Review Article

Effects of Vitamins on Auditory and Vestibular Systems: Narrative Review

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Running title: Vitamins and Auditory and Vestibular Systems

Abstract

Introduction: Hearing and balance are vital body functions that allow us to communicate with our surroundings and effectively participate in everyday activities. These two functions are influenced by a variety of factors, including vitamins. In this article, we will examine the role of vitamins on hearing and balance, and the effects of deficiencies in these nutrients on ear and balance health.

Materials and Methods: This review examined the effects of vitamins on hearing. We identified 71 studies published since 2000 through searches of Medline (PubMed), Google Scholar, ScienceDirect, PubMed, EBSCO, ASHA, Thieme and the ProQuest**.**

Results: Evidence suggests that vitamins A, B, C, D, and E are associated with auditory and vestibular health. Deficiencies in these vitamins have been linked to hearing loss, tinnitus, dizziness, and impaired inner ear function. In particular, vitamins A and E support hair cell integrity and protect against oxidative stress, while B and C vitamins contribute to neural function. Vitamin D is also important for vestibular health through its role in calcium regulation.

Conclusion: Ensuring adequate intake of these vitamins through diet or supplementation may help prevent hearing and balance disorders and improve quality of life

Keyword: Vitamin; Auditory; Vestibular

Introduction

Vitamins are organic compounds that play an important role in vital body processes, including normal cell function, growth, and development. These nutrients are an integral part of human health and must be supplied in small amounts through the diet for proper metabolic functions(1). They are divided into two main categories, water-soluble vitamins and fat-soluble vitamins. Water-soluble vitamins: These vitamins dissolve in water and are not usually stored in the body, with the exception of vitamin B12, which is stored in large quantities in the liver. For this reason, they need to be consumed regularly. Water-soluble vitamins include vitamin C and the B vitamins, which include: thiamine (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), pyridoxine (B6), biotin (B7), folate (B9), and cobalamin (B12)(2). Fat-soluble vitamins are vitamins that dissolve in fat and can be stored in adipose tissue and the liver. Vitamins A, D, E, and K are among these(3).
vitamins play important roles in systemic physiology; each vitamin exerts specific mechanisms on different organs, and deficiencies can have significant clinical consequences. It is worth noting that free radicals are very reactive because they have unpaired electrons, so they absorb electrons from healthy cells of the body to balance themselves, thereby damaging them. According to studies, vitamins and minerals, with their antioxidant effects, can prevent the destructive effects of free radicals that may be produced during various processes (1, 2).
Vitamins help regulate immune function and maintain overall health, and play a role in improving immune function and reducing damage from infections (1,2). Studies show that vitamins play an important role in maintaining the health of inner hair cells and the function of the auditory nerve, and are effective in improving the function of sensory cells in the inner ear. Vitamin deficiencies can lead to hearing loss, tinnitus, and dizziness (3-5).
Since hearing and balance are fundamental human senses that play a vital role in the processes of communication, learning, language development, social interactions, maintaining body position, and spatial orientation, respectively, and any disorder in the hearing system and balance can be associated with numerous consequences, including impaired communication, impaired speech understanding (6, 7), social isolation, emotional disorders such as depression and isolation (8), impaired quality of life (9), impaired postural stability, and increased risk of falling (10). On the other hand, vitamins are among the factors affecting the hearing and balance systems, and their deficiency can play a role in the occurrence or exacerbation of disorders of the two systems. Therefore, in this study, we decided to have a comprehensive review of the existing evidence on the effects of vitamins on the hearing and balance systems.

Material and Methods

We conducted a comprehensive search across multiple databases, including Medline (PubMed), Google Scholar, ScienceDirect, PubMed, EBSCO, ASHA, Thieme and the ProQuest, without imposing any date restrictions. The search keywords included: “vitamins,” “auditory system,” “vestibular system,” “tinnitus,” “vertigo,” and “sensorineural hearing loss.” In addition to the database search, we examined the reference lists of the selected articles to ensure inclusion of all relevant studies.

