



Recent Updates on Tinnitus Management

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In this comprehensive review, we discuss recent updates on tinnitus evaluation and treatment. Tinnitus evaluation commences with comprehensive medical history taking and audiological evaluation, which can provide valuable insight into the nature and extent of auditory disturbances. Additionally, tinnitus evaluation includes investigation of psychosomatic comorbidities to determine the intricate interplay between psychological factors and tinnitus perception. Various therapeutic approaches are available to minimize the burden of tinnitus. Cognitive behavioral therapy reshapes negative thought patterns and behaviors that are closely associated with tinnitus-induced distress. Acceptance and commitment therapy fosters mindfulness and value-aligned actions to address emotional effects. Tinnitus retraining therapy combines counseling and sound therapy for habituation. Tailor-made notched music therapy offers customized auditory experiences for symptom relief. Hearing aids and cochlear implants compensate for hearing loss and associated stress. Both neuromodulation and neurofeedback may be potentially useful. The role of pharmacotherapy and dietary supplements remains uncertain. Physiotherapy and head-neck manipulation relieve tinnitus associated with orofacial factors. Virtual reality, smartphone applications, and photobiomodulation may serve as novel therapeutic avenues. Although promising interventions are available, further research is warranted to confirm their effectiveness and long-term effects.

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Introduction

Tinnitus is not an uncommon symptom; instead, it is a prevalent condition that does not vary significantly based on gender but tends to increase with age. The annual incidence of tinnitus is approximately 1%. About 14% of adults experience some form of tinnitus, while 2% experience a more severe manifestation [1].

Tinnitus is the conscious perception of a tonal or composite noise without any identifiable external acoustic source. More recently, a novel concept known as tinnitus disorder has emerged [2]. Tinnitus disorder can be defined when tinnitus-associated emotional and/or cognitive dysfunctions, along with autonomic arousal leading to behavioral changes and func-

tional disability, are observed.

In 2014, a clinical practice guideline for tinnitus was published, serving as a fundamental resource for diagnosing and treating this condition [3]. Additionally, chronic tinnitus guidelines were released in Japan and Europe in 2019, England in 2020, and Germany in 2022 [4-7]. Table 1 summarizes these guidelines, which can significantly aid in the more effective management of tinnitus patients. The main focus of this article is to concisely present the updated information, primarily centered around these guidelines, along with recently published randomized controlled trials, meta-analyses, systematic reviews, and significant observational studies related to tinnitus management.

Basic Assessment for Tinnitus

A thorough medical history assessment is crucial. Following that, the German guideline outlines essential steps for a com-

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Table 1. Summary of the recent tinnitus guidelines

Released year	United States [3]	Japan [5]	Europe [6]	England [7]	German [4]
2014	2019	2020	2019	2020	2022
History and physical exam	Recommended	-	-	Ask people with tinnitus if they have problems sleeping because of tinnitus. If they do, consider screening with a questionnaire (such as the Insomnia Severity Index)	-
Questionnaires	THI	THI, TQ	THI, TQ	TFI, TQ, mini-TQ	TQ, mini-TQ, TBF12
Prompt audiologic examination	Recommended if unilateral, persistent, or associated with hearing loss	-	-	Offer an audiological assessment to people with tinnitus.	-
Specific Audiologic examination	Option	PTA, pitch match test, loudness balance test	LDL, vestibular function test	Do not offer psychoacoustic tests, for example pitch and loudness matching, to assess tinnitus.	PTA, SA, IA, tinitogram, ABR, OAEs, nystagmus
Imaging studies	Strongly recommended against	Recommended for pulsatile tinnitus and unilateral hearing loss	MRI	MRI for non-pulsatile tinnitus with associated with neurological, otological or head and neck signs and symptoms or for unilateral or asymmetric tinnitus. Offer imaging to people with pulsatile tinnitus.	Doppler ultrasonogram Brain MR HRCT Angiography
Education and Counseling	Recommended	Recommended	Recommended	Recommended	Recommended
Cognitive behavioral therapy	Recommended to persistent bothersome tinnitus	Recommended	Strong recommendation	Consider to tinnitus distress	Strongly recommended
Tinnitus retraining therapy	-	Effective	No recommendation	Recommendation for research	Considered as a long-term treatment option
Hearing aids	Recommended for hearing loss and persistent bothersome tinnitus	Recommended for hearing loss	Weak recommendation (only for diagnosed hearing loss)	Offer to hearing loss	Recommended in chronic tinnitus and hearing loss

