

# Do dietary factors significantly influence tinnitus?

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## Background

Tinnitus is a common and multifactorial condition that requires careful medical assessment and management. Many people with tinnitus believe foods can exacerbate or reduce their perception of the condition, but the research on the relationship between diet and tinnitus is limited.

## Objective

The aim of this article is to review the available literature on the efficacy of a healthy diet, use of dietary supplements, caffeine restriction and salt restriction against tinnitus.

## Discussion

There is very weak evidence that dietary quality affects tinnitus symptoms, and further high-quality analytical studies are needed. On the other hand, the research is clear that dietary supplements are ineffective in reducing the symptoms of people with tinnitus and should therefore not be recommended by clinicians. There is also no supporting empirical scientific evidence for the commonly advocated restriction of caffeine and dietary salt for tinnitus patients.

**WE OWE THE GREEK PHYSICIAN** Rufus of Ephesus (c. 80–150 AD) for a precise description of auricular anatomy of the ear. In his work for novice physicians, *De Corporis Humani Partium Appellationibus*, he used the words ‘helix’, ‘antihelix’ and ‘tragus’, which are the anatomical terms that are still in use today.<sup>1</sup> As the founder of the systematic anamnesis, Rufus of Ephesus also knew (and practised) that a detailed nutritional history, especially questions regarding the relationship between symptoms and food intake or certain foods, is essential for patient management and has timeless validity.<sup>2</sup> Many people with tinnitus also believe that certain foods can trigger/exacerbate or even improve their symptoms. But does altering diet significantly change the risk or severity of tinnitus?

Tinnitus (from the Latin *tinnire*, to ring), the perception of phantom sound in the head or ears in the absence of a corresponding external acoustical source, is a common disorder in the general population.<sup>3–5</sup> Depending on the applied diagnostic criterion for tinnitus, the prevalence rates in adult populations vary from 11.9–30.3%.<sup>5</sup> We know that tinnitus is a multifactorial condition – brought on by factors including age; noise exposure; ototoxic medications; vascular problems; genetic predisposition; temporomandibular disorders; or as a consequence of other diseases, such as Ménière’s disease (MD) – that requires careful medical assessment and management.<sup>3,6</sup> Table 1 features a list of widely used medications that can contribute to tinnitus.

The necessary multidisciplinary management of patients with tinnitus

includes strategies such as hearing aids, sound therapy, cognitive behavioural therapy, psycho-educational counselling or neuromodulation; however, potentially beneficial lifestyle modifications are generally not used so far.<sup>3,4,6,7</sup> For example, important and effective recommendations such as ‘patients who have tinnitus should stop smoking’ are rarely shared with those in primary care settings.<sup>8</sup>

## Follow healthy eating

Healthy fibre-rich dietary patterns and regular physical activity are recommended for tinnitus patients and all other patients.<sup>9–11</sup> In this way, the body is supplied with all of the important food components, which is also relevant for the undisturbed inner-ear biochemistry and function, and thus for hearing. For example, the desirable daily portion of wholegrain oats not only stabilises blood sugar levels, but also contains abundant magnesium and zinc, the two minerals that have a major role in neural and central auditory pathways. In the frequent causes of tinnitus, general practitioners (GPs) should therefore think about disturbances of carbohydrate and lipid metabolism – such as diabetes mellitus, hyperinsulinemia and hyperlipidemia – that have a negative impact on the inner ear with their microvascular complications (eg thickening of the capillaries of the stria vascularis and in the endolymphatic sac).<sup>9,12–17</sup> For example, Spankovich et al have observed that higher cholesterol and dietary fat intakes are also significantly associated with lower amplitudes of evoked

otoacoustic emissions and worse pure tone thresholds.<sup>18</sup>

In a recently adjusted cross-sectional analysis of the National Health and Nutrition Examination Survey (n = 2176), participants with healthier diet (measured by the healthy eating index) had a lower incidence of persistent tinnitus than those with poorer dietary practices (odds ratio [OR]: 0.67; 95% confidence interval [CI]: 0.45, 0.98; P = 0.03).<sup>19</sup> An examination of the subscales of the healthy eating index showed, in particular, a significant relationship between reported odds of persistent tinnitus and both healthier fat intake (OR: 0.69; 95% CI: 0.49, 0.99; P = 0.04) and fruit intake (OR 0.61; 95% CI: 0.41, 0.91; P = 0.02).

