

Beyond the Audiogram: Hidden Hearing Loss 101

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"I can hear you, but I can't make out what you're saying"

"I have difficulty following conversations in loud restaurants"

"I can't seem to focus in noisy settings"

Once coming to their senses (pun intended), those experiencing these challenges will consult an audiologist, who will administer, among other tests, a pure-tone audiometry test, the standard measure for assessing hearing ability. Feeling hopeful that their hearing test will help identify the problem, they may be surprised when the audiologist informs them that their audiogram indicates normal hearing.

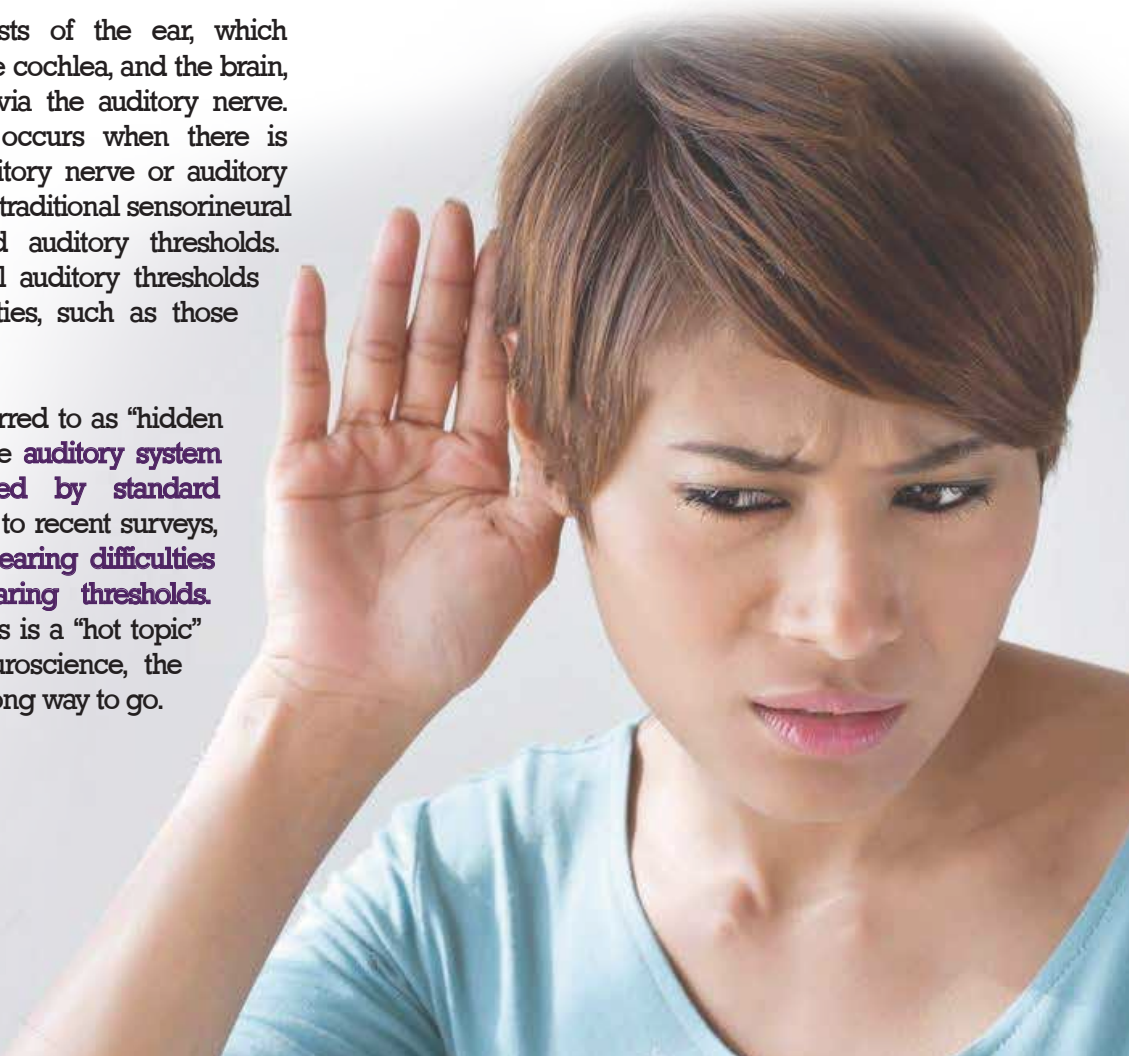
"I passed a hearing test, but I still feel like I have hearing loss"— alas, the final symptom to solidify the shared experience of those with hidden hearing loss.