Table 1. Summary of the recent tinnitus guidelines (continued)

	United States [3]	Japan [5]	Europe [6]	England [7]	German [4]
Cochlear implant	-	Recommended for profound hearing loss	No recommendation	-	Recommended in chronic tinnitus and deafness (including single-sided deafness)
Tailor-made notched music therapy (including music therapy)	-	Not proven	-	-	Should not be used for TMNMT Music therapy: not required
Sound therapy	Option	Recommendation 2C	No recommendation	Unable to make recommendation	Should not be used
Acoustic neuromodulation	-	-	-	-	Should not be used
Medications	Recommendation against routine prescription	Not recommended, but case selection for depression, insomnia or anxiety disorder	Weak recommendation against	Do not offer betahistine	Should not be used
Neuromodulation (rTMS, tVNS, tES)	Recommendation against	Not recommended	rTMS: recommendation against tES, tVNS: no recommendation	Unable to make recommendation	Should not be used
Physiotherapy	-	-	-	-	Should be offered in case with somatic modulation by comorbid lesions
Nutritional supplement	Recommendation against	-	-	-	Should not be used
acupuncture	No recommendation	Not recommended	No recommendation	-	Should not be used
Low-level laser treatment	-	Not recommended	-	-	Should not be used

THI, Tinnitus Handicap Inventory; TQ, Tinnitus Questionnaire; TFI, Tinnitus Functional Index; TIBF12, Tinnitus Impairment Questionnaire; PTA, pure-tone audiometry; LDL, loudness discomfort level test; SA, speech audiometry; IA, tympanometry; ABR, auditory brainstem response; OAEs, otoacoustic emissions; MRI, magnetic resonance imaging; HRCT, high resolution computed tomography; TMNMT, tailor-made notched music therapy; rTMS, repetitive transcranial magnetic stimulation; tVNS, transcutaneous vagus nerve stimulation; tES, transcranial electrical stimulation

prehensive tinnitus evaluation, including ear endoscopy, pure-tone audiometry, speech audiometry, tympanometry, auditory brainstem response, and otoacoustic emissions (Fig. 1). Additionally, tests for spontaneous nystagmus and provocative nystagmus should be performed, along with a crucial manual examination of the masticatory apparatus and the cervical spine [4]. In Japan, the pitch match test and loudness balance test are also recommended [5]. In addition, various additional hearing tests can be considered to diagnose decreased sound intolerance, extended-high frequency hearing loss, endolymphatic hydrops, auditory neuropathy, hidden hearing loss, and so forth [8]. In other words, a comprehensive diagnostic work-up involving audiological assessment and identification of hearing loss should be carried out as the initial step.

Additionally, concurrent psychosomatic comorbidities such as anxiety, depression, and severe stress should be assessed [8-10]. It is worth noting that the Tinnitus Handicap Inventory

(THI) is recommended for diagnosing tinnitus in the Japanese guideline [5]. The guideline also suggests utilizing questionnaires such as the Tinnitus Questionnaire, THI, Tinnitus Reaction Questionnaire, and 36-Item Short Form Survey (SF-36) for quality of life. THI, in particular, has demonstrated a strong correlation with psychological assessment surveys [9].

For imaging studies, imaging can be obtained if tinnitus localizes to one ear, pulsatile tinnitus, focal neurological abnormalities, or asymmetric hearing loss [3,5].

Overview of Current Tinnitus Treatments

This review explores a wide spectrum of tinnitus treatments, encompassing psychotherapies such as cognitive behavioral therapy, acceptance and commitment therapy, and tinnitus retraining therapy, sound-based therapies, hearing devices includ-

