani[3], Munirah Alohaymid[5], Alyaa Ali Albaradei[6], Reem Fouad Julaidan[7], Kasim Hassan Alsabban[8], Hamzah Hassan Alsabban[3] and Abdullah Matouq Khinkar[3]

[1]Consultant Family Medicine, Assistant Professor Family Medicine, King Saud Bin Abdulaziz University for Health Sciences, Jeddah, Saudi Arabia

[2]Collage of Medicine, University of Jeddah, Jeddah, Saudi Arabia

[3]Collage of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia

[4]Collage of Medicine, Umm AlQura University, Mecca, Saudi Arabia

[5]Collage of Medicine, King Faisal University, Hofuf, Saudi Arabia

[6]Collage of Medicine, Batterjee Medical College, Jeddah, Saudi Arabia

[7]Collage of Medicine, Ibn Sina National College for Medical Studies, Jeddah, Saudi Arabia

[8]Collage of Medicine, Alfarabi Colleges, Jeddah, Saudi Arabia

***Corresponding Author:** Nisreen Omar Asraf, onsultant Family Medicine, Assistant Professor Family Medicine, King Saud Bin Abdulaziz University for Health Sciences, Jeddah, Saudi Arabia.

Received: January 08, 2021; **Published:** January 16, 2021

Abstract

Background: Aging comes with physiologic changes that may lead to the development of corresponding diseases or morbidities involving body composition, eyes, ears, skin, cardiovascular or endocrine system, and metabolism. Hearing impairments followed by tinnitus along with ear disorders, epistaxis, and balance disorders are the chief complaints of the elderly in otorhinolaryngology clinic and are the most common audiological disorder.

Aim: In this review, we will look into the prevalence, risk factors, causes, pathophysiology, diagnosis and management of tinnitus in elderly.

Conclusion: Tinnitus is a common disorder in the elderly population. Tinnitus affect quality of life in the elderly which can be improved through management strategies discussed in this paper. Tinnitus affects elderly's' daily activities and alter their sleeping patterns and the emotional status. Hearing deficiency is an significant risk factor for tinnitus, but it is not a reliable indicator for tinnitus. Further research on the various patterns of tinnitus and the forms of dizziness with their corresponding lifestyle factors should be performed.

Keywords: *Tinnitus in Elderly; Geriatric Tinnitus; Epidemiology of Tinnitus in Elderly*

Introduction

Tinnitus is defined as the perception of sound in the absence of any external stimulus. Tinnitus does not signify a disease but a symptom of a range of causal diseases. Patients have hearing loss due to noise often experience a range of signs as tinnitus, dizziness, progres-

sive declines in hear, and speech comprehension problems [1]. Tinnitus is a in many age groups but age is one of the main identified risk factors associated with it as it has been found to be more prevalent in individuals aged 40 years or more [2].

Tinnitus is one of the most common and distressing otologic disorders affecting about 10 - 30 percent of the population, with about 3 - 4 percent reporting to doctor at least once during their lifetime. The incidence of tinnitus in older people ranges from 11.1 percent to 30 percent in various countries [3].

Aging comes with physiologic changes that may lead to the development of corresponding diseases or morbidities involving body composition, eyes, ears, skin, cardiovascular or endocrine system, and metabolism [4]. Hearing impairments followed by tinnitus along with ear disorders, epistaxis, and balance disorders are the chief complaints of the elderly in otorhinolaryngology clinic and are the most common audiological disorder [5]. Cardio-vascular diseases, otic disorders, head trauma, electrical shock, otic barotrauma, and many medications are all causes that can contribute to tinnitus. In addition, its influence on the functioning of the people affected renders it a significant contributor to morbidity in the elderly [6]. Numerous risks associated with tinnitus have been studied, including hearing loss, noise susceptibility, age, diet, obesity, smoking, and psychological depression [3]. Tinnitus, and dizziness have been associated with smoking, elevated blood pressure, diabetes, older age, illness history, and the occurrence of ear symptoms are correlated with noise exposure [5].