The auditory system consists of the ear, which includes a structure called the cochlea, and the brain, which connects to the ear via the auditory nerve. Sensorineural hearing loss occurs when there is damage to the cochlea, auditory nerve or auditory areas in the brain. Those with traditional sensorineural hearing loss show elevated auditory thresholds. However, some show normal auditory thresholds but have perceptual difficulties, such as those identified in our example.

This novel phenomenon, referred to as "hidden hearing loss", reflects that the **auditory system dysfunction is not revealed by standard audiometric tests**. According to recent surveys, **12%–15% of subjects report hearing difficulties despite having normal hearing thresholds**. Although hidden hearing loss is a "hot topic" in the field of auditory neuroscience, the research is mixed and has a long way to go.

There are still ambiguities about the nature of this condition, which has implications for hearing health professionals and, in turn, for those affected by it. However, it is still important to understand the current state of the literature in order to accommodate those affected.

Although most of the research on the condition's causes and underlying mechanisms is based on animal models, inferences can be made about humans. So, let's take a look beyond the audiogram for some insight into Hidden Hearing Loss 101...



Causes

Popular opinion suggests that **noise exposure** is the primary cause of hidden hearing loss. Repeated noise exposure, or even a single exposure to loud noise, can result in permanent damage to the auditory system. Today, noise pollution is pervasive, particularly among young adults, putting them at risk for not only developing this condition, but for also having more severe hearing loss as they get older. Another recognized cause of hidden hearing loss is **natural aging**, which is difficult to disentangle from noise exposure, as it might actually just be reflective of accumulated noise exposure. Some other causes include the side effects of **ototoxic medications**, such as high dose aminoglycoside antibiotics, like gentamicin. Altogether, these causes are consistently linked to impaired auditory functioning.



Mechanisms

Some researchers believe that the mechanism underlying hidden hearing loss is **cochlear synaptopathy**. The cochlea houses the inner hair cells that are connected to auditory nerve fibers. According to this perspective, those with hidden hearing loss have a loss of connections between inner hair cells and auditory nerve fibers. Other researchers suggest **cochlear demyelination** as an underlying mechanism. The auditory nerve fibers are myelinated, which ensures the quick and effective transmission of electrical signals to the brain. According to this perspective, those with hidden hearing loss have damaged auditory nerve myelin. There are also researchers who suggest **hair cell dysfunction** as an alternate mechanism. The inner hair cells transform vibrations into electrical signals. There are also outer hair cells in the cochlea that amplify the inner hair cell response. According to this perspective, those with this condition have a problem with their cochlea's hair cell functioning.

Although each of these perspectives revolve around a different mechanism, they all impact the process whereby electrical signals are sent to the brain. This results in the brain having difficulty blocking out competing background noise and making sense of the auditory information that it receives.



Diagnosis

We are currently lacking tests that can be used to identify hidden hearing loss in humans. There are tools available to assess hearing difficulty in complex listening conditions, such as **speech-in-noise tests** and **self-report surveys**, but they are not sufficient to make a clinical diagnosis. They can, however, be used to identify at-risk individuals before symptoms become increasingly apparent. Alternate assessment tools, such as **electrophysiological tests**, wherein electrodes are placed on the scalp or in the ear canal, are currently being studied.



Treatment

The saying “prevention is better than cure” holds true for hidden hearing loss, as **limiting noise exposure** and advocating for quieter environments in public spaces might help limit the prevalence of this condition. Treatments for those who have hidden hearing loss include **hearing aids** with directional microphones that improve speech discrimination in noise, and devices that use **signal-processing strategies** to amplify speech in noisy environments. Alternate treatments, wherein inner hair cells and auditory nerve fibers can be reconnected, and damaged auditory nerves repaired, are currently being investigated. And lastly, to those with hidden hearing loss: **disclosure** can go a long way! Communicating your hearing needs to those in your circle can make for more inclusive and enjoyable social experiences.



With the quick advancement of research and technology, it won't be long before the term “hidden hearing loss” becomes obsolete. But in the meantime, it is an apt descriptor of a condition for which there is currently no diagnostic tool. And for this, the experience for those affected can feel particularly frustrating. That being said, let's continue to search beyond the audiogram to best cater to those affected by hidden hearing loss – hear hear!

If you would like more information about hidden hearing loss, please feel free to consult Hear Québec's library or your health care professionals.



Jessy received her Bachelor of Arts degree in Psychology at Concordia University in 2020. In the final year of her undergraduate degree, she worked in the Adult Development and Cognitive Aging Lab on her Honours Thesis and developed a fascination with the auditory system. This led to her working at Hear Québec as the Database Analyst before beginning her master's degree in a related healthcare field in 2021.

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