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# Multidimensional considerations in tinnitus

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Tinnitus is defined as a subjective sound or subjectively perceived noise without an external sound source [1]. The causes are varied and can be both in the auditory system and psychosomatic in nature.

» Ringing in the ears is a widespread phenomenon, affecting about 15% of the European population

Ringing in the ears is a widespread phenomenon, affecting about 15% of the European population [2]. Thereby, the impact of tinnitus symptoms on daily life can be very different. At least 2% of the population experience tinnitus as very distressing and seek support from the healthcare system [3].

Publications of studies on tinnitus, on its pathophysiological basis and possible therapies, and especially on the concrete burden of affected persons have been increasing in recent years. Thus, scientific knowledge has improved considerably. Accordingly, there are diverse models of the development of tinnitus, mostly assuming an interplay of peripheral (concomitant hearing loss) and central mechanisms (neuroplastic processes along the auditory pathway to altered connectivity of tinnitus-processing brain areas; [4].

Furthermore, there is discussion that ear noise and tinnitus distress should be considered as different phenomena [5]. The distress associated with tinnitus is multidimensional and may include:

1. Other functional auditory phenomena such as hyperacusis
2. Correlated complaints such as disturbances in sleep or concentration

3. Underlying psychological cycles of stress, anxiety, or depression [1].

Tinnitus distress is also significantly shaped by associated psychosomatic influences [6].

In two special issues on the topic of “Tinnitus”, tinnitus basic research as well as ENT, psychosomatic, and psychological aspects are discussed broadly. Thus, current models of tinnitus development and maintenance are explained from different disciplinary perspectives, application-oriented psychosomatic aspects in ENT are highlighted, and the interaction of general stressors and tinnitus is examined in more detail. Furthermore, recent aspects on the interaction of cognition and emotion in tinnitus are summarized, which especially in recent years have become the focus of attention due to the involvement of limbic structures [7] and hearing-independent cognitive deficits in tinnitus [8] as an important component in the assessment of the complex phenomenon of tinnitus.

» There is growing interest in understanding multisensory integration in the cortex by tinnitus

There is increasingly growing interest in understanding multisensory integration in the cortex through activation of multiple sensory and motor pathways for the diagnosis and treatment of tinnitus [9]. Similarly, somatosensory tinnitus has been the focus of two articles.

The current gold standard for the treatment of tinnitus is, in addition to counseling, psychotherapeutic therapy, which



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can favorably influence tinnitus distress and quality of life as well as anxiety and depression [10]. Further improvements in diagnostics and therapy are to be expected. In this context the importance of standardized data collection is obvious [11, 12]. Methodological advances and expanded diagnostic possibilities have to be included in the increasingly individualized diagnostics and coordinated multimodal therapies of tinnitus [13]. From this point of view, possibilities of functional imaging in tinnitus and hearing disorders should be emphasized.

The extent to which inner ear research can contribute to the treatment of tinnitus in the future is highlighted in the article on current aspects of inner ear research. The methods by which hearing ability may be directly influenced in the future and the groundbreaking possibilities that this opens up for hearing and tinnitus therapy are presented in depth in these special issues.

Chronic tinnitus is associated with hearing impairment in a high percentage of cases [14–16]. Thus, hearing loss can be measured in approximately 90% of people with tinnitus; however, conversely, most people with hearing loss have not experienced tinnitus as limiting, regardless of the severity of the hearing loss [17]. Close examination and improvement of hearing in the presence of existing hearing loss are therefore essential in tinnitus and required by the German treatment guidelines, which were updated in 2021 [18]. Therefore, these special issues will also address hearing improvement measures as an integral part of successful tinnitus treatment.

The already proven facts regarding the improvement of hearing and tinnitus burden as well as the general quality of life through cochlear implant (CI) care [19] are expanded in the article “CI and tinnitus.” Age-related hearing loss is a common and increasing problem in older adults, and will affect approximately 1 billion people by 2050 [20]. In this regard, aspects of CI care in old age are also very relevant.

In summary, despite all the advances in clinical and scientific knowledge, no therapy currently makes it possible to completely eliminate tinnitus in the chronic stage, mainly because the development

and comorbidity of tinnitus are individual and very complex. German and European guidelines recommend a combination of multidimensional diagnostic and therapeutic components tailored to the needs of the individual. In view of the existing comorbidities in chronic tinnitus, multimodal systems-medicine-oriented treatment approaches are increasingly being taken into account [13].

### » Hearing aids are the treatment of choice for hearing loss and tinnitus

Currently, the description and treatment of chronic tinnitus symptoms should be based on solid otological, audiological, psychosomatic, and psychological diagnostics. Studies have shown that cognitive behavioral therapy in combination with other components has led to sustained improvement in tinnitus distress. Hearing aids are the treatment of choice for hearing loss that is often detected initially.