Tinnitus may be qualitatively classified as non-pulsatile (subjective) or pulsatile (objective). Subjective non-pulsatile tinnitus is by far the most frequent and it can only be detected by the patient, while analytical pulsatile tinnitus can also be noticed by the listener and is triggered by internal body activity or noise [7]. Objective tinnitus is described as tinnitus which is audible to another person as a sound emanating from the ear canal, whereas subjective tinnitus is audible only to the patient and is commonly known to be devoid of auditory etiology and related motions in cochlear partition or cochlear fluids. Most doctors use the word tinnitus to refer to subjective tinnitus and somato-sound as objective tinnitus [7]. Patients with tinnitus experience anxiety, sleep disturbances, or depression. The level of tinnitus disturbance correlates strongly with comorbid anxiety, depression, personality characteristics, behavioral situation, and tinnitus noise level [8].

Tinnitus impact assessment and evaluation can be through different methods. Newman, Jacobson, and Spritzer invented Tinnitus Handicap Inventory which is one of the most used instruments for tinnitus evaluation composed of 25 questions that evaluate how tinnitus interferes with daily activities [9].

Family doctors play a major role in treating tinnitus cases and are ideally positioned to treat both clinical and psychological symptoms. Since tinnitus has become common, helping patients deal with complaints by conservative interventions and reassurance will prove to have the better results [10].

In this review, we will look into the prevalence, risk factors, causes, pathophysiology, diagnosis and management of tinnitus in elderly.

Literature Review

A study conducted to determine the association of tinnitus with these chronic comorbidities among elderly community and its impact upon their quality of life on 471 ENT patients up to 60 years old prevalence of 24.2% was found. Gender, residence, economic status, alcohol and smoking were not significantly associated with tinnitus. Otic and sinonasal pathology, dizziness, hypertension, arteriosclerosis and diabetes were significantly correlated [11].

Teixeira AR., *et al*. conducted a study to evaluate the existence of a relationship between the quality of life and the impact caused by tinnitus in elderly individuals, considering the age and gender variables evaluated 36 elderly individuals with an average age of 68.6 ± 6.8 years old classified their tinnitus as weak (44.4%) or medium (36.1%). The score average in the THI was 20 points, predominant classification of tinnitus impact as negligible (41.7%) or mild (30.6%) [12].

Ogido., *et al*. previously reported that tinnitus was present in 80.81% of the population and concluded that auditory dysfunction is frequent. Symptoms such as tinnitus can cause distress and negatively affect the quality of life of workers [13].

A cross-sectional study investigating the prevalence of persistent tinnitus and chronic or recurrent dizziness in an elderly population and analyzing the association of certain comorbidities with tinnitus and dizziness in southern Taiwan on 597 volunteers aged ≥65 years participant found that; prevalence of persistent tinnitus and chronic/recurrent dizziness was 32.0% and 24.1%, respectively. Tinnitus or dizziness were not associated with age, BMI, hypertension and diabetes were associated with hearing impairment [14].

Participants and Methods

Study design: Review article.

Study duration: Data were collected between 1 June and 30 October 2020.

Data collection: Medline and PubMed public database searches have been carried out for papers written all over the world on epidemiology of tinnitus. The keyword search headings included "tinnitus in elderly, geriatric tinnitus, epidemiology of tinnitus in elderly", and a combination of these will be used. For additional supporting data, the sources list of each research was searched. Criteria of inclusion: the papers have been chosen on the basis of the project importance, including one of the following topics: tinnitus in elderly, geriatric tinnitus, epidemiology of tinnitus in elderly. Criteria for exclusion: all other publications that did not have their main purpose in any of these areas or multiple studies and reviews were excluded.

Statistical analysis

No predictive analytics technology has been used. In order to evaluate the initial results and the methods of conducting the surgical procedure, the group members reviewed the data. The validity and minimization of error were double revised for each member's results.

Prevalence

Tinnitus was already identified in about 15 percent of the world's population, most aged 40 to 80 years old. Age is a main risk factor contributed to chronic tinnitus, hitting a high of 14.3 per cent in individuals between 60 and 69 years of age [15]. In In UK; almost 4.7 million patients are affected by tinnitus and approximately 5 percent of them have suffered serious and chronic conditions affecting their quality of life [16]. The American Tinnitus Association has reported a prevalence of about 37 to 40 million increasing with degree of hearing impairment and age. Tinnitus occurrence was observed to be higher in males than in females, and this difference may be due to higher hearing levels in males [17]. Importantly, about 1% of individuals less than 45 years of age report tinnitus, while the incidence is about 12% within these 60 to 69 years of age and 25 to 30% in those > 70 years of age. Relevant statistics have also recently been described in a broad cross-sectional sample performed with respondents in the US National Health and Diet Review Surveys from 1999 to 2004 [18]. Tinnitus frequency has been found to be significantly higher in males than in females, and this difference may be due to higher hearing levels in males [17], 41% of those aged 3 to 79 years could develop tinnitus at minimum once in their lifetime. Age from 60 to 69 has been reported to increase 1 year prevalence, body mass index 30 kg / m2 or higher, smoking (old and current), diabetes mellitus, and hypertension [18]. Longitudinal prevalence studies are important for the detection of factors linked to the progression of disorders. In Beaver Dam, Wisconsin, a cross sectional study over 5-year incidence of tinnitus among those free of tinnitus at baseline was 5.7% [17].

