

# Tinnitus and the influence of hearing loss



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# Tinnitus described

Tinnitus is a condition in which sound is perceived without an external source. This sound is usually experienced as buzzing, hissing or ringing rather than fully-formed sounds e.g. speech or music.<sup>1</sup> It is not to be confused with the auditory hallucinations experienced during bouts of mental illness. Tinnitus noise can occur in one or both ears, or be experienced as arising within the head, and can have a profound effect on the sufferer (see Table 1).<sup>1,2</sup> Therefore, the goal of tinnitus management should be a reduction in its severity.

Tinnitus affects 10%–15% of the general population worldwide, i.e. around 280 million people.<sup>1</sup> Of these, 1%–2% (up to 5.6 million) suffer impairments of daily living. The burden of tinnitus is expected to grow further due to the increasing size of the elderly population and noise exposure in both work and leisure environments. Tinnitus is highly variable. Some patients are able to cope with the noise and their lives continue as normal. At the other extreme, some patients suffer so much that daily living is difficult and they are unable to work. Others suffer a level of impairment between these two levels.

There are well-established risk factors for tinnitus:<sup>1</sup>

- hearing impairment
- increasing age
- gender (male)
- noise exposure

The characteristics of tinnitus sounds are described in Table 1.

Noise criteria	Possible features
Onset	Sudden, gradual
Pattern	Pulsatile, intermittent, constant, fluctuating
Site	Right or left ear, both ears, within head
Loudness	Wide range, varying over time
Quality	Pure tone, noise, polyphonic
Pitch	Very high, high, medium, low

Table 1. Features of tinnitus noise



# Hearing loss, tinnitus and the brain

"Hearing loss is a hidden disability and to have tinnitus is sort of like a double whammy" (Interviewee reported by Southall et al<sup>3</sup>)

Several lines of evidence highlight a strong association of hearing loss and tinnitus (Figure 1).<sup>4-7</sup>

- Most patients with tinnitus have some degree of hearing loss.
- Between 75% and 90% of patients with otosclerosis have tinnitus.
- About 80% of patients with idiopathic sensorineural hearing loss have tinnitus.

A small study of people with normal hearing showed that simulated hearing loss can induce phantom sound perception.<sup>8</sup>

A group of 18 subjects wore an ear plug in one ear for 7 days. During this time, 14/18 reported experiencing phantom sounds, and 11/18 experienced stable phantom sounds after 7 days. On restoration of hearing by removing the ear plug, the experience of phantom sounds vanished within a few hours.

Current research is centered around the view that tinnitus is a systemic problem originating from imbalances in the excitatory and inhibitory inputs to auditory neurons.<sup>9</sup>

The currently accepted theory is that tinnitus is generated in the brain, triggered by the loss of normal input from the inner ear (Figure 1).<sup>10</sup> The decreased input from the cochlea due to outer hair cell damage results in readjustments in the central auditory system leading to abnormal neural activity including hyperactivity, bursting discharges and increases in neural synchrony (see Figure 2 and 3).<sup>9</sup>

