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The Role of Nutritional Factors and Age in the Pathogenesis and Treatment of Tinnitus

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ABSTRACT

Introduction: Tinnitus is a common and frequently debilitating condition affecting millions worldwide. Its pathogenesis is multifactorial, involving hearing procedure dysfunction and neuroplastic changes. Danger factors for tinnitus are separated into two categories: non-modifiable factors, such as age and hearing loss, and modifiable factors, which contain lifestyle and nutrition. *Results*: study indicates that dietary routines and nutritional status may significantly impact tinnitus onset, rigor, and management. However, the existing proof is often inconsistent and sometimes contradictory. Overall, comprehensive studies, frequent reviews, and clinical trials indicate a correlation between specific dietary patterns and nutrients and the risk and sign burden associated with tinnitus. Contrarily, high information about unhealthy fats, sodium, processed foods, and certain micronutrients (such as calcium and iron) is associated with increased risk or severity of tinnitus. The evidence for dietary supplements remains inconclusive, with most studies showing little or no benefit for symptom relief. Due to auditory degeneration and health issues, age influences tinnitus prevalence and severity, especially in older adults. Lifestyle modification, a healthy diet, and managing conditions can help manage tinnitus. *Conclusions*: While adopting a balanced, nutrient-rich diet may reduce risk and improve the quality of vitality-tinnitus, further high-quality research, including randomized controlled trials, is required to clarify causal relationships and report clinical guidelines. Integrating nutritional counseling and lifestyle change in holistic tinnitus care means a promising avenue for improving patient outcomes.

Keywords: tinnitus, nutrition, diet, age, risk factors, dietary supplements, Mediterranean diet

1. INTRODUCTION

Tinnitus is the perception of sound without an external auditory stimulus. It may be intermittent or persistent, unilateral or bilateral, and can fluctuate in intensity and distress. While for some individual's tinnitus is a mild nuisance, for others it can be profoundly disabling, interfering with sleep, concentration, emotional well-being, and overall quality of life (De Ridder et al., 2021).

The clinical and scientific understanding of tinnitus has evolved considerably over recent decades. Once regarded primarily as an otological disorder, it is now

recognized as a multifactorial phenomenon involving complex interactions between the peripheral and central auditory systems and non-auditory brain regions implicated in attention, emotion, and cognition (De Ridder et al., 2021). This multidimensional nature of tinnitus presents significant research and clinical management challenges, necessitating a holistic and interdisciplinary approach.

Tinnitus is one of the most prevalent auditory symptoms globally, with recent systematic reviews estimating that approximately 14% of adults experience some form of tinnitus, and 2% suffer from severe, chronic, or disabling tinnitus (Jarach et al., 2022). The prevalence of tinnitus increases with age, with the highest rates observed among older adults, particularly those with concomitant hearing loss (Oosterloo et al., 2021). Notably, tinnitus is not confined to adults; studies indicate that it also affects children and adolescents, with prevalence estimates ranging from 5% to 13%, depending on the population and diagnostic criteria used (Nemholt et al., 2020).

Global epidemiological data reveal substantial variation in tinnitus prevalence across regions, age groups, and socioeconomic strata (Jarach et al., 2022). Several factors contribute to this variability, including differences in noise exposure, occupational and environmental risk factors, genetic predisposition, existing medical conditions, and access to healthcare services. The rising prevalence of tinnitus among seniors and their heightened sensitivity to noise and ototoxic substances highlights the critical need for effective prevention and management strategies. Moreover, establishing standardized definitions and new diagnostic standards for tinnitus is necessary to address this growing issue and support particularly vulnerable aging individuals (Jarach et al., 2022).

According to an international multidisciplinary proposal, "tinnitus" refers to the conscious perception of an auditory sensation without a corresponding external stimulus, while "tinnitus disorder" is characterized by tinnitus accompanied by emotional distress, cognitive dysfunction, and/or functional disability that significantly impairs daily life (De Ridder et al., 2021). This distinction is clinically and scientifically significant, as it recognizes that not all people with tinnitus are equally affected or require the same level of intervention. The operationalization of these definitions facilitates more precise epidemiological studies, enhances comparability across research, and supports the development of tailored treatment approaches (De Ridder et al., 2021).

