



## Tinnitus: Ringing in the Ears —An Overview from the Vestibular Disorders Association

By The Vestibular Disorders Association, Portland, Oregon

### What is tinnitus?

Tinnitus is abnormal noise perceived in one or both ears or in the head. Tinnitus (pronounced either “TIN-uh-tus” or “tin-NY-tus”) may be intermittent, or it might appear as a constant or continuous sound. It can be experienced as a ringing, hissing, whistling, buzzing, or clicking sound and can vary in pitch from a low roar to a high squeal.

Tinnitus is very common. Most studies indicate the prevalence in adults as falling within the range of 10% to 15%, with a greater prevalence at higher ages, through the sixth or seventh decade of life.<sup>1</sup> Gender distinctions are not consistently reported across studies, but tinnitus prevalence is significantly higher in pregnant than non-pregnant women.<sup>2</sup>

The most common form of tinnitus is *subjective tinnitus*, which is noise that other people cannot hear. *Objective tinnitus* can be heard by an examiner positioned close to the ear. This is a rare form of tinnitus, occurring in less than 1% of cases.<sup>3</sup>

Chronic tinnitus can be annoying, intrusive, and in some cases devastating to a person’s life. Up to 25% of those with chronic tinnitus find it severe enough to seek treatment.<sup>4</sup> It can interfere with a person’s ability to hear, work, and perform

daily activities. One study showed that 33% of persons being treated for tinnitus reported that it disrupted their sleep, with a greater degree of disruption directly related to the perceived loudness or severity of the tinnitus.<sup>5,6</sup>

### Causes and related factors

Most tinnitus is associated with damage to the auditory (hearing) system, although it can also be associated with other events or factors: jaw, head, or neck injury; exposure to certain drugs; nerve damage; or vascular (blood-flow) problems. With *severe* tinnitus in adults, coexisting factors may include hearing loss, dizziness, head injury, sinus and middle-ear infections, or mastoiditis (infection of the spaces within the mastoid bone). Significant factors associated with *mild* tinnitus may include meningitis (inflammation of the membranous covering of the brain and spinal cord), dizziness, migraine, hearing loss, or age.<sup>7</sup>

Forty percent of tinnitus patients have decreased sound tolerance, identified as the sum of *hyperacusis* (perception of over-amplification of environmental sounds) and *misophonia/phonophobia* (dislike/fear of environmental sounds).<sup>8</sup> While most cases of tinnitus are associated with some form of hearing impair-

ment, up to 18% of cases do not involve reports of abnormal hearing.<sup>9</sup>

## Ear disorders

### Hearing loss from exposure to loud noise:

Acute hearing depends on the microscopic endings of the hearing nerve in the inner ear. Exposure to loud noise can injure these nerve endings and result in hearing loss. Hearing damage from noise exposure is considered to be the leading cause of tinnitus.

**Presbycusis:** Tinnitus can also be related to the general impairment of the hearing nerve that occurs with aging, known as presbycusis. Age-related degeneration of the inner ear occurs in 30% of persons age 65–74, and in 50% of persons 75 years or older.<sup>10</sup>

**Middle-ear problems:** Tinnitus is reported in 65% of persons who have preoperative *otosclerosis* (stiffening of the middle-ear bones),<sup>11</sup> with the tinnitus sound typically occurring as a high-pitched tone or white noise rather than as a low tone.<sup>12</sup> *Otitis media* (middle-ear infection) can be accompanied by tinnitus, which usually disappears when the infection is treated. If repeated infections cause a *cholesteatoma* (benign mass of skin cells in the middle ear behind the eardrum), hearing loss, tinnitus, and other symptoms can result.<sup>13</sup> Objective tinnitus has been associated with *myoclonus* (contraction or twitching) of the small muscles in the middle ear.<sup>14,15</sup> Conductive hearing loss resulting from an accumulation of earwax in the ear canal can sometimes cause tinnitus.

**Vestibular disorders:** Hearing impairment and related tinnitus often accompany dysfunction of the balance organs (vestibular system). Some vestibular disorders associated with tinnitus

include *Ménière's disease* and *secondary endolymphatic hydrops* (resulting from abnormal amounts of a fluid called *endolymph* collecting in the inner ear) and *perilymph fistula* (a tear or defect in one or both of the thin membranes between the middle and inner ear).