In these special issues, possible future developments in the diagnostics and therapy of tinnitus are described by renowned authors in a clinically substantiated manner and closely oriented to current trends in research. I thank all the contributors for their willingness to work on this topic and for making their expertise available.

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#### References

- Mazurek B, Hesse G, Sattel H, Kratzsch V, Lahmann C, Dobel C (2022) S3 guideline: chronic tinnitus: German Society for Otorhinolaryngology, Head and Neck Surgery e. V. (DGHNO-KHC). *HNO* 70(11):795–827
- Biswas R, Lugo A, Akeroyd MA, Schlee W, Gallus S, Hall DA (2022) Tinnitus prevalence in Europe:

- a multi-country cross-sectional population study. *Lancet Reg Health Eur* 12:100250
- Trochidis I, Lugo A, Borroni E, Cederroth CR, Cima R, Kikidis D et al (2021) Systematic review on healthcare and societal costs of tinnitus. *Int J Environ Res Public Health* 18(13):6881. <https://doi.org/10.3390>
- Roberts LE, Eggermont JJ, Caspary DM, Shore SE, Melcher JR, Kaltenbach JA (2010) Ringing ears: the neuroscience of tinnitus. *J Neurosci* 30(45):14972–14979
- De Ridder D, Schlee W, Vanneste S, Londero A, Weisz N, Kleinjung T et al (2021) Tinnitus and tinnitus disorder: theoretical and operational definitions (an international multidisciplinary proposal). *Prog Brain Res* 260:1–25
- Cederroth CR, Gallus S, Hall DA, Kleinjung T, Langguth B, Maruotti A et al (2019) Editorial: towards an understanding of tinnitus heterogeneity. *Front Aging Neurosci* 11:53
- Rauschecker JP, Leaver AM, Muhlau M (2010) Tuning out the noise: limbic-auditory interactions in tinnitus. *Neuron* 66(6):819–826
- Mohamad N, Hoare DJ, Hall DA (2016) The consequences of tinnitus and tinnitus severity on cognition: a review of the behavioural evidence. *Hear Res* 332:199–209
- Gloeckner CD, Nocon JC, Lim HH (2022) Topographic and widespread auditory modulation of the somatosensory cortex: potential for bimodal sound and body stimulation for pain treatment. *J Neural Eng*. <https://doi.org/10.1088/1741-2552>
- Fuller T, Cima R, Langguth B, Mazurek B, Vlaeyen JWS, Hoare DJ (2020) Cognitive behavioural therapy for tinnitus. *Cochrane Database Syst Rev* 8(1):CD12614. <https://doi.org/10.1002/14651858.CD012614.pub2>
- Hall DA, Haider H, Kikidis D, Mielczarek M, Mazurek B, Szczepek AJ et al (2015) Toward a global consensus on outcome measures for clinical trials in tinnitus: report from the first international meeting of the COMIT initiative, November 14, 2014, Amsterdam, the Netherlands. *Trends Hear* 19:1–7. <https://doi.org/10.1177/2331216515580272>
- Schlee W, Langguth B, Pryss R, Allgaier J, Mulansky L, Vogel C et al (2021) Using big data to develop a clinical decision support system for tinnitus treatment. *Curr Top Behav Neurosci* 51:175–189
- Mazurek B, Rose M, Schulze H, Dobel C (2022) Systems medicine approach for tinnitus with comorbid disorders. *Nutrients* 14(20):4320. <https://doi.org/10.3390>
- Baguley D, McFerran D, Hall D (2013) Tinnitus. *Lancet* 382(9904):1600–1607
- Langguth B, Kreuzer PM, Kleinjung T, De Ridder D (2013) Tinnitus: causes and clinical management. *Lancet Neurol* 12(9):920–930
- Shargorodsky J, Curhan GC, Farwell WR (2010) Prevalence and characteristics of tinnitus among US adults. *Am J Med* 123(8):711–718
- Sedley W (2019) Tinnitus: does gain explain? *Neuroscience* 407:213–228
- Mazurek B, Hesse G, Dobel C, Kratzsch V, Lahmann C, Sattel H (2022) Clinical practice guideline: chronic tinnitus-diagnosis and treatment. *Dtsch Arztebl Int* 119:219–225. <https://doi.org/10.3238/arztebl.m2022.0135>
- Olze H, Szczepek AJ, Haupt H, Forster U, Zirke N, Grabel S et al (2011) Cochlear implantation has a positive influence on quality of life, tinnitus, and psychological comorbidity. *Laryngoscope* 121(10):2220–2227

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20. Elliott KL, Fritsch B, Yamoah EN, Zine A (2022) Age-related hearing loss: sensory and neural etiology and their interdependence. *Front Aging Neurosci* 14:814528