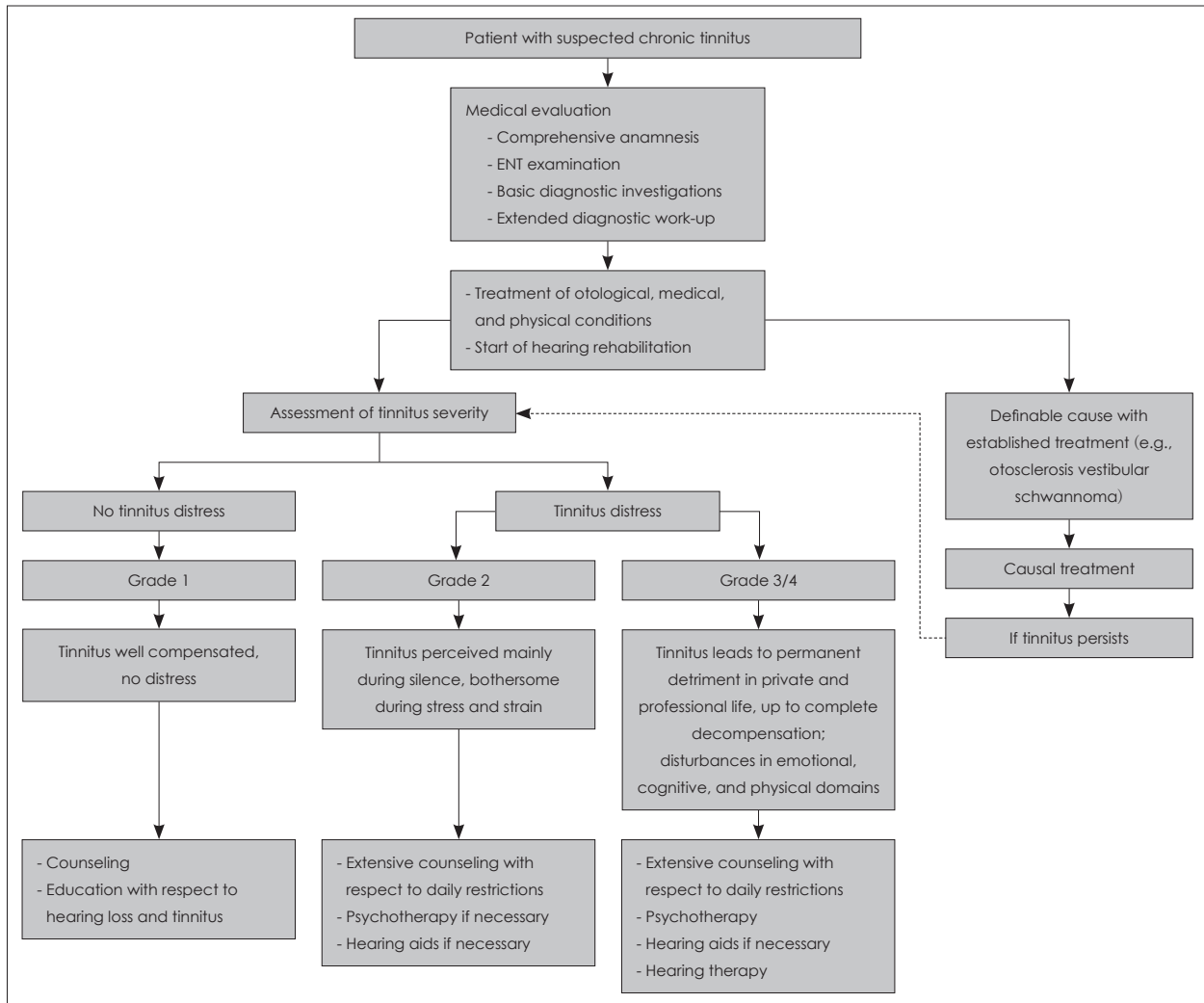


Fig. 1. Flowchart for treatment of chronic tinnitus. Adapted from Mazurek, et al. Dtsch Arztebl Int 2022;119:219-25, with permission of Deutscher Ärzteverlag GmbH [4].

ing hearing aids (HA) and cochlear implants (CI) for profound hearing loss, neurofeedback and neuromodulation techniques, the current status of pharmacotherapy, and emerging digital solutions.

Cognitive behavioral therapy for tinnitus

All of the recent guidelines strongly endorse cognitive behavioral therapy (CBT) [3-5]. CBT aims to identify and modify negative thought patterns and behaviors by recognizing the interconnectedness of thoughts, emotions, and actions. It challenges distorted beliefs and substitutes them with more balanced ones, employing methods such as cognitive restructuring, behavior activation, exposure therapy, and problem-solving (Table 2). CBT encompasses cognitive restructuring, behavior activation, exposure therapy, and problem-solving techniques.