## Vestibulo-cochlear nerve damage and central auditory system changes

The vestibulo-cochlear nerve, or eighth cranial nerve, carries signals from the inner ear to the brain. Tinnitus can result from damage to this nerve. Such damage can be caused by an *acoustic neuroma*, also known as a *vestibular schwannoma* (benign tumor on the vestibular portion of the nerve), *vestibular neuritis* (viral infection of the nerve), or *microvascular compression syndrome* (irritation of the nerve by a blood vessel).

The perception of chronic tinnitus has also been associated with hyperactivity in the central auditory system, especially in the auditory cortex.<sup>16</sup> In such cases, the tinnitus is thought to be triggered by damage to the *cochlea* (the peripheral hearing structure) or the vestibulo-cochlear nerve.

## Head and neck trauma

Compared with tinnitus from other causes, tinnitus due to head or neck trauma tends to be perceived as louder and more severe. It is accompanied by more frequent headaches, greater difficulties with concentration and memory, and a greater likelihood of depression.<sup>17</sup>

*Somatic tinnitus* is the term used when the tinnitus is associated with head, neck, or dental injury—such as misalignment of the jaw or temporomandibular joint (TMJ)—and occurs in the absence of hearing loss. Characteristics of somatic tinnitus include intermittency, large

fluctuations in loudness, and variation in the perceived location and pattern of its occurrence throughout the day.<sup>18</sup>

### **Medications**

Many drugs can cause or increase tinnitus. These include certain non-steroidal anti-inflammatory drugs (NSAIDs, such as Motrin, Advil, and Aleve), certain antibiotics (such as gentamicin and vancomycin), loop diuretics (such as Lasix), aspirin and other salicylates, quinine-containing drugs, and chemotherapy medications (such as carboplatin and cisplatin). Depending on the medication dosage, the tinnitus can be temporary or permanent.<sup>3</sup>

### **Vascular sources**

*Pulsatile tinnitus* is a rhythmic pulsing sound that sometimes occurs in time with the heartbeat. This is typically a result of noise from blood vessels close to the inner ear. Pulsatile tinnitus is usually not serious. However, sometimes it is associated with serious conditions such as high or low blood pressure, hardening of the arteries (arteriosclerosis), anemia, vascular tumor, or aneurysm.

### **Other possible causes**

Other conditions have been linked to tinnitus: high stress levels, the onset of a sinus infection or cold, autoimmune disorders (such as rheumatoid arthritis or lupus), hormonal changes, diabetes, fibromyalgia, Lyme disease, allergies, depletion of cerebrospinal fluid, vitamin deficiency, and exposure to lead. In addition, excessive amounts of alcohol or caffeine exacerbate tinnitus in some people.

### **Diagnosis**

Examination by a primary care physician will help rule out certain sources of tinnitus, such as blood pressure or medication problems. This

doctor can also, if necessary, provide a referral to an ear, nose, and throat specialist (an otolaryngologist, otologist, or neurotologist), who will examine the ears and hearing, in consultation with an audiologist. Their evaluations might involve extensive testing that can include an audiogram (to measure hearing), a tympanogram (to measure the stiffness of the eardrum and help detect the presence of fluid in the middle ear), otoacoustic emissions testing (to provide information about how the hair cells of the cochlea are working), an auditory brainstem response test (to measure how hearing signals travel from the ear to the brain and then within parts of the brain), electrocochleography (to measure how sound signals move from the ear along the beginning of the hearing nerve), vestibular-evoked myogenic potentials (to test the functioning of the saccule and/or inferior vestibular nerve), blood tests, and magnetic resonance imaging (MRI). Neuropsychological testing is also sometimes included to screen for the presence of anxiety, depression, or obsessiveness—which are understandable and not uncommon effects when tinnitus has disrupted a person's life.