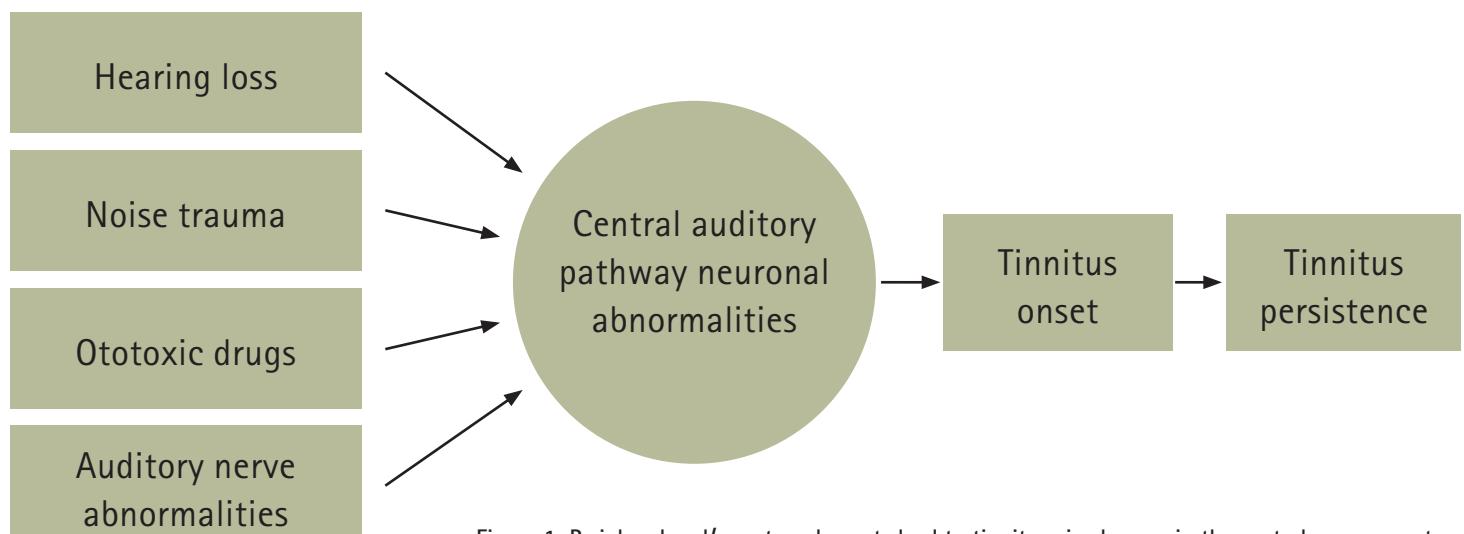


Figure 1. Peripheral and/or external events lead to tinnitus via changes in the central nervous system

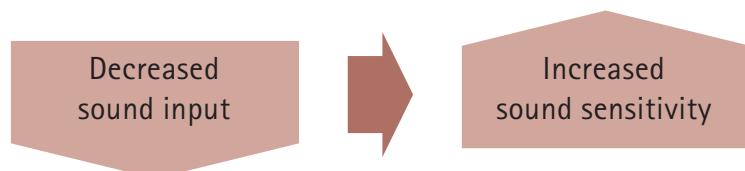


Figure 2. In response to auditory deprivation, many people who suffer tinnitus experience increased sensitivity to sound

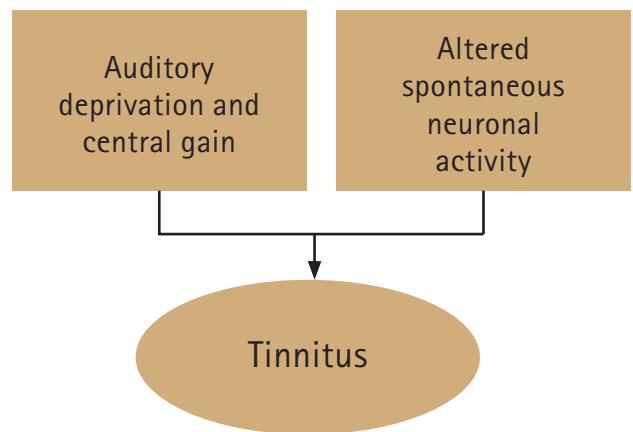


Figure 3. Auditory deprivation and altered spontaneous neuronal activity interact to produce tinnitus

# The psychological impact of tinnitus

"... perceived severity of tinnitus correlates closer to psychological and general health factors, such as pain or insomnia, than to audiological parameters ..."<sup>2</sup>

Experiencing sound in the absence of an external stimulus can be emotionally upsetting. Consequently, tinnitus is associated with increased levels of psychological problems (e.g. in one study, 26.7% reported psychological issues compared to 5.6% in an age-matched control group).<sup>2,11,12</sup> Levels of tinnitus-associated anxiety and depression match those reported by people suffering severe age-related hearing loss.<sup>13</sup>

Many sufferers are able to moderate their emotional reactions to 'unexplained' sounds, but in some cases, an adverse emotional reaction to tinnitus is established that makes the sound appear worse. As a result, the adverse reaction gets correspondingly greater, developing into a vicious cycle of increasing tinnitus severity and heightened distress levels (Figure 4).

Tinnitus sufferers regularly report or demonstrate a range of conditions, including anxiety, depression, sensitivity to sound and sleep problems as well as cognitive difficulties (Figure 5).<sup>2,11,12,14</sup>

- For example, the time needed to achieve sleep can be lengthened in tinnitus patients, and insomnia and tinnitus-associated distress can work together in a downward spiral to adversely affect psychological wellbeing.<sup>15</sup>
- Even in the absence of depression and anxiety, cognitive performance can be worse among tinnitus sufferers versus controls, and patients with tinnitus can exhibit depressive functioning and/or anxious vigilance.<sup>16,17</sup>

Levels of anxiety and depression among tinnitus sufferers vary between studies, but rates exceeding 50% are often reported.<sup>2,11,12</sup> Severity of tinnitus correlates strongly with clinical depression and anxiety (Table 2).<sup>2</sup> Therefore, interventions to reduce tinnitus severity can help to reduce the psychological impact of the disease on its sufferers.

