

Could a Vitamin Reduce Hearing Deficit?

Analysis by [Dr. Joseph Mercola](#)

✓ Fact Checked

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STORY AT-A-GLANCE

- › Loss of cholesterol in the inner ear may be involved in age-related hearing loss – and phytosterols may help resolve it
- › Phytosterols, which have a structure and function similar to cholesterol, led to improvements in the function of outer hair cells in the inner ear, which help amplify sounds
- › They may help balance cholesterol in the inner ear, which may be a useful strategy to prevent or delay hearing loss
- › Finally, phytosterols also have anti-inflammatory and anticancer activities and may target neuroinflammation and neurodegeneration
- › Early humans ate phytosterol-rich diets, consuming as much as 1 gram per day, but the typical modern U.S. diet is relatively low in these beneficial plant-derived compounds

Loss of cholesterol in the inner ear may be involved in age-related hearing loss – and phytosterols, a common over-the-counter supplement, may help resolve it. The finding, published in *PLoS Biology*, could be “an innovative therapeutic strategy in preventing and/or delaying hearing loss,” the team suggests.¹

Age-related hearing loss, also known as presbycusis, affects about 1 in 3 U.S. adults between the ages of 65 and 74. By age 75, close to half of adults may have hearing problems.² Typically, the loss is gradual, so you may not notice it until the hearing

difficulty becomes severe. Phytosterols, which have a structure and function similar to cholesterol,³ may be one option to help slow hearing loss that may occur due to aging.

Low Cholesterol in the Ear Linked to Hearing Problems

Cholesterol plays an important role in the function of neural cell membranes and their associated proteins. It binds to and conditions multiple protein complexes and, in the central nervous system, is involved in synapse formation, interactions between cells and intracellular signaling. Maintaining optimal cholesterol levels in the brain is therefore intricately involved in brain health. According to the PLOS Biology study:⁴

“Importantly, all cholesterol within the CNS is synthesized in situ due to the fact that peripheral cholesterol cannot cross the blood–brain barrier. Thus, cholesterol levels need to be tightly regulated in the brain, and disruption of cholesterol homeostasis has been linked to cognitive dysfunction and to the development of neurodegenerative diseases.”

It’s also known that cholesterol levels in the brain’s hippocampus may decline with age, affecting cell function, leading the researchers to hypothesize that cholesterol deficiency in the ear may also have ill effects.

Outer hair cells (OHCs) in the inner ear use electromotility to change their length, helping to amplify sounds. Electromotility involves the motor protein prestin, but with increasing age, OHCs may not stretch properly when sounds occur, preventing sound amplification and contributing to difficulty hearing.⁵ A lack of cholesterol may help explain why:⁶

“The organization of the OHC lateral wall is exclusive among hair cells and other mammalian cell types because it contains a tightly regulated level of cholesterol. It has been postulated that alterations in the cholesterol content in the OHC lateral wall might modulate the function and/or distribution of prestin within the plasma membrane.”

The team measured the amount of cholesterol 24-hydroxylase (CYP46A1), a brain-specific enzyme that breaks down cholesterol, in inner ear OHCs in mice, finding more of it – and therefore less cholesterol – in older mice compared to younger mice. Further, when CYP46A1 was over-activated with a drug – the antiretroviral efavirenz, used to treat HIV – in young mice, it also led to hearing loss.⁷

According to the researchers, “Our results show that cholesterol levels in the inner ear are reduced during aging, an effect that is associated with an increased expression of the cholesterol 24-hydroxylase (CYP46A1), the main enzyme responsible for cholesterol turnover in the brain.”⁸

Phytosterols Reversed Hearing Loss

The team then wanted to find out if increasing cholesterol in the brain could reverse the hearing loss caused by the CYP46A1-activating drug. Since cholesterol cannot cross the blood-brain barrier (BBB), they gave young mice phytosterols, which are structured similarly to cholesterol, and can cross the BBB, instead.

Mice given the CYP46A1-activating drug and phytosterols for three weeks had improvements in OHC function. “Strikingly, phytosterols supplementation increased the levels of prestin in the OHCs with an apparent recovery of the normal prestin distribution in the lateral wall,” the team explained.⁹

“Our findings show for the first time the importance of cholesterol homeostasis in the inner ear as a pharmacotherapeutic strategy to prevent and/or delay hearing loss.”¹⁰

Phytosterols Have Anti-Inflammatory, Anticancer Effects

In addition to influencing the rates at which cholesterol is absorbed, biosynthesized and excreted,¹¹ phytosterols have anti-inflammatory activities and may target neuroinflammation and neurodegeneration.¹²

The U.S. Food and Drug Administration even endorses the consumption of phytosterols, stating in a 2019 revision to the Code of Federal Regulations, “Scientific evidence demonstrates that diets that include plant sterol/stanol esters may reduce the risk of [coronary heart disease].”¹³

They may also have anticancer effects, and it’s estimated that eating a phytosterol-rich diet may lower cancer risk by 20%. A review published in *Biomedicine & Pharmacotherapy* detailed the many ways that phytosterols may act as natural anticancer agents:¹⁴

“Phytosterols may ... affect host systems, enabling antitumor responses by improving immune response recognition of cancer, affecting the hormone dependent endocrine tumor growth, and by sterol biosynthesis modulation. Moreover, phytosterols have also exhibited properties that directly inhibit tumor growth, including reduced cell cycle progression, apoptosis induction, and tumor metastasis inhibition.”