Risk factors

The correlation of hearing loss, exposure to noise, depression and anxiety with tinnitus is evident, although gender norms, smoking status, educational level and income levels vary from study to study level. It has been proposed that a history of arthritis be associated

with tinnitus. Risk factors for cardiovascular disease, such as elevated body mass index, cholesterol, diabetes, stroke, and angina, have been analyzed as potential risk factors for tinnitus in many other studies; however, their relationship with tinnitus remains controversial. Limited studies have tested the association regarding employment and tinnitus. Just one study identified asthma as an associated tinnitus cause. Tinnitus has been identified in some prevalence of thyroid disease [19] but the correlation of thyroid disease with tinnitus was never analyzed in a large population-based sample [20].

Causes

For several decades, hearing loss has been recognized as the most common risk of tinnitus, and population-based statistics suggest that unnecessary noise sensitivity is the second leading cause of tinnitus. Hearing loss, otosclerosis, sudden deafness, Meniere's disease, and other causes of hearing loss are all otologic causes of tinnitus. However, about 40% of patients cannot identify any cause associated with tinnitus onset [21].

Otitis media and sequelae of Lyme disease, meningitis, syphilis, and inflammatory processes that affect hearing are all of infectious. Neurological causes include head trauma, vertigo, multiple sclerosis, vestibular schwannoma and other cerebellopontin-angle tumors [22]. Oral medicines, such as salicylates, nonsteroidal anti-inflammatory drugs, aminoglycoside antibiotics, loop diuretics, and chemotherapy agents are all known causes of tinnitus. Temporomandibular-joint disease as well as other dental problems can also induce tinnitus. In certain cases, moreover, no actual physiological cause can be found [23].

Pathophysiology

Typically, as there is a hazard or risk, humans respond with traditional battle or flight reaction. This is why the initiation of tinnitus may be so frightening. The fractured finger does not actually cause this reaction, but the tinnitus does. Behavioral treatment is administered to avoid an involuntary response [24].

Central auditory system: Cochlea disruption increases neuronal function in the central auditory system. Tinnitus can be developed in the temporal lobe of the auditory interaction cortex and inferior colliculus [25]. The dorsal cochlear nucleus was involved as a potential site for the production of tinnitus-related signals due to its ability to be hyperactive after exposure to tinnitus-inducing agents such as strong sound and cisplatin. Mechanism might describe the temporary ringing sensation after exposure to loud sound [26].

Crosstalk theory where auditory nerve fibers are intact and certain other cranial nerves are impaired, artificial synapses may form between individual auditory nerve fibers, resulting in a phase-locking of the random behavior of auditory neuron classes which creates a neural pattern that resembles patterns evoked by actual sounds in absence of external sounds [27].

Auditory plasticity occurs as a result of the aberrant mechanism, and tinnitus can be perceived to be an auditory similar system to phantom limb experiences in amputees [28]. Tinnitus can be developed in the temporal lobe of the auditory interaction cortex and inferior colliculus [29].

Peripheral auditory system: Cochlea care emits spontaneous otoacoustic emissions usually inaudible and can be considered as tinnitus. SOAEs are usually inaudible, but they can become audible due to instability [30].

Tinnitus is caused by indistinct disruption of weakened OHCs and intact inner hair cells of the Corti organ according to discordant theory. It is believed that tinnitus is a result of the core benefit adaptation process when the auditory system is faced with hearing loss [31].

Contrast theory indicates that tinnitus is caused by elevated random activity in the edge area that reflects a transition from OHCs in the corti organ with comparatively normal morphology and work on the apical part of the lesion on OHCs to the basal side, which is absent or have a pathological morphology and poor functioning [32].