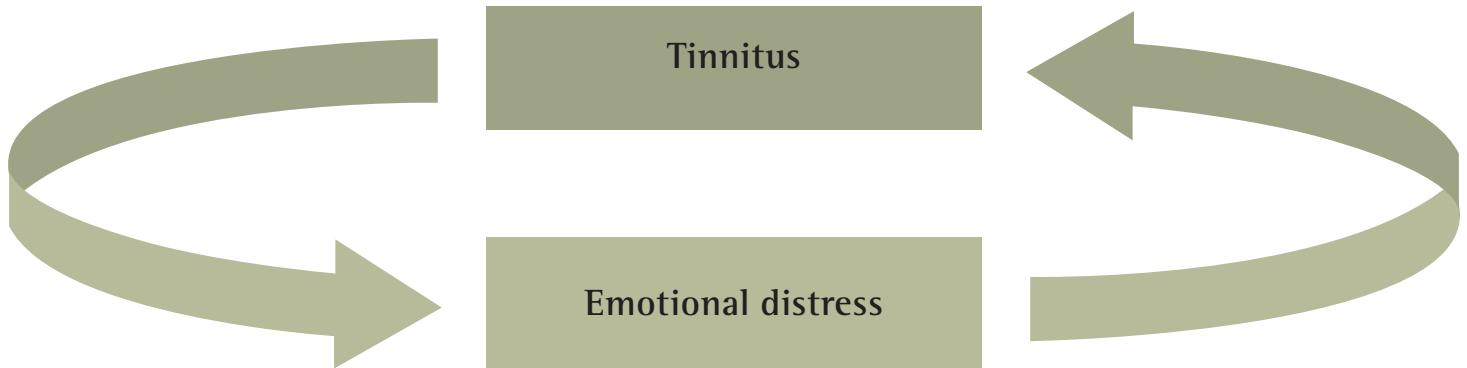


Figure 4. Tinnitus and emotional distress can interact to form a vicious cycle

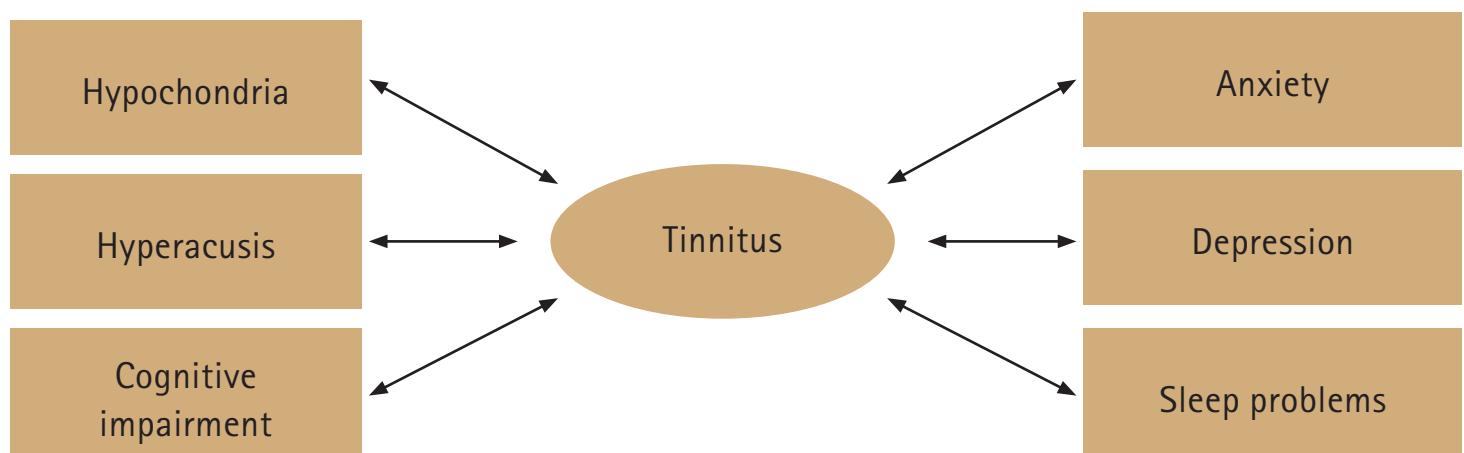


Figure 5. Tinnitus is associated with a variety of conditions that can severely affect daily living