Recent studies even challenge the notion that CBT only reduces annoyance and distress, showing it can also lower tinnitus loudness [11]. A Cochrane review notes CBT’s potential to alleviate tinnitus’s impact on quality of life, though long-term effects remain uncertain [12]. While CBT might alleviate depression symptoms, its effects on anxiety, health-related quality of life, and changing negative tinnitus interpretations need more investigation [12]. Internet-based CBT is promising for addressing tinnitus distress [9]. As CBT’s potential unfolds, including group sessions and internet-based approaches,

tinnitus management holds promise [13,14].

Acceptance and commitment therapy and mindfulness

Acceptance and commitment therapy (ACT) can indeed be considered a second-generation form of CBT. ACT encourages individuals to accept their thoughts and emotions without judgment (Fig. 2). Instead of battling unwanted feelings of tinnitus, ACT guides individuals toward values-driven actions that enhance overall well-being. By cultivating mindfulness, individuals can increase awareness of their thoughts, emotions, and bodily sensations, fostering a non-reactive stance to these experiences [15]. Some studies reported that ACT was superior to tinnitus retraining therapy (TRT) or internet-based CBT [16,17]. However, a recent meta-analysis showed that there is currently insufficient evidence to recommend the use of ACT or mindfulness for improving hearing-related distress or psychological well-being in people with audiological problems because these effects are limited to short-term [18].

Tinnitus retraining therapy

TRT is an approach aimed at habituating to tinnitus by reducing its auditory, emotional, and autonomic impact. This technique incorporates both counseling and sound therapy utilizing broadband noise [4]. TRT can be employed as a long-term intervention [4]. For TRT, the use of a sound generator is not deemed essential, as it does not offer any additional

Table 2. Common myths/misconceptions and information for patients

Example myth/misconception	Example information
Having tinnitus means you will go deaf.	It should be explained to the patient that this is not the case. Everyone’s hearing deteriorates as they get older, but tinnitus does not cause hearing loss. In many cases, tinnitus is caused by pre-existing hearing loss, but not the other way around.
Tinnitus is temporary and will go away.	It should be explained that tinnitus can be temporary, but often it is not. The attitude of “hoping” or “wishing” it will go away when it does not go away causes additional distress and monitoring, thus driving tinnitus distress.
Tinnitus will get worse over time.	It should be explained that tinnitus can be affected by life situations that make it more bothersome in time. In general, the severity of tinnitus decreases over time.
Hearing aids will make the tinnitus louder.	Where there is a hearing loss as well as tinnitus, and the hearing loss can be compensated by hearing aids, the hearing aids may also help to address tinnitus. Hearing aids amplify external sounds, i.e., those in our environment; hearing aids cannot and do not amplify an internal noise, which is what the tinnitus noise is.
Caffeine makes tinnitus worse.	This may be the case for a small number of individuals; however, a clinical trial found that caffeine had no effect on tinnitus severity. In fact, the same study reported a significant negative effect of caffeine withdrawal, concluding there is no evidence to justify caffeine abstinence as a therapy to alleviate tinnitus. However, the consumption of coffee does influence sleeping patterns. If there are sleeping problems associated with tinnitus, then coffee consumption should be limited.
Tinnitus means there is a very serious underlying illness.	Although there are many conditions that may cause or exacerbate serious it is extremely rare that it is a symptom of a serious illness.

Adapted from Cima, et al. HNO 2019;67(Suppl 1):10-42, with permission of Springer Nature [6].

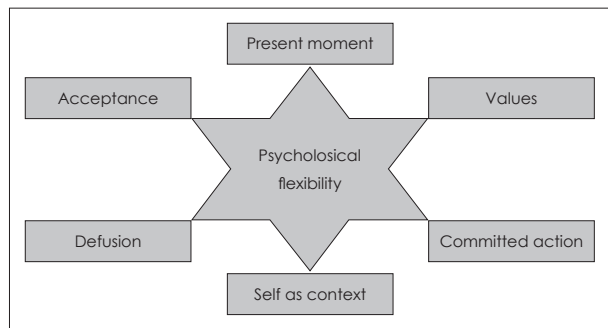


Fig. 2. A schematic diagram of acceptance and commitment therapy. It emphasizes accepting emotions and thoughts, pursuing value-driven actions for a meaningful life, practicing defusion and present-moment focus, and fostering psychological flexibility.

benefits [4].