The pathogenesis of tinnitus is multifactorial, affecting both peripheral and central mechanisms. Peripheral factors include damage to the cochlea or auditory nerve, often resulting from noise exposure, aging (presbycusis), ototoxic medications, or other insults (Piccirillo et al., 2020). Such damage can lead to abnormal spontaneous neural activity, which the brain interprets as sound.

Central mechanisms play a critical role in the persistence and distress associated with tinnitus. Neuroimaging and neurophysiological studies have identified maladaptive neuroplastic changes in the central auditory pathways, as well as altered activity in non-auditory brain regions such as the limbic system, anterior insula, and prefrontal cortex (De Ridder et al., 2021). These changes are thought to underlie the emotional and cognitive dimensions of tinnitus, including attention deficits, anxiety, depression, and impaired executive function (Brueggemann et al., 2021). Importantly, the heterogeneity of tinnitus pathophysiology means that no single mechanism can account for all cases, and individual differences in genetic, environmental, and lifestyle factors likely modulate susceptibility and clinical expression.

Age is a key risk factor for tinnitus, with higher prevalence and severity in older populations (Oosterloo et al., 2021). It is connected to age-related hearing loss, which significantly influences tinnitus risk through mechanisms involving peripheral auditory degeneration and central compensatory changes. Other established risk factors include chronic noise exposure (occupational or recreational), ototoxic drugs, head and neck trauma, metabolic and cardiovascular diseases, and psychiatric comorbidities (Piccirillo et al., 2020; Jarach et al., 2022). The interplay between these factors contributes to the wide variability in tinnitus onset, severity, and persistence observed in clinical practice. Emerging evidence implies that modifiable lifestyle factors, particularly nutrition and dietary habits, influence the risk and progression of tinnitus (Dawes et al., 2020; Marcrum et al., 2022; Zhang et al., 2025).

Historically, the role of nutrition in tinnitus has received limited attention, with most research focusing on pharmacological, audiological, and psychological interventions. However, recent years have witnessed a growing interest in the potential impact of dietary patterns, specific nutrients, and dietary supplements on tinnitus risk and severity (Dawes et al., 2020; Marcrum et al., 2022; Zhang et al., 2025; Wadhwa et al., 2024).

Several large-scale epidemiological studies and systematic reviews have identified associations between specific dietary factors and tinnitus. For example, increased consumption of fruits, vegetables, dietary fiber, dairy products, and caffeine has been linked to a reduced risk of tinnitus, possibly through anti-inflammatory, antioxidant, and vascular mechanisms (Marcrum et al., 2022; Zhang et al., 2025). Recent meta-analyses have confirmed that a higher intake of fruits, fiber, dairy products, and caffeine is consistently associated with a lower incidence of tinnitus, with robust findings across diverse populations and study designs (Zhang et al., 2025).

Conversely, diets high in saturated fats, sodium, processed foods, and certain micronutrients (such as calcium and iron) are associated with an increased risk or severity of tinnitus (Dawes et al., 2020; Zhang et al., 2025). For instance, higher intakes of calcium, iron, and fat have been linked to greater odds of tinnitus, while high-fat and high-sodium diets may exacerbate symptoms through mechanisms involving vascular dysfunction and elevated blood pressure (Dawes et al., 2020; Wadhwa et al., 2024).

The biological plausibility of these associations is supported by evidence that oxidative stress, inflammation, and vascular dysfunction play key roles in both auditory system health and tinnitus pathogenesis. Nutritional factors that modulate these pathways—such as antioxidants from fruits and vegetables, fiber, and nutrients supporting vascular health—may influence the onset, progression, and symptomatology of tinnitus (Marcrum et al., 2022; Wadhwa et al., 2024).

In addition to dietary patterns, dietary supplements such as Ginkgo biloba, magnesium, vitamin B12, zinc, melatonin, and bioflavonoids are commonly used by individuals with tinnitus (Wadhwa et al., 2024). However, the evidence supporting the efficacy of these supplements is mixed, with most randomized controlled trials showing limited or no benefit for tinnitus relief (Wadhwa et al., 2024). For example, systematic reviews indicate that Ginkgo biloba and vitamin B12 supplementation generally do not provide significant improvement in tinnitus symptoms for most patients, though some studies suggest possible benefit in specific subgroups, such as those with documented deficiencies. Magnesium supplementation may offer modest improvement in tinnitus severity for some individuals, but results remain inconsistent across studies. Zinc supplementation has shown subjective improvement in a subset of patients with low baseline zinc levels, though overall evidence is inconclusive. Melatonin may improve sleep quality and emotional well-being in tinnitus sufferers, but is not recommended as a primary therapy for tinnitus itself (Wadhwa et al., 2024). Bioflavonoids, such as lemon bioflavonoid complexes, are widely used, but available data suggest only modest symptom improvement and high patient satisfaction, with no robust evidence for significant tinnitus relief.