There are currently only two other reports of relationships between dietary factors and tinnitus in larger population-based studies.<sup>10,20</sup> In a UK cross-sectional analysis with 171,722 participants, McCormack et al observed a slight reduction in odds of persistent tinnitus with increased fish consumption (once or more per week), egg avoidance and higher intake of caffeinated coffee (refer to 'Caffeine restriction').<sup>10</sup> Conversely, higher

intake of fruits or vegetables and bread, and avoidance of dairy, were associated with a small increased report of persistent tinnitus. A lower odds of bothersome persistent tinnitus was only detectable among participants when wholemeal/wholegrain bread was consumed rather than white bread (OR 0.86; 95% CI: 0.79, 0.94; P = 0.001). The dietary associations were relatively modest and inconsistent in this observational study. In a recent report from the Korea National Health and Nutrition Examination Survey (n = 7621), tinnitus-related annoyance was significantly associated with lower intake of water (P = 0.038) and protein (P = 0.009).<sup>20</sup>

Some small dietary intervention trials have been shown to reduce tinnitus symptoms in patients with metabolic disorders.<sup>9,12-15,17</sup> For example, Lavinsky et al evaluated the efficacy of nutritional treatment in 80 patients with associated tinnitus and hyperinsulinemia. A long-term high-protein low-sugar diet, including restriction of fatty foods, resulted in a significant reduction of tinnitus symptoms in hyperinsulinemic patients when compared to participants

who did not follow the dietary management (relative risk 5.34; 95% CI: 1.85, 15.37; P = 0.000003), regardless of tinnitus intensity.<sup>14</sup>

It may therefore be helpful for tinnitus patients to monitor their individual dietary patterns in order to identify potential foods or food groups that aggravate or reduce their symptoms.<sup>10,21</sup> However, the few published nutritional studies have been characterised by several methodological weaknesses: lack of control group; no randomisation; CI being wide and cross, or perilously close to, 1.

A systematic review or randomised well-controlled trial on the link between healthy eating and tinnitus is yet to have been performed. Overall, there is very weak evidence that diet quality affects tinnitus symptoms, and further high-quality analytical studies are needed.

### Use of dietary supplements

Dietary supplements may contain vitamins, minerals, herbs or other botanicals, amino acids and certain other substances such as enzymes. Because dietary supplements are legally classified as food, they do not need regulatory approval, and thus come onto the market without regulatory scrutiny of safety, quality, efficacy and advertising claims.

Dietary supplements are readily available and are often labeled 'natural', but 'natural' does not always mean 'safe'. The use of dietary supplements by individuals with tinnitus (mostly without medical guidance) is popular: ginkgo biloba, zinc, melatonin and magnesium are the most widely marketed supplements for tinnitus. For example, in an online survey by Coelho et al of 1788 tinnitus patients from 53 countries, 23% of participants reported using dietary supplements to treat tinnitus. Interestingly, 81% indicated that supplements are ineffective for tinnitus or even make their tinnitus worse.<sup>22</sup>

The lack of efficacy is unanimously confirmed by several systematic reviews and existing clinical guidelines for the treatment of tinnitus: dietary supplements or herbs do not improve the symptoms of people with tinnitus and can cause serious side effects, especially if taken along