A meta-analysis involving 1,345 patients revealed that combining TRT with drugs led to higher response rates and reductions in THI scores compared to treatments involving drugs alone [19]. However, it is worth noting that the quality of evidence could have been more robust due to the limited number of studies and the potential for bias [19]. In a comparative study with TRT, counseling alone was mentioned as “partial” TRT, standard of care; results indicated no significant differences between TRT or partial TRT compared to standard of care across various tinnitus-related quality of life measures [20]. Similarly, a study divided patients into three groups: counseling only, counseling and total masking, and counseling and partial masking. The extent of improvement varied among groups, but no significant differences were observed, and individual differences were likely influenced by expectations [21].

Tailor-made notched music therapy & music therapy

Tailor-made notched music therapy (TMNMT) uses tinnitus-frequency removed music, and the mechanism of action is associated with the enhancement of lateral inhibition. It may be helpful, especially for individuals who prefer music-based interventions. However, the German guideline recommends that TMNMT should not be used in chronic tinnitus because it is no more effective than music and there is also potential harm [4]. In most recent studies, TMNMT did not differ in efficacy from other interventions, including conventional music or randomly removed frequency, counseling, and TRT [22-25].

In a double-blinded randomized controlled trial, 104 patients with chronic subjective tinnitus examined the effectiveness of TMNMT compared to ordinary music therapy until 6 months [22]. Divided into treatment and control groups, participants were assessed at 1, 3, and 6 months. However, THI and visual analog scale (VAS) were similar. Similarly, in a comparison between TMNMT and TRT, both TMNMT and

TRT significantly reduced THI scores over a 3-month treatment period [23]. A study comparing TMNMT, conventional music therapy, and counseling revealed that all three interventions contributed to decreased THI scores over time, but there were no significant differences [14].

Hearing aids

All of the guidelines recommend HA for individuals with hearing loss and tinnitus [3-5]. HA compensates for auditory deprivation, reduces attentional focus on tinnitus by amplifying the ambient environmental sounds, and reverses central changes related to tinnitus in the auditory brain. It also alleviates tension associated with straining to hear, reducing stress. However, research has shown a significant amount of disagreement regarding the effectiveness of amplification methods, the inclusion of notched filter, frequency lowering techniques, and the use of combined sound generators in treating tinnitus.

For patients with mild-to-moderate hearing loss and tinnitus, no significant difference was observed in the comparison between amplification with conventional HA and the use of a notched filter to exclude the tinnitus frequency band, enhancing lateral inhibition [26]. When comparing wide dynamic range compression (WDRC) with frequency compression, most patients reported greater satisfaction with the sound quality of WDRC, leading to the suggestion that traditional amplification methods are more effective in patients with hearing loss accompanied by tinnitus [27]. In contrast, over 3 months of HA use, no differences in THI were observed among WDRC, linear frequency transposition, and frequency translation, all of which showed significant reductions in the THI, and the tinnitus suppression effect of the HA was maintained even after discontinuation [28]. Comparisons between combined HA with sound generators with conventional HA did not show significant differences in their effects in most studies until now [29,30].

Cochlear implant

According to the guidelines, if HA is insufficient to address hearing loss, CI should be considered, even in cases of unilateral hearing loss [4,5]. CI has shown promising results in improving tinnitus-related distress and quality of life. A systematic review analyzing 1,285 patients demonstrated significant enhancements in tinnitus-related measures such as THI, VAS, and Tinnitus Questionnaire scores [31]. Recent studies reported the advantages of CI for single-sided deafness, underscoring its positive impact on speech perception, tinnitus control, sound localization, and overall quality of life [32]. Another avenue of exploration is CI programming for tinnitus suppression, which indicated potential benefits in reduc-

ing tinnitus severity. Research suggests that various parameters, including electrode numbers and stimulation levels, could contribute to effective tinnitus management [33]. Moreover, using smartphone apps, such as ReSound Tinnitus Relief, in CI users exhibited a mixed but encouraging outcome, with some users experiencing relief from tinnitus [34,35]. However, further validation and optimization are needed to harness the full potential of these interventions for tinnitus management.