All identified papers were reviewed, and a subset was selected based on the following inclusion criteria: availability of an abstract or full text, relevance to the auditory and vestibular systems, and publication in English.
Initially, 106 relevant articles were identified. From these, 71 papers most directly related to vitamins and the auditory/vestibular systems were purposefully selected in accordance with the inclusion criteria (Figure 1). This rigorous search and selection process allowed us to compile a robust body of literature, providing a solid foundation for understanding the impact of vitamins on the health of both the auditory and vestibular systems.

Results and Discussion

Among the various vitamins, the role of vitamins B, C, A, D, and E in the health and function of the hearing and balance systems has been proven figure2. The effects of these vitamins on these systems will be described below.

Water-soluble vitamins

B Vitamins

There are several types of vitamins in the vitamin B group. They are well-known examples of water-soluble nutrients that are essential for vital physiological functions and play an important role in maintaining optimal health (11). These vitamins are found in animal proteins, dairy products, leafy vegetables, and legumes and play a role in energy metabolism and nerve function (12).
While vitamin B1 (thiamine) is essential for the production of energy from carbohydrates, its deficiency can lead to disorders of the nervous system, digestion, and heart function (13). Vitamin B2 (riboflavin) deficiency can increase the risk of anemia, migraines, and cataracts(14). In addition , vitamin B3 (niacin) deficiency can lead to pellagra and various health problems(15). Vitamin B5 (pantothenic acid) deficiency can disrupt the use of carbohydrates, fats, and proteins for energy, as well as impair hormone production and immune system function(16). Vitamin B6 (pyridoxine) is vital for red blood cell production, carbohydrate metabolism, liver detoxification, and brain health(17) And its deficiency can lead to anemia, depression, and chronic inflammatory conditions(18). Vitamin B9 (folate) plays a vital role in brain health and the production of neurotransmitters(19). And its deficiency can increase the risk of depression and cancer(20). Moreover, vitamin B12 deficiency can lead to anemia, neuropathy, and various neurological disorders(21).
Among the B vitamins, the role of vitamins B12, B9, and B6 on the auditory system And the balance is more apparent. deficiency of B vitamins can cause neurological symptoms, dizziness, and tinnitus(22). Studies have shown that vitamin B12 deficiency can negatively affect cochlear function. For example, one comparative study found that the amplitude of TEOAE and SOAE was significantly lower in a group with vitamin B12 deficiency than in a control group(23). Evidence also showed that 63% of patients with tinnitus had low B12 levels. However, vitamin B12 replacement therapy did not significantly improve tinnitus symptoms (24). In addition, studies have shown that vitamins B12 and B9 can reduce the risk of low-frequency hearing loss (10, 25). Also, in patients with NIHL, the prevalence of vitamin B12 deficiency was higher and serum levels of this vitamin were reported to be significantly lower than in healthy subjects(10).
In a study by Doğukan Özdemir et al., patients with vitamin B12 deficiency showed a higher rate of absent VEMP waves and reduced amplitudes with normal latencies, indicating dysfunction in the vestibular system (26). Meanwhile, vitamin B6 has been recognized as an effective agent in

the treatment of vertigo. Research suggests that this vitamin plays an important role in maintaining neurological health and may help reduce symptoms associated with vertigo(22).