**Table 1. List of common medications that can cause or increase tinnitus<sup>4,48-50</sup>**

Class of drug	Subclass of drug	Examples
<b>Antibiotics</b>	Aminoglycosides	Amikacin, gentamycin, kanamycin, neomycin, netilmicin, streptomycin, tobramycin
	Macrolides	Azithromycin, clarithromycin, erythromycin
	Glycopeptides	Vancomycin
<b>Antimalarials</b>	Quinine-based agents	Chloroquine, mefloquine, quinine
<b>Cancer chemotherapeutic drugs (cytotoxics)</b>	Antineoplastic platinum-based agents	Carboplatin, cisplatin, cyclophosphamide
<b>Diuretics</b>	Loop diuretics	Bumetanide, ethacrynic acid, furosemide, torasemide
<b>Nonsteroidal anti-inflammatory drugs</b>		Acetaminophen, aspirin (high doses), ibuprofen, indomethacin, salicylates
<b>Antidepressants</b>	Tricyclics	Amitriptyline, imipramine

*Depending on the medication and dosage, the effects of ototoxic medications can be temporary (as in the case of nonsteroidal anti-inflammatory drugs, diuretics and quinine) or permanent (especially with the use of aminoglycoside antibiotics or platinum-based drugs).*

with conventional medications (eg blood thinners, antibiotics).<sup>4,6,7,23,24</sup> Dietary supplements may increase or decrease the effectiveness of medication and alter the results of blood or urine tests. According to Cochrane reviews, supplementation with ginkgo biloba or zinc does not relieve tinnitus symptoms and is no more effective than placebo (adverse effects such as gastrointestinal disturbances, headache or allergic reactions may occur).<sup>25,26</sup>

Randomised, double-blinded, placebo-controlled trials also failed to show any effects on the use of antioxidant agents for tinnitus management (eg vitamins C and E,  $\beta$ -carotene,  $\alpha$ -lipoic acid).<sup>27,28</sup>

Nonetheless, after medications (45%) and hearing aids (9%), dietary supplements (8%) are one of the most widely discussed interventions in tinnitus management with physicians, as shown by a cross-sectional analysis of the representative 2007 National Health Interview Survey.<sup>29</sup>

As a result of the clear research data, the American Academy of Otolaryngology – Head and Neck Surgery Foundation contains the following evidence-based statement in its clinical practice guideline: ‘Clinicians should not recommend Ginkgo biloba, melatonin, zinc, or other dietary supplements for treating patients with persistent, bothersome tinnitus’.<sup>4</sup>

### Caffeine restriction

For many years, people with tinnitus were advised to avoid caffeine-containing drinks such as coffee, tea, soft drinks or energy drinks.<sup>30,31</sup> The main arguments are caffeine’s stimulatory effects on the central nervous system and a potential interaction with central auditory processing (eg caffeine can cause a shortening of cochlear outer hair cells).<sup>31,32</sup> However, there is no supporting empirical scientific evidence for a caffeine restriction recommendation. The few published studies on the link between caffeine consumption and tinnitus are listed in Table 2. So far, only one properly controlled investigation has been performed.<sup>33</sup> None of the studies showed any significant improvement in controlling attacks or delaying disease progression in

tinnitus patients with caffeine restriction. In three observational studies, higher caffeine intake was associated with a lower prevalence of tinnitus.<sup>10,34,35</sup> Of course, a causal relationship for a protective effect of caffeine against neuro-otological problems cannot be deduced from these observations.

### Salt restriction

Restriction of dietary salt intake (sodium intake less than 3 g/day) is recommended by many clinicians as one of the first-line treatments for MD and is based on anecdotal experience in the 1930s.<sup>36–38</sup> Salt is associated with fluid retention and it is currently believed that a low-salt diet may induce an increase in the plasma aldosterone concentration, possibly affecting the endolymph regulation and helping to maintain inner-ear homeostasis (endolymph absorption in the endolymphatic sac).<sup>38,39</sup>

Recent international consensus statements mention a reduced-salt diet as a lifestyle change for MD management,<sup>40,41</sup> but there is currently no good supporting evidence for this common recommendation (Level 4 evidence).<sup>42</sup> The search yielded no systematic review and only a single randomised controlled trial.

Acharya et al investigated three first-line treatment options of MD over three months in a double-blind randomised controlled trial (97 tinnitus patients with a mean age of 47.9 years were randomised into three groups):

- dietary sodium restriction and placebo
- diuretics as amiloride 5 mg and furosemide 40 mg
- vasodilator as betahistine 24 mg.