Neuromodulation

The guidelines advise against neuromodulation due to a lack of placebo-controlled studies or proven efficacy [3-5]. Transcranial direct current stimulation (tDCS) and repetitive transcranial magnetic stimulation (rTMS) are representative neuromodulation techniques, often targeting the left auditory and prefrontal cortex. Studies consistently show positive tinnitus suppression outcomes when targeting the temporoparietal junction midway between T3 and P3 or between T4 and P4 [36]. Anodal and cathodal stimulation types are used in tDCS to modulate excitability, with potential side effects including fatigue, tingling, skin burns, headaches, itching, and insomnia. Notably, six sessions of tDCS (F4: anode, F3: cathode, intensity: 1.5 mA) were found most effective for tinnitus [37]. However, high-definition-tDCS (HD-tDCS), delivering more intense stimulation through smaller electrodes, has not yielded the expected results [38]. A recent dual-site tDCS study showed no difference in TFI between active and sham groups, suggesting a placebo effect [39]. Transauricular vagus nerve stimulation (tVNS) is promising for tinnitus relief, yet methodological limitations necessitate robust trials for conclusive evidence [40,41].

The emerging trend of bimodal stimulation has gained attention in tinnitus management, encompassing multisensory approaches that include visual, auditory, and tactile elements. One of the simplest methods for achieving bimodal stimulation involves combining neuromodulation with sound therapy. Furthermore, the combination of different stimulation modes has demonstrated promise in reducing tinnitus severity, as demonstrated by the Leniere device, which integrates sound and tongue electrical stimulation. This approach resulted in a notable 14.6-point reduction in the THI scores after 12 weeks of use. Notably, patient satisfaction with bimodal neuromodulation settings has been consistently high, ranging between 70% and 80% [42-44].

Neurofeedback

Neurofeedback holds promise in alleviating tinnitus distress and its associated effects, supported by studies demonstrating favorable results by manipulating alpha and delta wave pat-

terns. Nonetheless, the certainty of these findings is constrained by the need for more extensive research in this domain [45]. Recent systematic reviews and randomized trials have highlighted notable reductions in tinnitus intensity and distress following repeated neurofeedback sessions focusing on alpha/delta and beta/theta ratios. While the efficacy of alpha/delta neurofeedback is evident, additional investigations are necessary to establish its distinct role as a viable tinnitus treatment [45,46].

Pharmacotherapy

In guidelines, insufficient data supports the effectiveness of drug treatments for tinnitus [3-5]. Some drugs such as beta-histidine, *Ginkgo biloba* extract, the combination of *G. biloba* extract plus St. John's wort, antidepressants, benzodiazepines, zinc, melatonin, cannabis, oxytocin, steroids, and gabapentin have been found ineffective for chronic tinnitus, and these drugs should not be recommended [4,47]. Regarding *G. biloba* extract, the combination of *G. biloba* extract and HA led to significant improvements in tinnitus severity [48].

In addition to the mentioned drugs, a randomized-controlled trial evaluated acamprosate, an antagonist of glutaminergic activity, and a gamma-aminobutyric acid (GABA) agonist used for alcoholism treatment for tinnitus. The study found that participants receiving acamprosate experienced significant reductions in tinnitus-related scores and positive electrophysiological changes in cochlear and auditory nerve function [49]. As for methylenedioxymethamphetamine (MDMA), a study exploring its effects on tinnitus perception indicated that MDMA had similar effects to placebo in terms of tinnitus perception. However, after a higher dose, it showed reduced annoyance and altered brain connectivity. Further research is warranted to explore the potential of MDMA as a tinnitus treatment [50].

A network meta-analysis for pharmacotherapy for primary tinnitus showed that medications with brain-acting effects (e.g., amitriptyline, acamprosate, gabapentin) and those with anti-inflammation/antioxidant effects (e.g., intra-tympanic dexamethasone plus oral melatonin) were associated with better improvement in tinnitus severity and response rates compared to placebo. Additionally, amitriptyline demonstrated the highest improvement in severity [51].

Overall, the efficacy of pharmacotherapy for tinnitus remains uncertain. The field is characterized by positive and inconclusive findings, necessitating more rigorous research to better understand the potential benefits and risks of these interventions. However, as described in the guideline, it is essential not to overlook the fact that drugs can still be used to treat conditions related to tinnitus, such as anxiety and depression, fol-

lowing established guidelines (Table 3).

Dietary supplements

Recent German guideline advises against using dietary supplements like vitamins, traditional herbal medicine, minerals, homeopathy, and lipoflavonoids for tinnitus treatment due to insufficient evidence of effectiveness [4]. Similarly, an online survey-based study revealed that while caffeine, alcohol, and salt could slightly impact tinnitus severity for some participants, the effects were generally mild. The researchers emphasized that dietary changes are not a primary treatment for chronic tinnitus in the general population, although some individuals might see meaningful effects [52].