Limbic and autonomic nervous systems: For the first time, over 80 per cent of those who encounter tinnitus do not equate hearing with any negative sense and undergo spontaneous habituation. At the subconscious stage, tinnitus can escalate gradually without the patient being aware of it, resulting in increased activity in the nervous systems [33].

Somatosensory system: Somatic tinnitus may arise from the triggering of oto-somatic interactions. Somatic tinnitus, like otic tinnitus, is caused by the dis-inhibition of the ipsilateral DCN mediated by nerve fibers whose cells lie in the ipsilateral medullar somatosensory nucleus [34].

Diagnosis

The differential diagnosis is driven by the patient's clinical history. History of acoustic trauma, sensitivity to workplace noise or use of oto-toxic drugs should be used [35]. Primary elements of the physical examination involve the head, eyes, ears, nose, mouth, neck, and neurological system [36]. Ear should be well examined as well as the nervous system. The ear canal must be examined for discharge, foreign body, and cerumen. Tympanic membrane should be examined as well for infection and tumor. There should be a bedside hearing test. Cranial nerves, especially vestibular activity, should be tested alongside peripheral force, perception, and reflexes using stethoscope to listen to artery noise in and near the carotid arteries and jugular veins and next to the ear [37].

Both patients with tinnitus should be referred to an audiologist for an audiological examination to better evaluate the auditory ability and the occurrence of some hearing loss [38]. X-rays and MRI are not generally conducted for tinnitus because there is an unexpected change in hearing and coordination in the ears. Magnetic resonance angiogram and venogram of the brain and neck is the most useful test for patients with pulsatile tinnitus to rule out vascular anomalies. Relation to otolaryngologist or non-contrast magnetic resonance imaging of internal auditory canals is indicated for patients with non-pulsatile unilateral tinnitus and regular otoscopy results or asymmetrical SNHL [39]. If tinnitus is pulsatile or unilateral in nature, or suspicious otoscopy results are found, referring to an otolaryngologist is advised to rule out root causes [40].

Management

Sound amplification: Sound therapist involves noises occurring in natural environments, such as those correlated with rivers, rain, waterfalls, and breeze, to reduce the intensity of tinnitus-related neural activation within the auditory system [41]. In comparison, the use of white-noise machines was already found to be helpful in reducing the incidence of tinnitus and improving sleep. Other forms of natural noise as fan or music around going to bed may also be beneficial [42]. Sounds must be balanced and not alarming; thus, waves are not advised. The sound volume must be at or below the level where tinnitus and external noise can be perceived independently by the patient [43]. Based on study that constant sound stimulation increases the blood flow to the inner ear of rats, sound therapy can affect the physiology of human cochlea [44].

Cognitive therapy: Cognitive treatment includes teaching people how to deal with their tinnitus by changing unpleasant positive thoughts ideas. Cognitive therapy includes altering the mind correlated with tinnitus. Cognitive - behavioral therapy is intended to remove the sense of sound and correct one's negative reactions to tinnitus, concentrating mainly on counselling and calming strategies [45]. Patients are motivated to consider the fact that tinnitus is not deserving of all the consideration it receives. Stress relief instruction uses a directed method to instruct patients to apply gradual relaxation, including discomfort and relaxation of arms, face, hands, shoulders, belly, hips, and legs [46].

Hearing aids: Hearing aids are another type of sound therapy that is typically helpful to tinnitus patients with hearing loss. Hearing assistance is often helpful when tinnitus is combined with hearing damage. Any of the supports come with built-in calming or masking sounds [47]. Use of hearing aids will significantly decrease the neuronal function responsible for the development and perception of tinnitus and is typically the first therapy in patients with hearing difficulties [48].

Pharmacotherapy: Many pharmacological interventions can be effective when offered in conjunction with cautious control. The only treatment that produces a reliable improvement of tinnitus is injectable lidocaine. Lidocaine induces a difference in the neuronal function of the right temporal lobe of the cortex auditory association. Sadly, lidocaine should not be used orally as it has to be injected, has short-term consequences and also causes harmful side effects. Even so, in patients with underlying depression or anxiety, the use of antipsychotic drugs and antidepressants has been found to be successful in treating tinnitus conditions, lowering the level of irritability [49].

Conclusion

Tinnitus is a common disorder in the elderly population. Tinnitus affect quality of life in the elderly which can be improved through management strategies discussed in this paper. Tinnitus affects elderly's' daily activities and alter their sleeping patterns and the emotional status. Hearing deficiency is an significant risk factor for tinnitus, but it is not a reliable indicator for tinnitus. Further research on the various patterns of tinnitus and the forms of dizziness with their corresponding lifestyle factors should be performed.