The popularity of supplements highlights both the limited efficacy of conventional therapies and patients' desire for self-management strategies (Wadhwa et al., 2024).

While tinnitus is often regarded as a condition of older adults, it also affects children and adolescents, with important implications for development, education, and psychosocial health (Nemholt et al., 2020). The prevalence of tinnitus in pediatric populations varies widely but is generally lower than in adults, with estimates ranging from 4.7% to 46% in the general pediatric population and higher rates among children with hearing loss (Nemholt et al., 2020). Risk factors in children include congenital or acquired hearing loss, recurrent otitis media, noise exposure, and psychological stress (Nemholt et al., 2020; Brueggemann et al., 2021). Tinnitus in children can adversely impact auditory function, cognitive performance, emotional health, and overall quality of life, with distress correlating closely with deficits in cognitive domains such as attention, memory, and executive functioning (Brueggemann et al., 2021; Nemholt et al., 2020).

These effects may be particularly pronounced in older adults at greater risk of cognitive decline. In addition, the bidirectional relationship between tinnitus and psychological disorders—such as anxiety, depression, and insomnia—complicates management and accentuates the necessity for integrated, multidisciplinary care strategies (De Ridder et al., 2021; Brueggemann et al., 2021). Current clinical guidelines emphasize a patient-centered approach that includes education, reassurance, sound therapy, hearing aids (for hearing loss), and psychological interventions such as cognitive behavioral therapy (CBT) (Piccirillo et al., 2020; De Ridder et al., 2021). Integrating lifestyle interventions, including dietary modifications, represents a promising but underutilized component of holistic tinnitus care (Wadhwa et al., 2024).

Despite significant advances in understanding the epidemiology, pathophysiology, and management of tinnitus, many questions remain regarding the role of nutritional factors in its onset, progression, and treatment. This review aims to synthesize the most recent and robust evidence on the relationship between nutritional factors and tinnitus, with a particular focus on mechanisms, epidemiological trends, and clinical implications.

2. REVIEW METHOD

This review followed a systematic approach using the PRISMA guidelines. Databases searched included PubMed, EMBASE, Web of Science, and Scopus. The search strategy incorporated keywords such as tinnitus, diet, nutrition, dietary factors, dietary supplements, risk factors, hearing loss, aging, prevalence, management, sleep disturbance, and physical activity. Inclusion criteria: peer-reviewed studies from January 2019 – May 2025, human populations, English language, and studies examining the relationship between nutritional factors and tinnitus. Exclusion criteria: case reports, non-English publications, and non-peer-reviewed articles. 1,245 studies were identified, with 36 meeting the inclusion criteria after screening.

Search Strategy

Databases: PubMed, EMBASE, Web of Science, Scopus.

Keywords: Tinnitus, diet, nutrition, dietary factors, dietary supplements, risk factors, hearing loss, aging, prevalence, management, sleep disturbance, physical activity.

Inclusion Criteria:

Peer-reviewed observational studies, interventional studies, systematic reviews, and meta-analyses (January 2019– May 2025).

Studies in human populations (adults or children) examining the relationship between nutritional factors (dietary patterns, specific nutrients, or supplements) and tinnitus onset, severity, or management.

Outcomes:

Tinnitus prevalence, incidence, severity, risk factors, and response to dietary or nutritional interventions.

Exclusion Criteria:

Case reports, non-English publications, and non-peer-reviewed articles.

Screening:

One thousand two hundred forty-five studies were identified; 36 met inclusion criteria after deduplication, title/abstract screening, and full-text review.