### **Treatment**

If a specific cause of the tinnitus is identified, treatment may be available to relieve it. For example, if TMJ dysfunction is the cause, a dentist may be able to relieve symptoms by realigning the jaw or adjusting the bite with dental work. If an infection is the cause, successful treatment of the infection may reduce or eliminate the tinnitus.

Many cases of tinnitus have no identifiable cause, however, and thus are more difficult to treat. Although a person's tolerance of tinnitus tends to increase with time,<sup>19</sup> severe cases can be disturbing for many years. In such chronic cases, a variety of treatment approaches are

available, including medication, dietary adjustments, counseling, and devices that help mask the sound or desensitize a person to it. Not every treatment works for every person.

### **Masking devices**

A masking device emits sound that obscures, though does not eliminate, the tinnitus noise. The usefulness of maskers is based on the observation that tinnitus is usually more bothersome in quiet surroundings<sup>20</sup> and that a competing sound at a constant low level, such as a ticking clock, whirring fan, ocean surf, radio static, or white noise produced by a commercially available masker, may disguise or reduce the sound of tinnitus, thus making it less noticeable. Some tinnitus sufferers report that they sleep better when they use a masker. In some users, maskers produce *residual inhibition*—tinnitus suppression that lasts for a short while after the masker has been turned off.

Hearing aids are sometimes used as maskers. If hearing loss is involved, properly fitted hearing aids can improve hearing and may reduce tinnitus temporarily. However, tinnitus can actually worsen if the hearing aid is set at an excessively loud level.

Cochlear implants, used for persons who are profoundly deaf or severely hard-of-hearing, have been shown to suppress tinnitus in up to 92% of patients.<sup>21,22</sup> This is likely a result of masking due to newly perceived ambient sounds or from electrical stimulation of the auditory nerve.

Other devices under development may eventually prove effective in relieving tinnitus. For example, the recently introduced acoustics-based Neuromonics device involves working with an audiologist who matches the frequency

spectrum of the perceived tinnitus sound to music that overlaps this spectrum. This technique aims to stimulate a wide range of auditory pathways, the limbic system (a network of structures in the brain involved in memory and emotions), and the autonomic nervous system such that a person is desensitized to the tinnitus. Assessing the true effectiveness of this device will require further scientific study, although observations from an initial stage of clinical trials indicate that the device can reduce the severity of symptoms and improve quality of life.<sup>23</sup>

### **Tinnitus retraining therapy**

Tinnitus retraining therapy (TRT) is designed to help a person retrain the brain to avoid thinking about the tinnitus. It employs a combination of counseling and a non-masking sound that decreases the contrast between the sound of the tinnitus and the surrounding environment.<sup>24</sup> The goal is not to eliminate the perception of the tinnitus sound itself, but to retrain a person's conditioned negative response (annoyance, fear) to it.

In one comparison of the effectiveness of tinnitus masking and TRT as treatments, masking was found to provide the greatest benefit in the short term (three to six months), while TRT provided the greatest improvement with continued treatment over time (12–18 months).<sup>25</sup>

### **Psychological treatments**

Chronic tinnitus can disrupt concentration, sleep patterns, and participation in social activities, leading to depression and anxiety. In addition, tinnitus tends to be more persistent and distressful if a person obsesses about it. Consulting with a psychologist or psychiatrist can be useful when the emotional

reaction to the perception of tinnitus becomes as troublesome as the tinnitus itself<sup>19</sup> and when help is needed in identifying and altering negative behaviors and thought patterns.

### Medication

No drug is available to cure tinnitus; however, some drugs have been shown to be effective in treating its psychological effects. These include anti-anxiety medications in the benzodiazepine family, such as clonazepam (Klonopin) or lorazepam (Ativan); antidepressants in the tricyclic family, such as amitriptyline (Elavil) and nortriptyline (Aventyl, Nortrilen, Pamelor); and some selective serotonin reuptake inhibitors (SSRIs), such as fluoxetine (Prozac).<sup>26,27,28,29</sup>

Other drugs have been anecdotally associated with relief of tinnitus. These include certain heart medications, anesthetics, antihistamines, statins, vitamin or mineral supplements, vasodilators, anticonvulsants, and various homeopathic or herbal preparations. Scientific evidence is lacking to support the effectiveness of many of these remedies.<sup>27,30,31</sup> Some appear to be placebos, while some are possibly mildly or temporarily effective but with potential side effects that are serious.