Bibliography

1. Marchiori LM., *et al*. "Hypertension as a factor with hearing loss". *Revista Brasileira de Otorrinolaringologia* 72.4 (2006): 533-540.

2. Park K H., *et al*. "Prevalence and associated factors of tinnitus: data from the Korean National Health and Nutrition Examination Survey 2009-2011". *Journal of Epidemiology* 24.5 (2014): 417-426.

3. Kim HJ., *et al*. "Analysis of the prevalence and associated risk factors of tinnitus in adults". *PLoS One* 10 (2015): e0127578.

4. Homeier D. "Aging: physiology, disease, and abuse". *Clinics in Geriatric Medicine* 30 (2014): 671-686.

5. Ferreira LM., *et al*. "Characterization of tinnitus in the elderly and its possible related disorders". *Brazilian Journal of Otorhinolaryngology* 75 (2009): 249-255.

6. Schleuning AJ. "Management of the patient with tinnitus". *Medical Clinics of North America* 75.6 (1991): 1225-1237.

7. Song M., *et al*. "Chief Complaints of Elderly Individuals on Presentation to Emergency Department: A Retrospective Analysis of South Korean National Data 2014". *Asian Nursing Research* 10 (2016): 312-317.

8. Penger M., *et al*. "Country-specific and individual determinants of dizziness in Europe: results from the Survey of Health Ageing and Retirement in Europe (SHARE)". *Public Health* 149 (2017): 1-10.

9. Al-Swiahb J and Park SN. "Characterization of tinnitus in different age groups: A retrospective review". *Noise Health* 18.83 (2016): 214-219.

10. Wu V., *et al*. "Approach to tinnitus management". *Canadian Family Physician* 64.7 (2018): 491-495.

11. Negrila-Mezei A., *et al*. "Tinnitus in elderly population: clinic correlations and impact upon QoL". *The Journal of Medicine and Life* 4.4 (2011): 412-416.

12. Teixeira AR., *et al*. "Tinnitus in Elderly Individuals: Discomfort and Impact in the Quality of Life". *International Archives of Otorhinolaryngology* 21.1 (2017): 66-71.

13. Ogido R., *et al*. "Prevalência de sintomas auditivos e vestibulares em trabalhadores expostos a ruído ocupacional". *Revista de Saúde Pública* 43.2 (2009): 377-380.

14. Chang NC., *et al*. "Prevalence of Persistent Tinnitus and Dizziness in an Elderly Population in Southern Taiwan". *The Journal of International Advanced Otology* 15.1 (2019): 99-105.

15. Jastreboff PJ and Hazell JWP. "A neurophysiological approach to tinnitus: Clinical implications". *British Journal of Audiology* 27 (1993): 7-17.

16. Shargorodsky J., *et al*. "Change in prevalence of hearing loss in US adolescents". *The Journal of the American Medical Association* 304 (2010): 772-778.

17. Brunger K. "Managing tinnitus". *Journal of Family Medicine and Health Care* 18 (2008): 47-48.

18. Shargorodsky J., *et al*. "Prevalence and characteristics of tinnitus among US adults". *The American Journal of Medicine* 123 (2010): 711-718.

19. Statistics Canada [website]. Hearing loss of Canadians, 2012 and 2013. Ottawa, ON: Statistics Canada; (2015).

20. Hinton DE., *et al*. "Tinnitus among Cambodian refugees: relationship to PTSD severity". *Journal of Traumatic Stress* 19 (2006): 541-546.

21. Henry JA. "Audiologic Assessment". In: Snow J, editor. Tinnitus: theory and management. Ontario: BC Decker Inc (2004): 220-236.

22. Lockwood AH., *et al*. "Tinnitus". *The New England Journal of Medicine* 347 (2002): 904-910.

23. Leske MC. "Prevalence estimates of communicative disorders in the U.S. Language, hearing and vestibular disorders". *ASHA* 23 (1981): 229-237.

24. Tamir SO., *et al*. "Tinnitus Perspectives among Israeli Ear, Nose and Throat Physicians: A Nationwide Survey". *The Journal of International Advanced Otology* 14.3 (2018): 437-442.

25. Kaltenbach JA., *et al*. "Neural correlates of tinnitus". In: Snow J, editor. Tinnitus: theory and management. Ontario: BC Decker Inc (2004): 141-161.