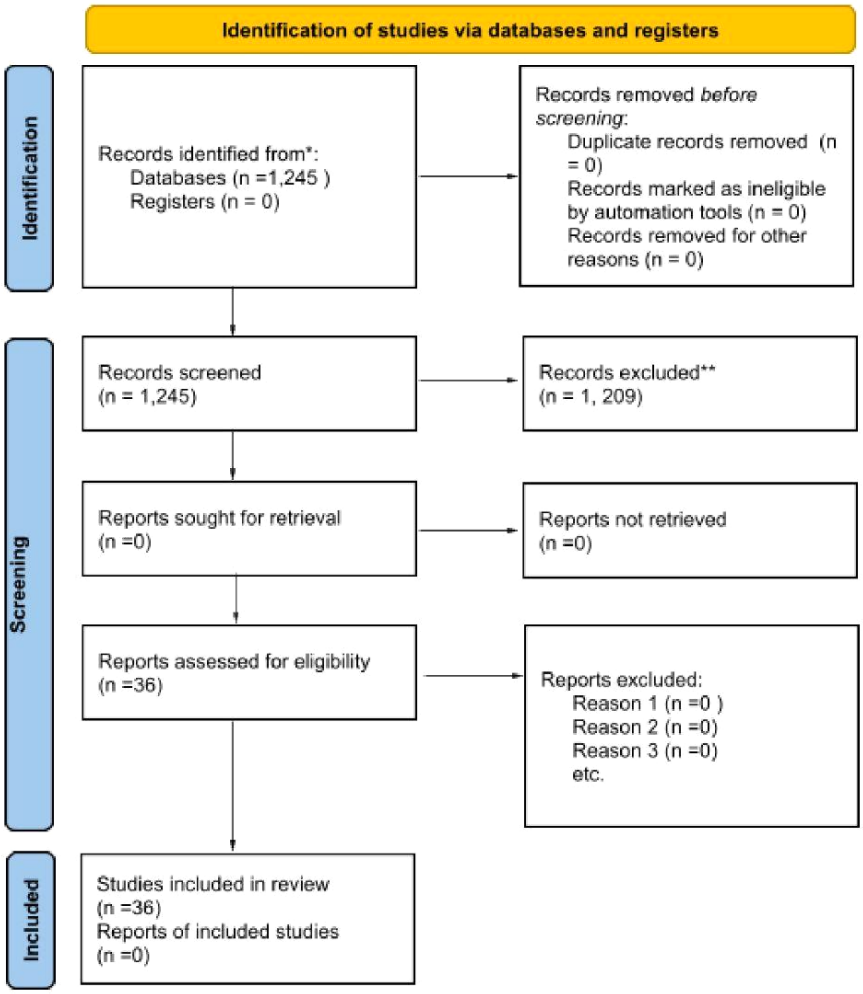

Figure 1. PRISMA flow diagram.

As shown in Figure 1, the PRISMA 2020 flow diagram summarizes the procedure for selecting the analysis. It includes the count of records identified, screened, excluded, and ultimately included in the final review. A total of 1,245 records were obtained through

database searching. After removing duplicates, all 1,245 records were screened based on titles and abstracts, excluding 1,209 records that did not meet the inclusion criteria. Thirty-six articles reviewed eligibility, and all met the provisions of the qualitative synthesis. This process provided a transparent and methodical method for identifying the most relevant studies for this review (Zhang et al., 2025).

3. RESULTS

Tinnitus is one of the most common auditory symptoms worldwide, and recent systematic reviews and population-based studies have provided a clearer picture of its epidemiology and burden across age groups. According to a comprehensive meta-analysis of 83 studies published between 1972 and 2021, the pooled global prevalence of any tinnitus among adults is 14.4% (95% CI, 12.6%–16.5%), with severe tinnitus affecting 2.3% (95% CI, 1.7%–3.1%) and chronic tinnitus 9.8% (Jarach et al., 2022). This translates to an estimated 749 million adults worldwide experiencing tinnitus, and over 120 million adults suffering from severe forms, most of whom are 65 years or older. The annual incidence rate is approximately 1% (Jarach et al., 2022).

Age is a strong determinant of tinnitus risk. Prevalence rises from 9.7% among adults aged 18–44 years, to 13.7% in those aged 45–64 years, and 23.6% in adults aged 65 and older (Jarach et al., 2022). In a large elderly cohort, about 21.4% reported tinnitus, with slight variation across age subgroups above 50, but with a consistent association with hearing loss (Oosterloo et al., 2021). While tinnitus is often considered a disorder of older adults, it is also present in the pediatric population. Prevalence estimates in children and adolescents are highly variable, ranging from 4.7% to 46% in the general pediatric population and 23.5% to 62.2% among children with hearing loss. Most studies in children report rates between 5% and 13% (Nemholt et al., 2020).