Examples of recent research studies on some of these anecdotal treatments follow, although this list is not exhaustive:

- In assessing the effectiveness of atorvastatin (Lipitor) in the treatment of tinnitus, scientists observed a trend toward relief of symptoms; however, this trend was not statistically significant when compared with results produced by administration of a placebo.<sup>32</sup>
- The relationship between low blood zinc levels and subjective tinnitus was inspected in a small placebo-controlled study.

Administration of oral zinc medication produced results that prompted the researchers to note that additional tests were needed to investigate whether duration of treatment might be a significant factor.<sup>33</sup>

- Immediate suppression of subjective tinnitus has been observed in patients administered intravenous lidocaine,<sup>34</sup> although such relief has been shown to be very short term.<sup>35</sup> The effect of such tinnitus treatment is thought to occur in the central auditory pathway rather than in the cochlea.<sup>36</sup>
- Scientists demonstrated that the anti-convulsant gabapentin (Neurontin) is no more effective than placebo in treatment of tinnitus.<sup>37,38</sup>
- When scientists reported their finding that *Ginkgo biloba* extracts and placebo treatments produce very similar results, they also noted that use of the extract could lead to adverse side effects, especially if used unsupervised and with other medications.<sup>39,40</sup>

Some alternative approaches may eventually yield helpful options in tinnitus treatment. However, most scientists agree that additional well-constructed research is needed before any anecdotally associated preparation can be applied as a proven and effective treatment option.

### Surgery

Treating tinnitus with surgery is generally limited to being a possible secondary outcome of surgery that is used in cases when the source of the tinnitus is identified (such as acoustic neuroma, perilymph fistula, or otosclerosis) and surgical intervention is required to treat that condition.<sup>41</sup>

## Other proposed treatments

Stress-reduction techniques are often advocated for improving general health, as they can help control muscle groups and improve circulation throughout the body. Such relaxation training, the use of biofeedback to augment relaxation exercises, and hypnosis have been suggested as treatments for tinnitus. Limited research is available on the effectiveness of these methods.

Acupuncture, electrical stimulation, application of magnets, electromagnetic stimulation, and ultrasound have been found to be placebo treatments for tinnitus or to have limited scientific support for their effectiveness.<sup>27,30,42,43</sup>

Recent and ongoing research studies have attempted to assess whether transcranial magnetic stimulation could be an effective tinnitus treatment. This application is based on the thought that tinnitus is associated with an irregular activation of the temporoparietal cortex (a part of the brain), and thus that disturbing this irregular activation could result in transient reduction of tinnitus.<sup>44,45,46</sup>

## Prevention

Precautionary measures to help lessen the severity of tinnitus or help a person cope with tinnitus are related to some of the causes and treatments listed above. Avoiding exposure to loud sounds (especially work-related noise) and getting prompt treatment for ear infections have been identified as the two most important interventions for reducing the risk of tinnitus.<sup>47</sup> Wearing ear protection against loud noise at work or at home and avoiding listening to music at high volume can both help reduce risk.<sup>48</sup>

Other important factors are exercising daily, getting adequate rest, and having blood pressure monitored and controlled, if needed. Additional

precautionary measures include limiting salt intake, avoiding stimulants such as caffeine and nicotine, and avoiding ototoxic drugs known to increase tinnitus (some of which are listed above under “Causes and Related Factors”).

## Summary

Tinnitus is a common condition that can disrupt a person’s life. Our understanding of the mechanisms of tinnitus is incomplete, and many unknown factors remain. These limitations contribute to the lack of medical consensus about tinnitus management, stimulate continued research efforts, and motivate anecdotal and commercially based speculation about potential but unproven treatments. Prior to receiving any treatment for tinnitus or head noise, it is important for a person to have a thorough examination that includes an evaluation by a physician. Understanding the tinnitus and its possible causes is an essential part of its treatment.