26. Schreiner CE and Cheung SW. "Cortical plasticity and tinnitus". In: Snow JB, editor. Tinnitus: Theory and management. Ontario: BC Decker Inc (2004): 189-204.

27. Kaltenbach JA., *et al*. "Plasticity of spontaneous neural activity in the dorsal cochlear nucleus after intense sound exposure". *Hearing Research* 147 (2000): 282-292.

28. Lockwood AH., *et al*. "Neuroanatomy of tinnitus". *Scandinavian Audiology* 51 (1999): 47-52.

29. Reyes SA., *et al*. "Brain imaging of the effects of lidocaine on tinnitus". *Hearing Research* 171 (2002): 43-50.

30. Huang ZW., *et al*. "Paradoxical enhancement of active cochlear mechanics in long-term administration of salicylate". *Journal of Neurophysiology* 93 (2005): 2053-2061.

31. Parra LC and Pearlmutter BA. "Illusory percepts from auditory adaptation". *Journal of the Acoustical Society of America* 121 (2007): 1632-1641.

32. Nuttal AL., *et al*. "Peripheral process involved in tinnitus". In: Snow JB, editor. Tinnitus: theory and management. Ontario: BC Decker (2004): 52-68.

33. Jastreboff PJ and Hazell JW. "Tinnitus Retraining Therapy". New York: Cambridge University Press (2004).

34. Levine RA. "Somatic (craniocervical) tinnitus and the dorsal cochlear nucleus hypothesis". *American Journal of Otolaryngology* 20 (1999): 351-362.

35. Sismanis A. "Pulsatile tinnitus". *Otolaryngologic Clinics of North America* 36.2 (2003): 389-402.

36. Gopinath B., *et al.* "Risk factors and impacts of incident tinnitus in older adults". *Annals of Epidemiology* 20.2 (2010): 129-135.

37. Nondahl DM., *et al.* "Prevalence and 5-year incidence of tinnitus among older adults: the epidemiology of hearing loss study". *The Journal of the American Academy of Audiology* 13.6 (2002): 323-331.

38. Henry JA., *et al.* "Progressive tinnitus management. Clinical handbook for audiologists". San Diego, CA: Plural Publishing Inc (2010).

39. Beukes EW., *et al.* "Internet-based interventions for adults with hearing loss, tinnitus and vestibular disorders: a protocol for a systematic review". *Systematic Reviews* 7.1 (2018): 205.

40. Fortnum H., *et al.* "The role of magnetic resonance imaging in the identification of suspected acoustic neuroma: a systematic review of clinical and cost effectiveness and natural history". *Health Technology Assessment* 13.18 (2009): 1-154.

41. Jastreboff PJ and Jastreboff MM. "Tinnitus retraining therapy". In: Snow J, editor. Tinnitus: theory and management. Ontario: BC Decker Inc (2004): 295-309.

42. Folmer RL., *et al.* "Tinnitus sound therapy". In: Tyler RS, editor. Tinnitus treatment. New York: Thieme (2006): 176-186.

43. Quirk WS., *et al.* "The influence of loud sound on red blood cell velocity and blood vessel diameter in the cochlea". *Hearing Research* 63 (1992): 102-107.

44. Sandlin RE and Olsson RJ. "Evaluation and selection of maskers and other devices used in the treatment of tinnitus and hyperacusis". *Trends In Amplification* 4.1 (1999): 6-26.

45. Jun HJ and Park MK. "Cognitive behavioral therapy for tinnitus: evidence and efficacy". *Korean Journal of Audiology* 17.3 (2013): 101-104.

46. Tyler RS., *et al.* "Psychological treatments for tinnitus". In: Snow J, editor. Tinnitus: theory and management. Ontario: BC Decker Inc (2004): 314-325.

47. Andersson G and Kaldo V. "Cognitive-behavioral therapy with applied relaxation". In: Tyler RS, editor. Tinnitus treatment. New York: Thieme (2006): 96-115.

48. Robinson S. "Antidepressants for treatment of tinnitus". *Progress in Brain Research* 166 (2007): 263-271.

49. Fornaro M and Martino M. "Tinnitus psychopharmacology: a comprehensive review of its pathomechanisms and management". *Neuropsychiatric Disease and Treatment* 6 (2010): 209-218.

Volume 17 Issue 2 February 2021