While it’s believed that early humans ate phytosterol-rich diets, consuming as much as 1 gram per day, the typical U.S. diet is relatively low in these beneficial plant-derived compounds.¹⁵ It’s estimated that modern humans eat between 150 and 450 milligrams (mg) of phytosterols per day, depending on diet.

Vegetarians and vegans may have generally higher intakes, as phytosterols are found in all plant foods.¹⁶ Some good food sources of phytosterols include:¹⁷

Oranges	Brussels sprouts	Pomegranates and pomegranate seed oil
Celery	Broccoli	Onions
Tangerines	Mangos	Cauliflower
Romaine lettuce	Peas	

Age-Related Hearing Loss Is Linked to Dementia

Age-related hearing loss doesn't typically exist in a bubble – it's strongly associated with accelerated cognitive decline and risk of dementia in older adults¹⁸ This, too, may have a low cholesterol connection. According to the PLOS Biology study:¹⁹

“Several works have demonstrated a reduction in cholesterol levels in the hippocampus during aging, leading to a profound effect on the plasma membrane structure and cell function. Reduced cholesterol content in the aged brain and in neurodegenerative diseases was also reported in humans’ brain samples.

Among the causes for age-associated cholesterol loss, an increase in the levels of the cholesterol-hydroxylating enzyme CYP46A1 in the hippocampus, associated with oxidative stress accumulation, has been proposed ... Interestingly, restoring brain cholesterol levels can rescue biochemical, synaptic, and cognitive deficits of aged mice and in a mouse model of Huntington’s disease.”

Lower levels of low-density lipoprotein (LDL) cholesterol are also linked to a higher risk of dementia, as is the use of statin cholesterol-lowering drugs. One study found that people with early mild cognitive impairment and low to moderate cholesterol levels at the start of the study who used lipophilic statins had more than double the risk of dementia compared to those who did not use statins.²⁰

Lipophilic statins, such as atorvastatin (Lipitor), simvastatin (Zocor), Fluvastatin (Lescol), and lovastatin (Altoprev), dissolve more readily in fats²¹ and can easily enter cells²² and be distributed throughout your body.

The subjects also had significant decline in metabolism of the brain’s posterior cingulate cortex, which is the brain region that declines most significantly in early Alzheimer’s disease.²³ Cholesterol, in fact, has many ties to brain health:²⁴

- Decreasing cholesterol levels in the elderly may be associated with cerebral atrophy, which occurs with dementia
- High LDL cholesterol may be beneficial by reducing neurons' impairments or helping repair injured neurons
- Acceleration of neurodegeneration has occurred when neurons were short on cellular cholesterol or cholesterol supply
- Cholesterol plays an important role in the synthesis, transportation and metabolism of steroid hormones and lipid-soluble vitamins, and both of these are important to synaptic integrity and neurotransmission

What Else Contributes to Hearing Loss?

Cholesterol is just one factor that may be involved in hearing. Other nutrients, including a lack of vitamins A, B, C, D and E, as well as zinc, magnesium and selenium, may also play a role.²⁵ Researchers with Hanyang University in Korea explained in the journal *Nutrients*:²⁶

“Antioxidants such as vitamins, which inhibit the formation of free radicals, may play a specific role in preventing and treating HL [hearing loss]. Therefore, several studies have been reported on the relationship between HL and vitamins A, C, and E in humans. Magnesium (Mg) has also been reported to reduce HL through synergistic effects with vitamins.

These findings suggest that free radical scavengers, such as vitamins A, C and E, act in synergy with Mg to reduce changes in hearing thresholds more reliably than treatment with any single agent. Therefore, higher intake of antioxidants and/or magnesium may be associated with a lower risk of HL. Selenium (Se) may also play a role in hearing. Moreover, a lack of vitamin B has been reported to increase the risk of HL.”

Exposure to loud noise, including noise pollution, also contributes to hearing loss over time. The PLOS Biology team explained that a lifetime of loud noise exposure even

exacerbates and may trigger age-related hearing loss. “The high level of noise exposure in modern society makes presbycusis a mixture of acquired auditory stress, trauma and otological disease superimposed upon an intrinsic aging process.”²⁷

Unsafe listening practices in young people using personal listening devices (earbuds) and attending loud venues also increase their risk of hearing loss, which one study estimates may affect more than 1 billion 12- to 34-year-olds worldwide.²⁸

Noise pollution, which can come from heavy traffic, construction machinery, loud music, leaf blowers and countless other sources, is another common risk factor. It’s estimated that 10 million Americans have permanent hearing loss due to noise pollution or noise-related trauma.²⁹

In addition to eating well, including a nutrient- and phytosterol-rich diet, you can help protect your hearing and prevent age-related hearing loss by avoiding loud noises as much as possible, reducing your exposure to loud sounds, including music, and wearing protective earplugs or earmuffs when using loud equipment, such as a lawnmower.³⁰

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