## References

1. Henry JA, Dennis KC, Schechter MA. General review of tinnitus: prevalence, mechanisms, effects, and management. *Journal of Speech, Language, and Hearing Research* 2005;48(5):1204–1235.
2. Gurr P, Owen G, Reid A, Canter R. Tinnitus in pregnancy. *Clinical Otolaryngology & Allied Sciences* 1993;18(4):294–297.
3. Folmer L, Hal Martin W, Shi Y. Tinnitus: Questions to reveal the cause, answers to provide relief. *Journal of Family Practice* 2004;53(7):532–540.
4. Seidman MD, Jacobson GP. Update on tinnitus. *Otolaryngologic Clinics of North America* 1996;29:455–465.
5. Folmer RL, Griest SE. Tinnitus and insomnia. *American Journal of Otolaryngology* 2000;21(5):287–293.
6. Hiller W, Goebel G. Factors influencing tinnitus loudness and annoyance. *Archives of Otolaryngology—Head & Neck Surgery* 2006;132(12):1323–1330.
7. Sindhusake D, Golding M, Wigney D, Newall P, Jakobsen K, Mitchell P. Factors predicting severity of tinnitus: a population-based assessment. *Journal of the American Academy of Audiology* 2004;15(4):269–280.

8. Jastreboff PJ, Jastreboff MM. Chapter 22: Tinnitus and Hyperacusis In: Snow JB, Ballenger JJ, eds. *Ballenger's Otorhinolaryngology Head and Neck Surgery*. 16<sup>th</sup> ed. Hamilton, Ontario: BC Decker; 2003:456–475.
9. Stouffer JL, Tyler RS. Characterization of tinnitus by tinnitus patients. *Journal of Speech and Hearing Disorders* 1990;55(3):439–453.
10. Blackwell DL, Collins JG, Coles R. Summary health statistics for U.S. adults: National Health Interview Survey, 1997. *Vital Health Statistics* 2002;10:1–109.
11. Gristwood RE, Venables WN. Otosclerosis and chronic tinnitus. *Annals of Otolaryngology, Rhinology, & Laryngology* 2003;112(5):398–403.
12. Sobrinho PG, Oliveira CA, Venosa AR. Long-term follow-up of tinnitus in patients with otosclerosis after stapes surgery. *International Tinnitus Journal* 2004;10(2):197–201.
13. Falcioni M, et al. Pulsatile tinnitus as a rare presenting symptom of residual cholesteatoma. *Journal of Laryngology & Otolaryngology* 2004;118(2):165–166.
14. Golz A, Fradis M, Martzu D, Netzer A, Joachims HZ. Stapedius muscle myoclonus. *Annals of Otolaryngology, Rhinology, & Laryngology* 2003;112(6):522–524.
15. Howsam GD, Sharma A, Lambden SP, Fitzgerald J, Prinsley PR. Bilateral objective tinnitus secondary to congenital middle-ear myoclonus. *Journal of Laryngology & Otolaryngology* 2005;119(6):489–491.
16. Lockwood AH, Salvi RJ, Coad ML, Towsley ML, Wack DS, Murphy BW. The functional neuroanatomy of tinnitus: evidence for limbic system links and neural plasticity. *Neurology* 1998;50(1):114–120.
17. Folmer RL, Griest SE. Chronic tinnitus resulting from head or neck injuries. *Laryngoscope* 2003;113(5):821–827.
18. Levine RA. Somatic Tinnitus. In Snow JB, ed. *Tinnitus: Theory and Management*. Lewiston, NY: BC Decker; 2004:108–124.