The author concurs with these perspectives. While dietary supplements are essential for maintaining health, tinnitus is influenced by factors beyond nutrition. Most supplement research relies on large-scale studies such as the National Health and Nutrition Examination Survey. A recent US study linked low blood manganese to tinnitus frequency and impact, while serum zinc and vitamin B12 had no significant links to tinnitus [53]. This underscores the need for more research into manganese supplementation for tinnitus patients.

Similarly, a Korean study using the Korea National Health and Nutrition Examination Survey (KNHANES) found no connection between hypozincemia and tinnitus [54]. Additionally, middle-aged individuals (ages 51–60 years) with tinnitus showed lower vitamin B2 intake—and reduced water,

protein, and vitamin B3 intake related to tinnitus-related annoyance. The study underscores proper nutrition's importance in managing tinnitus and highlights the necessity for further research [55].

Other surgeries

Apart from CI, one of the most commonly performed surgeries for tinnitus is sigmoid sinus resurfacing surgery. Patients with venous pulsatile tinnitus experience tinnitus synchronized with their heartbeat, and ipsilateral neck compression directly alleviates tinnitus and improves low-frequency hearing loss. The elimination of pulsatile tinnitus after compression has been reported as an excellent prognostic factor following repair of the sigmoid sinus [56]. The results of the water occlusion test may also predict the surgical outcome after resurfacing surgery [57].

Additionally, middle ear myoclonus (MEM) is another condition that can be surgically treated to ameliorate tinnitus. A simple transcanal endoscopic resection of the stapedial tendon and/or tensor tympani tendon is necessary for this procedure [58]. On the other hand, intratympanic Botox injection has been introduced and is under study. It could be applied to patients with MEM if positive results are revealed [59].

Physiotherapy and head and neck manipulation

Tinnitus, often influenced by orofacial factors like temporomandibular disorders (TMD) or neck pain, can benefit

Table 3. Typical comorbidities in chronic tinnitus

Psychological/psychosomatic/psychiatric comorbidities
Mood disorders
Dysthymia (ICD-10: F34.1)
Depressive episode (ICD-10: F32.0, F32.1, F32.2, F32.3)
Recurrent depressive episodes (ICD-10: F33.0, F33.1, F33.2, F33.3)
Anxiety disorders
Phobic disorders (ICD-10: F40)
e.g., specific phobia (ICD-10: F40.2)
Anxiety disorders (ICD-10: F41)
e.g., generalized anxiety disorder (ICD-10: F41.1)
Anxiety and depressive disorder, mixed (ICD-10: F41.2)
Reactions to severe stress and adjustment disorders
Acute reaction to burdening (ICD-10: F43.0)
Posttraumatic stress disorder (ICD-10: F43.1)
Adjustment disorder (ICD-10: F43.2)
Somatoform disorders
Somatization disorder (ICD-10: F45.0)
Hypochondriacal disorder (ICD-10: F45.2)
Somatic stress disorder (bodily distress disorder, bodily distress syndrome) (ICD-11)
Psychological factors or behavioral factors associated with disorders or diseases classified elsewhere (ICD-10: F54)

Adapted from Mazurek, et al. *Dtsch Arztebl Int* 2022;119:219-25, with permission of Deutscher Ärzteverlag GmbH [4].

from physiotherapy and head and neck manipulation [60]. TMD pain reduction mediates the improvement of somatic tinnitus after orofacial treatment, emphasizing the link between these factors [60]. Orofacial treatment or combining cervico-mandibular manual therapies with exercise and education yields better outcomes for TMD-associated tinnitus [61,62]. Baseline tinnitus severity, tinnitus-related handicap, and pressure pain thresholds over the temporalis muscle significantly predict treatment effectiveness in TMD-related tinnitus [63]. A pilot study explored the effectiveness of EMS (exercise to improve muscle strength, motion of joints, and stretch training) as a somatosensory stimulation therapy for somatosensory tinnitus symptoms [64]. The study findings suggest that EMS therapy is effective and safe for improving somatosensory tinnitus symptoms, with sustained therapeutic effects over weeks. Together, physiotherapy and head and neck manipulation have shown promising results in ameliorating tinnitus severity in patients with TMD, somatic tinnitus, and related conditions.