	Tinnitus (all severities), N=80		High-risk of chronic, disabling tinnitus, N=144	
	r	P	r	P
Current minor depression (SCID)	0.42	<0.0001	0.43	<0.0001
Major depression (SCID)	0.41	0.0002	0.39	<0.0001
Current anxiety disorder (SCID)	0.12	NS	0.28	0.0010
Current multiple anxiety disorders (SCID)	0.01	NS	0.26	0.0023
Current depression and/or anxiety disorders (SCID)	0.42	<0.0001	0.48	<0.0001
Depression (HADS)	0.30	0.0079	0.38	<0.0001
Anxiety (HADS)	0.35	0.0018	0.45	<0.0001
Total (HADS)	0.36	0.0014	0.46	<0.0001

Table 2. Tinnitus severity correlates with depression and anxiety and depression<sup>2</sup>

r = correlation coefficient between severity of tinnitus and prevalence of depression and anxiety (higher r = stronger correlation)

HADS: Hospital Anxiety and Depression Scale; NS: not statistically significant; SCID: Structured Clinical Interview for DSM-III-R



# Managing tinnitus: a central role for hearing aids

There is no cure for tinnitus at present, but management is possible by tackling both the physical causes (hearing loss etc.) and the psychological impact. This can be facilitated by multidisciplinary teams including hearing care professionals and psychologists or psychiatrists in addition to ENT specialists.

As previously mentioned, hearing loss is often associated with tinnitus. Therefore, it is worth considering the impact of at least partial restoration of hearing on tinnitus symptoms and severity. It might be that reducing the central gain in auditory perception that is a possible cause of tinnitus could reduce the severity of tinnitus.

A recent scoping review of interventional studies of hearing aids in tinnitus revealed that 10/11 showed improvements in tinnitus symptoms by fitting hearing aids (Figure 6).<sup>18</sup> In these 11 studies, one of six tinnitus evaluation questionnaires were used: THI: Tinnitus Handicap Inventory; THQ: Tinnitus Handicap Questionnaire; TRQ: Tinnitus Reaction Questionnaire; TSI: Tinnitus Severity Index; TQ: Tinnitus Questionnaire; VAS: visual analogue scale (various).

Fitting a hearing aid resulted in tinnitus severity being reduced by up to 50%, and improvements of at least 10% were observed in 10 of the 11 studies.

Another study not included in the review by Shekhawat et al,<sup>18</sup> of 70 patients with tinnitus in Australia, showed that 51% of patients experienced "clinically significant" improvements in tinnitus (defined as  $\geq 40\%$  change in TRQ score).<sup>19</sup>

"The majority of studies reviewed support the use of hearing aids for tinnitus management. Clinicians should feel reassured that some evidence shows support for the use of hearing aids for treating tinnitus ..."<sup>18</sup>