19. Andersson G, Vretblad P, Larsen H, Lyttkens L. Longitudinal follow-up of tinnitus complaints. *Archives of Otolaryngology—Head & Neck Surgery* 2001;127(12):175–179.
20. Tucker DA, Phillips SL, Ruth RA, Clayton WA, Royster E, Todd AD. The effect of silence on tinnitus perception. *Otolaryngology—Head & Neck Surgery* 2005;132(1):20–24.
21. Ruckenstein MJ, Hedgepeth C, Rafter KO, Montes ML, Bigelow DC. Tinnitus suppression in patients with cochlear implants. *Otology and Neurotology* 2001;22(2):200–204.
22. Yonehara E, Mezzalana R, Porto PR, Bianchini WA, Calonga L, Curi SB, Stoler G. Can cochlear implants decrease tinnitus? *International Tinnitus Journal* 2006;12(2):172–174.
23. Davis PB, Paki B, Hanley PJ. Neuromonics tinnitus treatment: third clinical trial. *Ear and Hearing*. 2007;28(2):242–259.
24. Jastreboff PJ, Gray WC, Gold SL. Neurophysiological approach to tinnitus patients. *American Journal of Otolaryngology* 1996;17(2):236–240.
25. Henry JA, Schechter MA, Zaugg TL, Griest S, Jastreboff PJ, Vernon JA, Kaelin C, Meikle MB, Lyons KS, Stewart BJ. Clinical trial to compare tinnitus masking and tinnitus retraining therapy. *Acta Otolaryngologica Supplementum* 2006;(556):64–69.
26. Dobie RA, Sakai CS, Sullivan MD, Katon WJ, Russo J. Antidepressant treatment of tinnitus patients: report of a randomized clinical trial and clinical prediction of benefit. *American Journal of Otolaryngology* 1993;14(1):18–23.
27. Dobie RA. A review of randomized clinical trials in tinnitus. *Laryngoscope* 1999;109(8):1202–1211.
28. Ganança MM, Caovilla HH, Ganança FF, Ganança CF, Munhoz MS, da Silva ML, Serafini F. Clonazepam in the pharmacological treatment of vertigo and tinnitus. *International Tinnitus Journal* 2002;8(1):50–53.
29. Folmer RL, Shi YB. SSRI use by tinnitus patients: interactions between depression and tinnitus severity. *Ear, Nose, & Throat Journal* 2004;83(2):107–8,110,112 passim.
30. Dobie RA. Clinical trials and drug therapy for tinnitus. In Snow JB, ed. *Tinnitus: Theory and Management*. Lewiston, NY: BC Decker; 2004:266–277.
31. Seidman MD, Babu S. Alternative medications and other treatments for tinnitus: facts from fiction. *Otolaryngologic Clinics of North America* 2003;36(2):359–381.
32. Olzowy B, Canis M, Hempel JM, Mazurek B, Suckfüll M. Effect of atorvastatin on progression of sensorineural hearing loss and tinnitus in the elderly: results of a prospective, randomized, double-blind clinical trial. *Otology and Neurotology* 2007;28(4):455–458.
33. Arda HN, Tuncel U, Akdogan O, Ozluoglu LH. The role of zinc in the treatment of tinnitus. *Otology and Neurotology* 2003;24(1):86–89.
34. Otsuka K, Pulec JL, Suzuki M. Assessment of intravenous lidocaine for the treatment of subjective tinnitus. *Ear, Nose, & Throat Journal* 2003;82(10):781–784.
35. Kalcioğlu MT, Bayindir T, Erdem T, Ozturan O. Objective evaluation of the effects of intravenous lidocaine on tinnitus. *Hearing Research* 2005; 199(1–2):81–88.