The burden of tinnitus extends beyond auditory discomfort, often leading to significant distress, impaired sleep, anxiety, depression, and reduced quality of life (Piccirillo et al., 2020; Brueggemann et al., 2021).

Table 1. Summary of key nutritional factors associated with tinnitus risk and severity.

Nutritional Factor	Association with Tinnitus	Evidence Source
Fruit consumption	35% reduced risk	Zhang et al., 2025
Dairy products	17% reduced risk	Zhang et al., 2025
Caffeine	10% reduced risk	Zhang et al., 2025
Dietary fiber	8–9% reduced risk	Zhang et al., 2025
High fat intake	Increased risk/severity	Dawes et al., 2020
Unhealthy fats/sodium	Increased risk/severity	Dawes et al., 2020
Processed foods	Increased risk/severity	Dawes et al., 2020
Supplements (e.g., Ginkgo, Magnesium)	No consistent benefit	Healthline, 2024; Wadhwa et al., 2024

As summarized in Table 1, several dietary factors are consistently associated with tinnitus risk and severity in recent large-scale studies. Increased fruit, dairy, fiber, and caffeine consumption is linked to a lower risk of tinnitus. In contrast, a high intake of unhealthy fats, sodium, and processed foods may increase risk or severity (Zhang et al., 2025; Marcrum et al., 2022; Dawes et al., 2020).

Tinnitus arises from a complex interplay of peripheral and central mechanisms. Injury to the cochlea or auditory nerve, often from noise exposure, aging, or ototoxic drugs, can lead to abnormal neural activity that the brain interprets as sound (Piccirillo et al., 2020). Central mechanisms involve maladaptive neuroplastic changes in auditory pathways and altered activity in non-auditory brain regions, which are associated with the emotional and cognitive aspects of tinnitus (De Ridder et al., 2021; Brueggemann et al., 2021).

The prevalence and severity of tinnitus increase with advancing age, primarily due to age-related hearing loss (presbycusis) and cumulative exposure to risk factors such as noise and ototoxic substances (Oosterloo et al., 2021). Age-related changes in central auditory processing may also reduce the brain's ability to suppress tinnitus, as shown by ecological and clinical studies. Furthermore, cognitive decline associated with aging can exacerbate tinnitus-related distress and impair coping strategies (Brueggemann et al., 2021).

Recent reviews and meta-analyses have identified dietary factors linked to a reduced risk of tinnitus (Zhang et al., 2025; Marcrum et al., 2022):

1. *Fruit:* Regular fruit consumption is associated with a 35% reduction in tinnitus risk.
2. *Dairy products:* Associated with a 17% lower risk.
3. *Caffeine:* Linked to a 10% reduction in risk.
4. *Dietary fiber:* Associated with an 8% reduction in risk.

These findings are robust across multiple large-scale studies and meta-analyses, with consistent negative correlations between these dietary components and tinnitus incidence (Zhang et al., 2025; Marcrum et al., 2022). Conversely, diets high in unhealthy fats, sodium, and processed foods have been associated with an increased risk of tinnitus or greater symptom severity (Dawes et al., 2020; Zhang et al., 2025). High glycemic index foods like white bread, fast food, and sweetened sodas may also increase risk, potentially via mechanisms involving hyperinsulinemia and metabolic dysfunction (Dawes et al., 2020).

Population-based studies indicate that individuals with healthier overall diet quality, characterized by fruits, vegetables, whole grains, and fish, and a lower intake of processed foods, have lower odds of persistent tinnitus (Dawes et al., 2020; Wadhwa et al., 2024). Research involving more than 170,000 individuals shows higher fish and wholegrain bread consumption is vital for decreasing tinnitus. Several mechanisms support the biological plausibility of the role of nutrition in tinnitus:

1. *Oxidative Stress and Inflammation:* Diets rich in antioxidants (fruits and vegetables) may protect auditory structures from oxidative damage.
2. *Vascular Health:* Nutrients that support vascular function (fiber, dairy, omega-3 fatty acids) may improve cochlear blood flow and reduce tinnitus risk.
3. *Neural Function:* Micronutrients such as magnesium and zinc are essential for neural signaling and may influence central auditory processing (Wadhwa et al., 2024; Zhang et al., 2025).