Others

In the rapidly expanding digital hearing healthcare market, combining virtual reality and sound therapy and treatments through smartphone applications like sound therapy and CBT is proving promising [65,66]. Furthermore, new treatment approaches are being introduced, including methods like photobiomodulation [67]. Although current meta-analyses do not indicate significant therapeutic effects in acupuncture, there remains a potential for notable individual differences and placebo effects [68,69].

Conclusion

When treating patients with tinnitus, the initial steps involve conducting a detailed medical history assessment, checking for abnormalities in the auditory system, identifying any accompanying psychological issues, and evaluating the severity of tinnitus discomfort through auditory tests and questionnaires.

Table 4 provides a concise overview of current tinnitus treatments, distinguishing between established recommendations

Table 4. Summary of non-pulsatile tinnitus treatments: current recommendations and areas requiring further research

Category	Treatment method	Description
Currently recommended treatment	Cognitive behavioral therapy (CBT), acceptance and commitment therapy (ACT) and mindfulness	CBT focuses on modifying negative thought patterns and behaviors related to tinnitus. It employs techniques such as cognitive restructuring, behavior activation, exposure therapy, and problem-solving. ACT encourages individuals to accept thoughts and emotions without judgment, guiding them toward values-driven actions.
	Hearing aids (HA)	HA is recommended for individuals with hearing loss and tinnitus.
	Cochlear implant (CI)	CI is recommended if HA is insufficient and for profound hearing loss and tinnitus.
Treatment needing further research	Physiotherapy and head-and-neck manipulation	Physiotherapy and head-neck manipulation can benefit tinnitus influenced by orofacial factors like temporomandibular disorder or neck pain.
	Tinnitus retraining therapy (TRT)	TRT aims to habituate individuals to tinnitus by combining counseling and sound therapy. Current results are inconclusive.
	Tailor-made notched music therapy & music therapy	Tailor-made notched music therapy (TMNMT) uses music with tinnitus-frequency removed.
	Neuromodulation	Guidelines advise against neuromodulation due to a lack of placebo-controlled studies or proven efficacy.
	Neurofeedback	Neurofeedback shows promise in reducing tinnitus distress by manipulating brainwave patterns
	Pharmacotherapy	Insufficient evidence supports drug treatments for tinnitus
	Dietary supplement	Recent guidelines advise against using dietary supplements due to insufficient evidence. While some studies suggest links between certain nutrients and tinnitus, more research is needed.
Virtual reality	Need more validations	
Smartphone applications	Need more validations	
Photobiomodulation	Need more validations	

and areas warranting additional research. Among the currently utilized treatments, those incorporating counseling, such as CBT, ACT, mindfulness, or TRT, have proven to be the most effective and should be prioritized. Other methods like TM-NMT or music therapy have limited efficacy. Recommending HA or CI is beneficial for patients with tinnitus accompanied by hearing loss.

Certain medications, such as amitriptyline, acamprosate, gabapentin, intratympanic dexamethasone, and melatonin, have been reported to show some effects potentially. However, as there is no definitive medication to treat tinnitus, routine use of these drugs should be avoided. Nevertheless, in cases where tinnitus is accompanied by insomnia, depression, anxiety, or other conditions, referring to relevant guidelines can lead to appropriate medication usage.

While no specific nutritional supplements are recognized exclusively for tinnitus treatment, deficiencies in specific nutrients vary depending on the presence of tinnitus. Neuro-modulation techniques like rTMS, tDCS, and tVNS should not be routinely applied to all patients, but they do show efficacy in some instances. Therefore, their application should be tailored to individual patients, and discussions about more suitable stimulation methods and targeted areas are necessary. Neurofeedback has shown positive treatment results recently, suggesting a promising outlook. In cases where tinnitus is accompanied by temporomandibular joint or neck problems, physiotherapy or manual medicine appears helpful.

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Conflicts of Interest

The authors have no financial conflicts of interest.

Author Contributions

Conceptualization: Ho Yun Lee. Data curation: Ho Yun Lee, Da Jung Jung. Formal analysis: Ho Yun Lee. Funding acquisition: Ho Yun Lee. Methodology: Ho Yun Lee, Da Jung Jung. Supervision: Ho Yun Lee. Validation: Ho Yun Lee, Da Jung Jung. Visualization: Ho Yun Lee. Writing—original draft: Ho Yun Lee. Writing—review & editing: Ho Yun Lee. Approval of final manuscript: Ho Yun Lee, Da Jung Jung.

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