36. Baguley DM, Jones S, Wilkins I, Axon PR, Moffat DA. The inhibitory effect of intravenous lidocaine infusion on tinnitus after translabyrinthine removal of vestibular schwannoma: a double-blind, placebo-controlled, crossover study. *Otology and Neurotology* 2005;26(2):169–176.
37. Piccirillo JF, Finnell J, Vlahiotis A, Chole RA, Spitznagel E Jr. Relief of idiopathic subjective tinnitus: is gabapentin effective? *Archives of Otolaryngology—Head & Neck Surgery* 2007;133(4):390–397.
38. Witsell DL, Hannley MT, Stinnet S, Tucci DL. Treatment of tinnitus with gabapentin: a pilot study. *Otology and Neurotology* 2007;28(1):11–15.
39. Drew A, Davies E. Effectiveness of Ginkgo biloba in treating tinnitus: double blind, placebo controlled trial. *BMJ* 2001;322(7278):73.
40. Smith PF, Zheng Y, Darlington CL. Ginkgo biloba extracts for tinnitus: More hype than hope? *Journal of Ethnopharmacology* 2005;22(1–2):95–99.
41. House JW, Brackmann DE. Tinnitus: surgical treatment. *Ciba Foundation Symposium* 1981;85:204–216.
42. Park J, White AR, Ernst E. Efficacy of acupuncture as a treatment for tinnitus: A systematic review. *Archives of Otolaryngology—Head & Neck Surgery* 2000;126(4):489–492.
43. Ghossaini SN, Spitzer B, Mackins CC, Zschommler A, Diamond BE, Wazen JJ. High-frequency pulsed electromagnetic energy in tinnitus treatment. *Laryngoscope* 2004;114(3):495–500.
44. Plewnia C, Bartels M, Gerloff C. Transient suppression of tinnitus by transcranial magnetic stimulation. *Annals of Neurology* 2003;53(2):263–266.
45. Folmer RL, Carroll JR, Rahim A, Shi Y, Hal Martin W. Effects of repetitive transcranial magnetic stimulation (rTMS) on chronic tinnitus. *Acta Oto-laryngologica Supplementum* 2006;556:96–101.
46. Smith JA, Mennemeier M, Bartel T, Chelette KC, Kimbrell T, Triggs W, Dornhoffer JL. Repetitive transcranial magnetic stimulation for tinnitus: a pilot study. *Laryngoscope* 2007;117(3):529–534.
47. Sindhusake D, Golding M, Newall P, Rubin G, Jakobsen K, Mitchell P. Risk Factors for tinnitus in a population of older adults: the Blue Mountains hearing study. *Ear and Hearing* 2003;24(6):501–507.
48. Schmuziger N, Patscheke J, Probst R. Hearing in nonprofessional pop/rock musicians. *Ear and Hearing* 2006;27(4):321–330.

---

© 2007 Vestibular Disorders Association

VEDA's publications are protected under copyright. For more information, see our permissions guide at [www.vestibular.org/](http://www.vestibular.org/).

*This document is not intended as a substitute for professional health care.*



# Did this free publication from VEDA help you?

Thanks to VEDA, vestibular disorders are becoming recognized for their impacts on lives and our economy. We see new diagnostic tools and research studies, more accessible treatments, and a growing respect for how life-changing vestibular disorders can be.

VEDA provides tools to help people have a better quality of life: educational materials, support networks, professional resources, and elevated public awareness.

Your support of VEDA matters. Please help us to continue providing such great help by becoming a member or donor.

Members receive an information packet; discounts on purchases; a subscription to VEDA's newsletter, *On the Level*, containing information on diagnosis, treatment, research, and coping strategies; and the option of communicating directly with others who understand the personal impacts of a vestibular disorder. Professional members also receive the option to list training opportunities on our site, bulk-discounted prices on patient education materials, and a listing on VEDA's provider directory, the only of its kind serving patients seeking help from a vestibular specialist.

## SUPPORT VEDA

### Membership, 1-year

- \$ 35 ... Basic (US)
- \$ 45 ... Basic (international)
- \$100 ... Professional  
(1 specialist, all countries)

\$ \_\_\_\_\_ Please indicate your desired subscription amount here.

### Optional Contribution

I'd to support VEDA with a donation (instead of- or in addition to membership).

\$ \_\_\_\_\_ Please indicate your desired subscription amount here.

Check this box if you prefer that your donation remain anonymous.

\$  Total

## PAYMENT INFORMATION

If you prefer, you can make your purchases online at <https://vestibular.org/shop/>.

Check or money order in US funds, payable to VEDA (enclosed)

Visa \_\_\_\_\_  
 MC \_\_\_\_\_ Card number \_\_\_\_\_ Card exp. date (mo./yr.)  
 Amex \_\_\_\_\_  
 Billing address of card (if different from mailing information) \_\_\_\_\_

## MAILING INFORMATION

Name \_\_\_\_\_  
 Address \_\_\_\_\_ City \_\_\_\_\_  
 State/Province \_\_\_\_\_ Zip/Postal code \_\_\_\_\_ Country \_\_\_\_\_  
 Telephone \_\_\_\_\_ E-mail \_\_\_\_\_