Although vitamin B12 deficiency is frequently observed among individuals with tinnitus and hearing loss, clinical outcomes following supplementation remain inconsistent. For instance, Rodrigues et al. (2025) reported that while B12 deficiency is significantly associated with auditory dysfunction, replacement therapy alone did not always result in symptomatic improvement. This discrepancy may be attributed to several factors, including irreversible neural degeneration caused by prolonged deficiency, variability in treatment dosage and duration, and methodological limitations in study design such as small sample sizes or lack of placebo control. Moreover, tinnitus is a multifactorial condition influenced by oxidative stress, vascular compromise, and neurotransmitter imbalance, suggesting that B12 deficiency may act as a contributing factor rather than a direct cause. Therefore, early detection and correction of deficiency, combined with multimodal management strategies, may be more effective than isolated supplementation (27-29)
A recent systematic review by Rodrigues et al. (2025) found that low serum vitamin B12 levels were associated with higher prevalence of hearing impairment, particularly at frequencies ≥ 4 kHz (30). Additionally, a 2023 case-control study observed that deficiencies in B12 and folate correlated with worse outcomes in sudden sensorineural hearing loss (SSNHL) patients (31). These results imply that adequate B vitamins may support cochlear and vestibular function via neural transmission and antioxidative pathways, though larger randomized trials are needed to confirm causality
Recent clinical evidence has strengthened the link between vitamin B deficiencies and auditory dysfunction. In a 2023 case–control study, Kose Celebi et al. found that patients with SSNHL had significantly lower serum levels of vitamin B12 and folate compared with healthy controls, suggesting that deficiencies in these vitamins may contribute to cochlear damage through impaired methylation and oxidative stress mechanisms (32). Additionally, Abu-Zaid et al. (2024) reported that combination therapy including vitamin B2, magnesium, and coenzyme Q10 improved clinical outcomes in patients with vestibular migraine, indicating a potential neurometabolic role of B-vitamins in vestibular disorders (33). These findings align with prior observations of B-vitamin–related neuroprotection and reinforce the need for further controlled human studies.

Vitamin C

Vitamin C, also known as ascorbic acid, is a water-soluble micronutrient and a potent antioxidant(34). It is found in many food sources, such as fruits and vegetables, and is effective in protecting cells from oxidative stress and maintaining tissue health (35). It also plays an important role in boosting immunity and supporting various cellular functions in the immune system (34). Epidemiological studies have shown an association between high vitamin C intake and improved hearing in the mid-frequency range (36). This vitamin is used as an antioxidant in the treatment of SSNHL and may help improve treatment outcomes(6).
Evidence from animal models suggests that vitamin C may have a protective effect on hearing(37). This vitamin helps improve hearing function by inhibiting the activity of the NLRP3 (NOD-like receptor family, pyrin domain containing 3) inflammasome and reducing cytosolic mtDNA (Mitochondrial DNA) levels in the auditory pathway(38). This vitamin helps reduce oxidative stress in hair cells and may prevent noise-induced damage. Combining vitamin C with other micronutrients such as B vitamins and magnesium may help protect hearing and reduce damage caused by noise exposure(35, 39).

The protective effect of vitamin C supplementation in preventing NIHL noise-induced hearing loss was investigated by McFadden et al. in guinea pigs. In this study, animals were fed three diets: a normal diet, a diet lacking vitamin C, and a diet containing a vitamin C supplement. The results showed that after exposure to noise, the hearing threshold in the group receiving the supplement was about 15 dB better than in the control group. In addition, vitamin C supplementation significantly reduced the change in the permanent hearing threshold, while its deficiency had no effect on HL hearing loss (40). In another study using rats, the preventive effect of vitamins B1, B2, B6, E, C, and L-carnitine on cisplatin-induced auditory toxicity was evaluated. ABR thresholds and DPOAE distortion-induced ear acoustic emissions were measured 72 hours after drug administration, and the results showed that these compounds, including vitamin C, play a role in reducing or preventing cisplatin-induced auditory toxicity (41) .

Emerging preclinical research continues to highlight the antioxidative and neuroprotective potential of vitamin C. Cao et al. (2024) demonstrated that vitamin C mitigates excitotoxicity in the auditory cortex of noise-induced tinnitus models by upregulating glutamate transporter-1 (GLT-1), thereby enhancing synaptic regulation and reducing neural hyperactivity [3]. This mechanistic insight complements prior reports on vitamin C's role in preserving cochlear hair-cell function under oxidative stress and suggests a promising therapeutic target for tinnitus and noise-related hearing loss(42)

Fat-soluble vitamins

Vitamin A

Vitamin A is a fat-soluble vitamin that is considered an essential nutrient for the human body. It exists in two main forms. Retinol is the active form of vitamin A and is found mainly in animal sources, and carotenoids are precursors of vitamin A and are found mainly in plant sources. Retinol can be used directly in the body and serves as the main source of vitamin A in the human diet. However, carotenoids, such as beta-carotene, are converted to retinol in the body (43, 44). Beta-carotene prevents damage caused by oxidative stress and plays a role in improving immune function (1, 2).