Tinnitus sufferers widely use supplements such as ginkgo biloba, magnesium, melatonin, B vitamins, zinc, and lipo-flavonoids (Healthline, 2024). However, the evidence for their efficacy is limited and often conflicting. Most clinical trials and surveys report little to no benefit; some users even report worsening symptoms. Notably, supplements are often used without medical supervision, and "natural" does not always mean safe (Wadhwa et al., 2024).

4. DISCUSSION

Some dietary intervention trials suggest that targeted nutritional changes may reduce tinnitus symptoms, particularly in patients with metabolic disorders. For example, a high-protein, low-sugar diet with restricted fatty foods has been shown to significantly reduce tinnitus symptoms in hyperinsulinemic patients (Lavinsky et al., 2020, Wadhwa et al., 2024). Regular physical activity and maintaining a healthy weight are also recommended as part of a holistic approach to tinnitus management (Wadhwa et al., 2024).

While most research focuses on adults, tinnitus in children and adolescents is increasingly recognized. Youth risk factors include hearing loss, otitis media, noise exposure, and psychological stress (Nemholt et al., 2020). Dietary patterns in adolescents also appear relevant, with high intake of sweetened sodas and low intake of healthy foods linked to greater tinnitus risk (Dawes et al., 2020).

The evidence supports the integration of dietary assessment and counseling into tinnitus management, particularly for patients with comorbid metabolic or cardiovascular conditions. While there is no universal "tinnitus diet," encouraging a balanced, fiber-rich, and antioxidant-rich diet, while discouraging excessive intake of processed foods, sodium, and unhealthy fats, is prudent (Dawes et al., 2020; Marcrum et al., 2022). Clinicians should also be cautious regarding supplement recommendations, given the lack of robust evidence and potential for harm (Wadhwa et al., 2024).

Despite promising findings, study design heterogeneity, population, and dietary assessment methods limit the current evidence base. Most data are observational, precluding causal inference. High-quality randomized controlled trials and mechanistic studies are needed to clarify the role of specific nutrients and dietary patterns in tinnitus prevention and management (Zhang et al., 2025; Wadhwa et al., 2024).

Recent epidemiological studies and systematic reviews have provided compelling evidence that dietary patterns and specific nutrients are associated with tinnitus risk and symptom burden. Diets rich in fruits, vegetables, fiber, dairy products, and moderate caffeine intake are consistently linked to a lower risk of tinnitus, likely through mechanisms involving improved vascular health, reduced oxidative stress, and anti-inflammatory effects (Zhang et al., 2025). Conversely, high consumption of unhealthy fats, sodium, processed foods, and certain micronutrients (such as calcium and iron) may increase the risk or severity of tinnitus (Dawes et al., 2020).

While the evidence for dietary supplements remains inconclusive, and most are not recommended as primary interventions, the integration of nutritional counseling and lifestyle modification into tinnitus management is increasingly supported by current research (Wadhwa et al., 2024). The role of nutrition is particularly relevant for older adults at greater risk of both tinnitus and nutritional deficiencies, and for whom dietary interventions may offer meaningful adjunctive benefits.

High-quality randomized controlled trials are needed to clarify causality and guide evidence-based dietary recommendations. Further research should investigate the mechanisms connecting nutrition, auditory health, and central nervous system function and the potential for personalized dietary interventions that take into account genetic, metabolic, and lifestyle aspects (Zhang et al., 2025; Wadhwa et al., 2024).

5. CONCLUSION

In summary, this review shows that non-modifiable factors, such as age and modifiable lifestyle elements, particularly dietary patterns, significantly influence the risk and management of tinnitus. Diets rich in fruits, vegetables, fiber, and dairy products are associated with lower tinnitus risk, while high intake of unhealthy fats, sodium, and processed foods may increase risk or severity. The evidence for dietary supplements remains inconclusive. Integrating nutritional counseling and lifestyle modification into tinnitus management is supported by current research, but further high-quality studies are needed to clarify causality and inform clinical guidelines.

Author's Contributions

Eliza Mędrek - Conceptualization; writing - rough preparation; supervision
Natalia Kawczyńska- Writing - rough preparation
Paulina Zegarska- Writing - review and editing

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Informed consent

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Conflict of interest

The authors declare that there is no conflict of interest.

Data and materials availability

All data associated with this study will be available based on the reasonable request to corresponding author.

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