No benefit could be found attributable to dietary salt restriction alone in terms of hearing improvement, number or severity of vertigo, and tinnitus score.<sup>43</sup> However, a systematic Cochrane review to determine the effectiveness of a dietary salt restriction for the treatment of MD is currently under preparation.<sup>44</sup>

It should be noted that too much salt in food is a worldwide problem. Australia consumes more salt than the recommended level of <5–6 g/day.

According to current data, daily dietary salt intake is 10.1 g for Australian men and 7.3 g for women.<sup>45</sup> The main suppliers of salt are bread and processed foods,<sup>46</sup> with 70–80% of daily dietary salt found in breads/cereals/grains, meat products and dishes, and cheese, but also in ready-made meals, dressings/sauces and snacks/desserts. Moderate reduction of dietary salt intake also helps to lower systemic hypertension, which is considered a vascular risk factor. There is likely a positive association between tinnitus and arterial hypertension.<sup>47</sup>

### Historical view

The existing evidence situation for nutritional intervention of tinnitus is not very good. As a result of a clear lack of efficacy and the risk of side effects, clinicians should not recommend dietary supplements or herbs for treating patients with tinnitus. There is also no supporting empirical evidence for the commonly advocated caffeine and dietary salt restriction recommendation for tinnitus patients. The paper’s titular question can be seriously answered only with ‘no’. Well-controlled randomised trials are needed to clarify whether GPs should ask individuals with tinnitus about their eating habits (food preferences, dislikes, etc) as part of the physician–patient interaction.

Rufus of Ephesus would certainly support this suggestion today – he would probably complement this with the instruction of a routine nutritional screening in patients’ electronic clinical records in primary care and hospital settings. It may sometimes be useful for GPs to receive support from Rufus of Ephesus’ *Quaestiones Medicinales* in the assessment and management of tinnitus patients.

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Table 2. Studies on the relationship between caffeine consumption and tinnitus

Authors (year)	Study design	Sample size	Mean age (years)	Outcome
Claire et al (2010) <sup>33</sup>	A phase 2, pseudo-randomised, double-blinded, placebo-controlled crossover trial	66	59.2	Caffeine abstinence had no effect on tinnitus severity, but acute side effects of caffeine withdrawal were noted (headaches and nausea) and might add to the burden of existing tinnitus
Petersen Schmidt Rosito et al (2011) <sup>51</sup>	Transversal case-control study	136	63.8	Daily intake of black coffee (about 2.5 cups per day) had no influence on the degree of discomfort and quality of life of tinnitus patients
Figueiredo et al (2014) <sup>32</sup>	Contemporary longitudinal cohort study	26	56.9	There is no justification for the universal restriction of caffeine intake as a treatment for all patients with tinnitus; however, some groups may benefit from consumption reduction (patients under 60 years with bilateral tinnitus and daily coffee intake between 150-300 mL)
Glicksman et al (2014) <sup>34</sup>	Longitudinal and prospective study (18-year follow-up)	65,085 (5289 incident cases of tinnitus)	36.3 (at baseline)	Higher caffeine intake was associated with a lower risk of incident tinnitus in women (4-6 cups versus 1 cup of coffee per day); there was no association between decaffeinated coffee intake and incident tinnitus
McCormack et al (2014) <sup>10</sup>	Cross-sectional study	171,722 (33,897 incident cases of tinnitus)	57.1	Higher caffeinated coffee consumption was associated with a small lower prevalence of transient and persistent tinnitus
Figueiredo et al (2016) <sup>47</sup>	Transversal case-control study	288	58.2	No association between tinnitus and caffeine consumption was detectable
Lee et al (2018) <sup>35</sup>	National population-based observational study	13,448 (3642 incident cases of tinnitus)	Age groups (no mean age): 19-39, 40-64 and ≥65	Frequency of coffee consumption had an inverse correlation with tinnitus

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