Vitamin A plays a role in the production of inner ear fluid and the proper functioning of hair cells (43, 44).In humans, vitamin A and its precursors, as a potent antioxidant, can help reduce lipid oxidation and neutralize free radicals, and play an important role in protecting hair cells and repairing damaged cells in the inner ear(45, 46). Some studies have shown that beta-cryptoxanthin and beta-carotene are associated with a reduced risk of hearing loss, and vitamin A deficiency can lead to an increased prevalence of hearing loss(47, 48). This vitamin is also used as an antioxidant in the treatment of SSNHL and may help improve treatment outcomes(46).

In addition, retinoic acid (the metabolically active form of vitamin A) is required for normal development of the inner ear. Its deficiency can lead to dose-dependent abnormalities(49). During pregnancy, adequate supply of this vitamin also plays a key role in preventing SNHL (50).

On the other hand, a synergy between vitamin A deficiency and infections is known, and the association of vitamin A deficiency with an increased risk of otitis media has been reported, in other words, vitamin A supplementation can reduce the risk of HL caused by otitis media (51).

Vitamin D

Vitamin D is a fat-soluble vitamin that exists in two main forms, D2 and D3(52). It helps absorb calcium and phosphorus and is effective in maintaining bone health, strengthening the immune system, and reducing the risk of chronic diseases(53). Vitamin D deficiency can lead to serious

problems such as muscle weakness, bone pain, and an increased risk of bone diseases and infections. Adequate supply of this vitamin through sunlight and a varied diet is very important for maintaining health(54, 55).

This vitamin plays an important role in hearing function and the balance system(56). Vitamin D deficiency can affect bone metabolism and lead to impaired calcium absorption, which can affect hearing function. Several studies have suggested that plasma vitamin D levels may play a critical role in the development of acute otitis media and other hearing problems (26, 57, 58). Studies have shown an association between low plasma vitamin D levels and chronic otitis media (COM) compared to controls (58, 59). A systematic review provided evidence that deficiencies in certain nutrients, including vitamin D, are associated with middle ear diseases and infections, particularly chronic suppurative otitis media, although direct human evidence of this association remains limited (22).

Low vitamin D levels are associated with an increased risk of age-related hearing loss (ARHL) in men over the age of 65 years(60) .According to Feng Chen et al., different types of vitamin D have different effects on hearing. High blood levels of vitamin D2 are associated with hearing problems at low and high frequencies. While certain levels of vitamin D3 are associated with a reduced risk of hearing loss at high frequencies(53).

A high prevalence of vitamin D deficiency has been reported in patients with diseases of the inner ear, including benign paroxysmal positional vertigo, Ménière's disease, vestibular neuritis, idiopathic facial palsy, and acute idiopathic hearing loss and tinnitus(35, 39). Vitamin D plays a role in maintaining the structure of the otoconia by regulating calcium levels within the semicircular canals. Therefore, impaired vitamin D levels can lead to impaired calcium metabolism and transport, which in turn can lead to impaired otoconia absorption and synthesis (61). Finally, providing adequate vitamin D levels through diet or supplementation can be considered as a therapeutic approach to reduce the risk of BPPV and hearing problems(62). In a randomized controlled trial by Shen et al. (2025), combining vitamin D supplementation with standard therapy in SSNHL patients with vitamin D deficiency led to significantly greater improvements in hearing recovery and tinnitus relief compared to therapy alone (63). Complementing this, a Mendelian randomization study by Zhao et al. (2025) found no evidence of a causal link between genetically predicted serum 25-hydroxyvitamin D levels and idiopathic sudden sensorineural hearing loss (64).

Vitamin E

Vitamin E is a fat-soluble vitamin that acts as a potent antioxidant and plays important roles in maintaining body health (65). This vitamin is divided into two main groups: tocopherols and tocotrienols, both of which have antioxidant and anti-inflammatory properties (66). This vitamin can neutralize free radicals and prevent glutamate-induced neurotoxicity. Vitamin E helps maintain healthy skin, strengthen the immune system, and reduce the risk of chronic diseases. Adequate intake of this vitamin through a varied diet is important for maintaining general health(67). It is found in food sources such as vegetable oils, nuts, seeds, and leafy green vegetables(66). Vitamin E is used as an antioxidant in the treatment of sudden onset hearing loss and may help improve treatment outcomes(46). In combination with other vitamins and magnesium, vitamin E may help protect hearing and reduce damage from noise exposure(39). In patients with BPPV, vitamin E supplementation may improve function(67).