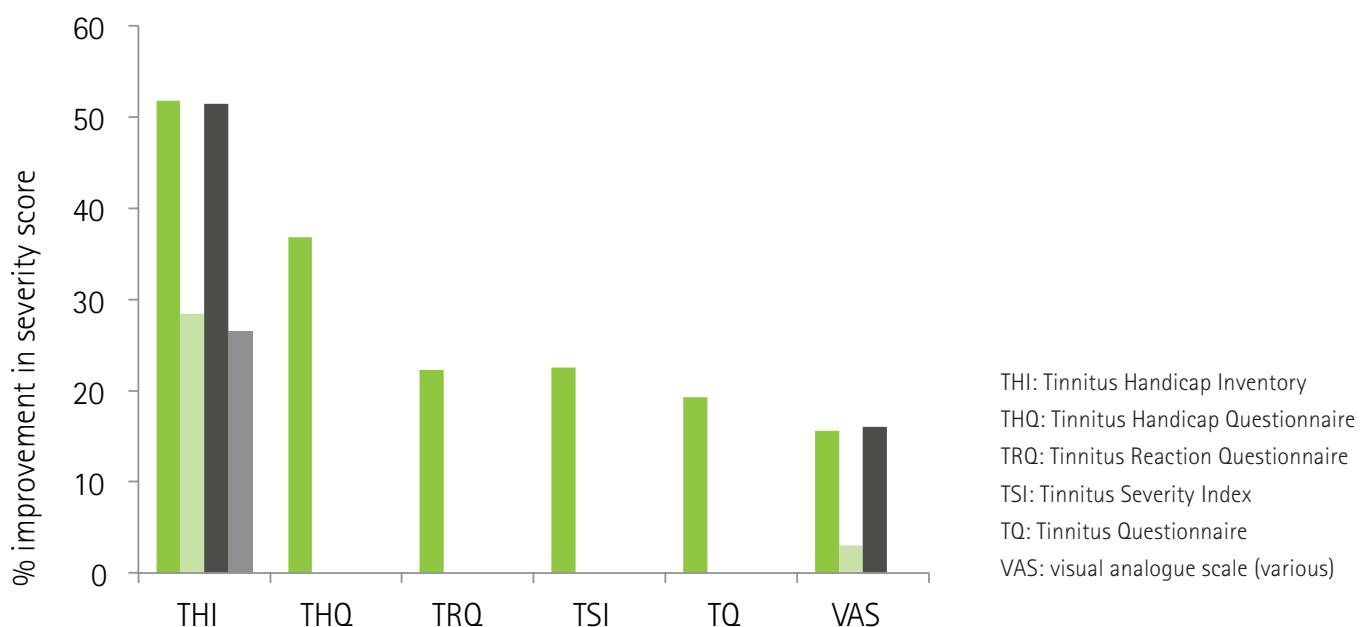


Figure 6. Multiple interventional studies show that hearing aids help reduce tinnitus severity<sup>18</sup>

# Summary

Tinnitus is a distressing condition that can severely affect patients' lives. Many people with tinnitus experience some degree of psychological impairment, which can be debilitating in a small number. However, tinnitus can be managed by addressing both its physical and psychological components. For example, fitting a frequency-matched hearing aid can reduce tinnitus symptom severity in many patients.

To help your patients manage their tinnitus, performing a hearing test and fitting a suitable hearing aid could lead to more manageable symptoms and a better quality of life.



## References

1. Langguth B et al. (2013) Tinnitus: causes and clinical management. *Lancet Neurol.* 12:920-930.
2. Zöger S et al. (2006) Relationship between tinnitus severity and psychiatric disorders. *Psychosomatics.* 47:282-288.
3. Southall K et al. (2011) Factors that influence disclosure of hearing loss in the workplace. *Int J Audiol* 50: 699-707.
4. Axelsson A, Ringdahl A. (1989) Tinnitus – a study of its prevalence and characteristics. *Br J Audiol* 23:53-62.
5. Ayache D et al. (2003) Characteristics and postoperative course of tinnitus in otosclerosis. *Otol Neurotol* 24:48-51.
6. Nosrati-Zarenoe R et al. (2007) Idiopathic sudden sensorineural hearing loss: results drawn from the Swedish national database. *Acta Otolaryngol* 127:1168-1175.
7. Sobrinho PG et al. (2004) Long-term follow-up of tinnitus in patients with otosclerosis after stapes surgery. *Int Tinnitus J* 10:197-201.
8. Schaette R et al. (2012) Reversible induction of phantom auditory sensations through simulated unilateral hearing loss. *PLoS One* 10.1371/journal.pone.0035238.
9. Kaltenbach JA. (2011) „Tinnitus: models and mechanisms“. *Hear Res.* June; 276 (1-2) : 52 – 60.
10. Schaette R and Kempter, R (2012) „Computational models of neurophysiological correlates of tinnitus“ *Front Syst Neurosci.* 6:34.
11. Belli H et al. (2012) Psychopathological dimensions of tinnitus and psychopharmacologic approaches in its treatment. *Gen Hosp Psychiatry.* 34:282-9.
12. Geocze L et al. (2013) Systematic review on the evidence of an association between tinnitus and depression. *Braz J Otorhinolaryngol.* 79:106-111.
13. National Council on Aging. (1999) The consequences of untreated hearing loss in older persons.
14. Hebert S, et al. (2013) The auditory sensitivity is increased in tinnitus ears. *J Neurosci* 33:2356-2364.
15. Wallhäuser-Franke E et al. (2013) Tinnitus and insomnia: is hyperarousal the common denominator? *Sleep Med Rev.* 17:65-74.
16. Andersson G, McKenna L. (2006) The role of cognition in tinnitus. *Acta Otolaryngol Suppl.* 556:39-43.
17. Jackson J et al. (2013) A preliminary investigation of potential cognitive performance decrements in non-help-seeking tinnitus sufferers. *Int J Audiol.* E-pub ahead of print.
18. Shekhawat GS et al. (2013) Role of hearing aids in tinnitus intervention: a scoping review. *J Am Acad Audiol.* 24:747-762.
19. McNeill C et al. (2012) Tinnitus pitch, masking, and the effectiveness of hearing aids for tinnitus therapy. *Int J Audiol.* 51:914-919.

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