Vitamin K

There is no direct, strong, and well-established evidence demonstrating that vitamin K has a specific and reliable effect on hearing, whether in preventing or treating hearing loss. Studies that have examined vitamin K as an independent and specific factor related to hearing are very limited or incomplete. Regarding vitamin K itself, there are basic animal studies and some research on the effects of vitamin K_2 on the brain and aging; however, these do not constitute direct evidence of any impact on the cochlea or improvement of auditory thresholds in humans. Therefore, clinical conclusions cannot be reliably drawn from animal data.(68, 69). Some smaller, non-review papers—such as surveys or nutritional reports—have mentioned vitamin K intake in certain groups, but these do not provide causal links or robust clinical evidence.(70, 71). Summary of studies on the effect of vitamins on the auditory and vestibular system has been shown in table1.

The findings indicate that adequate intake of water- and fat-soluble vitamins may contribute to the prevention and adjunctive management of auditory and vestibular disorders. Key applications include: screening elderly or at-risk populations for B12 and folate deficiencies to prevent SNHL and vestibular dysfunction, considering vitamin C supplementation in noise-exposed individuals or those receiving ototoxic drugs like cisplatin, utilizing vitamin D supplementation as an adjunct in SSNHL therapy and for patients with BPPV or other vestibular disorders and combined supplementation of vitamins B, C, and E may enhance neuroprotection and auditory recovery in clinical settings.

Despite strong preclinical evidence, several gaps remain: a, randomized controlled trials (RCTs) with standardized dosing and long-term follow-up are needed to confirm the efficacy of vitamin supplementation in hearing and balance disorders. b, investigations should assess the synergistic effects of combined vitamins on cochlear and vestibular protection, particularly in elderly populations or patients with chronic conditions. c, mechanistic studies using advanced imaging and electrophysiological measures (e.g., TEOAE, DPOAE, VEMP) are required to delineate the pathways by which vitamins influence auditory and vestibular function. d, Studies should explore personalized supplementation strategies based on genetic, dietary, and environmental factors to maximize clinical benefit. e, Longitudinal cohort studies are necessary to determine whether early correction of vitamin deficiencies can prevent age-related hearing loss and vestibular decline.

Conclusion

Current evidence suggests that various vitamins and nutrients may influence auditory and vestibular health. Deficiencies in vitamins A, B, C, D, and E have been associated with hearing problems and balance disorders. In particular, vitamins A and E are suggested to support hair cell integrity and protect against oxidative stress, while vitamins B and C are linked to improved neural function and a potentially reduced risk of hearing loss. Ensuring adequate vitamin intake through diet or supplementation may serve as a supportive measure for maintaining hearing and balance function.

Furthermore, deficiencies in vitamins B2, B3, and B6 can contribute to neurological symptoms, dizziness, and tinnitus, and vitamin D may influence vestibular function through its role in bone metabolism and calcium homeostasis. Vitamin E, as a potent antioxidant, may also help mitigate oxidative damage in inner ear tissues. Considering the relatively high prevalence of vitamin deficiencies among individuals with vestibular disorders, maintaining sufficient vitamin levels could represent a valuable adjunctive strategy for preserving auditory and vestibular function and improving quality of life

Limitation

This review is narrative in nature and based on heterogeneous studies varying in design, sample size, and methodology. Many included studies were observational or animal-based, limiting causal interpretation. Publication bias and the exclusion of non-English literature may also affect completeness.

Authors' contributions

Conceptualization: Nasrin Gohari, Aylin Mellati. Data curation: Nasrin Gohari, All author. Formal analysis:Nasrin Gohari, Aylin Mellati. Investigation: all authors. Methodology: all authors. Project administration: Nasrin Gohari, Nayiere Mansouri. Supervision: Nasrin Gohari, Aylin Mellati. Validation: all authors. Visualization: Aylin Mellati. Writing—original draft: all authors. Writing—review & editing: Nasrin Gohari, Aylin Mellati, Approval of final manuscript: all authors.

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Table 1. Summary of studies on the effect of vitamins on the auditory and vestibular system

Number	Source	Year	Vitamin	Study Type	Sample Size	Human/Animal	Age Range	Key Outcome	Limitations
1	Curhan et al., AJCN (47)	2015	A, C, E, Folate	Cohort	65,000	Human	NR	Large cohort; higher carotenoid and folate intake linked to reduced hearing loss risk.	Self-reported hearing; dietary recall bias; observational design limits causal inference.
2	Schmitz et al., BMJ (51)	2012	Vitamin A	RCT Follow-up	2,300	Human	Children → Teens	Childhood vitamin A supplementation linked to lower adolescent hearing loss.	Hearing not primary endpoint; follow-up loss; no noise exposure control.
3	Aydogan et al. (59)	2013	Vitamin A & E	Case–control	80	Human	Children	Lower serum A/E levels associated with otitis media with effusion.	Small sample; cross-sectional; vitamin levels fluctuate; no diet adjustment.
4	Singh et al., Noise	2016	Vitamin B12	Pilot Clinical Trial	40	Human	Adults	B12 therapy improved	No placebo group; very small

	Health (28)							tinnitus severity.	sample; limited generalizability.
5	Karli et al. (23)	2013	Vitamin B12	Case–control	40	Human	Adults	B12 deficiency associated with abnormal OAE.	Limited sample; no control for noise exposure or comorbidities.
6	Rodrigues et al., ENT J (30)	2025	Vitamin B12	Systematic Review	40+ studies	Mixed	Varied	Strong evidence linking B12 deficiency to hearing loss.	Heterogeneous studies; limited RCT evidence; potential confounding.
7	Gopinath et al., J Nutr Health Aging (48)	2011	Vitamin C & E	Cohort	2000+	Human	Older adults	Antioxidant intake associated with lower prevalence of ARHL.	No effect on incidence; dietary recall issues; lifestyle confounders.
8	McFadden et al., Hear Res (40)	2005	Vitamin C	Animal Experiment	Guinea pigs	Animal	NR	Vitamin C reduced NIHL.	Animal model; limited human translation; high-dose exposure.
9	Cao et al., ACS Chem Neurosci (42)	2024	Vitamin C	Animal tinnitus model	Rats	Animal	NR	Vitamin C increased GLT-1 expression and improved tinnitus markers.	Mechanistic; animal-only; not clinically validated.
10	Ghazavi et al., Am J Otolaryngol (31)	2020	Vitamin D	Case–control	70	Human	Adults	Vitamin D deficiency more common in SSNHL patients.	Observational; cannot show causality; vitamin D influenced by lifestyle.
11	Shen et al., Head Face Med (63)	2025	Vitamin D	RCT	102	Human	Adults	Vitamin D supplementation improved hearing recovery in deficient SSNHL patients.	Only deficient subjects included; limited generalizability.
12	Zhao et al., PLOS	2025	Vitamin D	Mendelian Randomization	2 cohorts	Human	Adults	Genetic evidence supports	MR assumptions; limited

	ONE (64)							causal role of low vitamin D in SSNHL.	ethnic diversity.
13	Tokgöz et al. (41)	2012	E, B, C	Animal Ototoxicity Study	Rats	Animal	NR	Vitamin combinations reduced cisplatin ototoxicity.	Animal doses not comparable to humans; limited translation.
14	Libonati et al., Audiology Res (62)	2022	Vitamin D + antioxidants	Clinical Cohort	150	Human	Adults	Supplementation reduced recurrence of BPPV.	Non-randomized; cannot rule out placebo effect; diet uncontrolled.
15	Ahsan et al. (66)	2014	Vitamin E (Tocotrienols)	Review	-	Mixed	Varied	Tocotrienols have antioxidant and neuroprotective potential.	Narrative review; lacks direct hearing studies.
16	Soutif-Veillon et al., Maturitas (70)	2016	Vitamin K	Observational	600+	Human	Older adults	Higher vitamin K intake associated with better cognitive performance.	Indirect relation to hearing; confounders; cognitive—not auditory—endpoint.

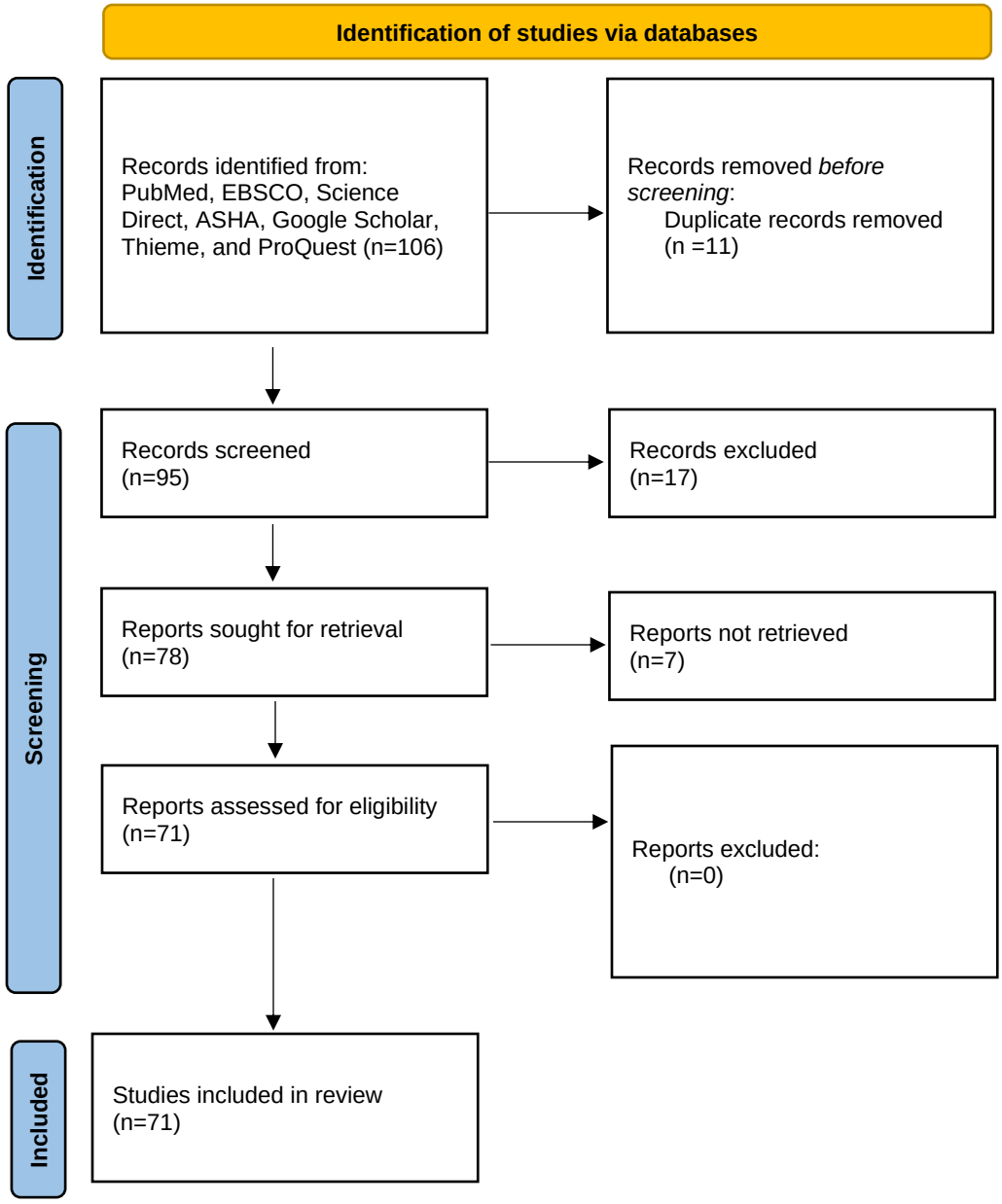

Figure 1. The flow diagram

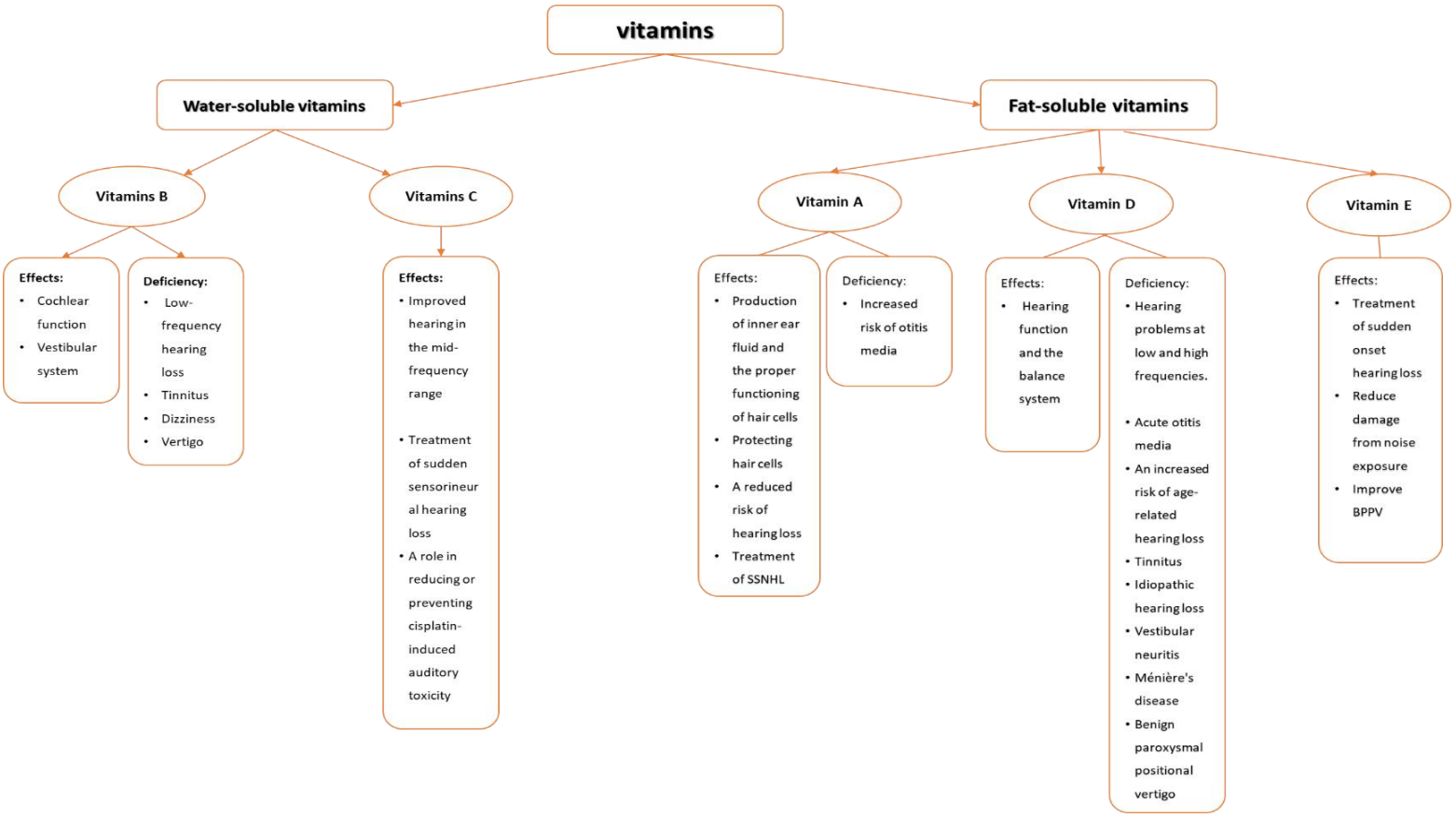

Figure 2. Schematic picture of relationship between vitamins and auditory and vestibular system

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