

COGNITIVE DECLINE + HEARING LOSS

BY GRACE GORE STURDIVANT

Since communication difficulties are one of the earliest signs of dementia, audiologists are poised to make timely and appropriate referrals when necessary, which can improve long-term outcomes by allowing earlier diagnosis and management of cognitive decline.

Cognitive decline and hearing loss is a current hot topic in audiology. While recent findings offer compelling incentives for adult patients to make the jump to accept hearing aids, we must be careful to present the information accurately to patients and avoid unintentionally using misinformation as a scare tactic. Let's look at what we know.

Epidemiology

Hearing loss is the third most prevalent chronic health condition facing older adults, and we know that very few people have no cognitive decline with age. This presents a large overlap of older adults with both hearing loss and cognitive decline; a population which will only grow with the aging of today's adults. In 2010, 4.7 million people in the United States older than age 65 had the most common form of dementia, Alzheimer's

disease. In 2016, that number grew to 5.4 million; and in 2050, 13.8 million Americans are expected to have Alzheimer's (Herbert, 2013).

We, as audiologists, have an important role to play in the management of this expanding population since multiple factors related to hearing loss may contribute to meaningful functional outcomes. These factors include increased cognitive load or "effortful listening" with hearing loss; structural changes





THOUGH WE CAN'T SAY THAT HEARING LOSS CAUSES COGNITIVE DECLINE, THERE IS EVIDENCE THAT NEUROPLASTIC BRAIN CHANGES OCCUR WITH SENSORY DEPRIVATION.

and neurobiological factors to which hearing loss may contribute; and social-emotional changes that exist with both hearing loss and cognitive decline.

The Baltimore Longitudinal Study of Aging (BLSA), an ongoing prospective study of adults beginning in 1958, has found that the severity of hearing loss has a significant positive correlation with the risk of developing dementia. Individuals with severe hearing loss at the baseline were five times more likely to develop dementia. Second, the National Health and Nutrition Examination Survey (NHANES), an ongoing cross-sectional study, has findings consistent with the BLSA study showing a much higher impact of cognitive decline with hearing loss than with aging alone. Additionally, Frank Lin and colleagues at Johns Hopkins found that adults with untreated hearing loss developed cognitive impairment 3.2 years sooner than the normal hearing cohort; and that the rate of cognitive decline was 30–40 percent faster in individuals with hearing loss than in individuals with normal hearing (Lin et al, 2011, 2013).

While these are compelling findings, still we cannot conclude that hearing loss causes cognitive decline or that hearing aids prevent cognitive decline. The two conditions have associations, but no documented causal links.

Cortical Changes

Though we can't say that hearing loss causes cognitive decline, there is evidence that neuroplastic brain changes occur with sensory deprivation. Anu Sharma and colleagues at the University of Colorado have demonstrated cross-modal plasticity

and cortical resource re-allocation in adults with early-stage, age-related hearing loss. Cross-modal plasticity is the ability of a well-functioning sensory system, like the visual or somatosensory system, to recruit cortical brain regions from a deprived sensory system like the auditory system when hearing loss is present.

Cross-modal plasticity has been seen in cases of long-term, severe-to-profound deafness in adults and children, and more recently in adults with acquired mild-to-moderate, high-frequency hearing loss (2014).

One study used cortical visual-evoked potential (CVEP) recordings with adults who had mild-moderate hearing loss from 2–8kHz, many of whom were not even aware of their hearing loss at the time that they enrolled in the study. Even with these milder cases, subjects showed increased activity in auditory cortical regions in response to a visual stimulus. In other words, the visual system was beginning to recruit areas of the auditory cortex, even in cases of mild-to-moderate, high-frequency hearing loss. Also, a negative correlation was seen between the CVEP latency and the patients' speech perception in noise performance. This finding suggests that this cross-modal plasticity and recruitment by the visual system in early-stage hearing loss may negatively impact speech understanding in noise (Campbell and Sharma, 2014).

In addition to cross-modal plasticity, Sharma and colleagues have studied the brain's resource re-allocation, occurring as a compensatory mechanism for degraded auditory cortical activity. In a study of early-stage, age-related hearing loss, auditory temporal cortex activity

decreased and frontal and pre-frontal cortical activity increased on auditory tasks. This shift in cortical activity from the temporal auditory cortex to the frontal and pre-frontal cortex, which is critical for working memory and executive function, results in increased effortful listening and cognitive load, logically leading to negative behavioral speech perception outcomes (Campbell and Sharma, 2013).

So, with even mild, high-frequency hearing loss, auditory cortex activation is decreased due to the abnormal auditory input to that cortical area. This decreased auditory cortex activation leads to the following two important changes:

- An increase in cross-modal activation of the auditory cortex by the visual cortex
- Compensatory cross-modal activation of the frontal and pre-frontal cortex for processing auditory information

These modifications lead to functional changes in speech perception, and can negatively impact cognitive reserve for working memory and executive function thereby potentially contributing to cognitive decline.

Effectiveness of Intervention with Hearing Aids

So, now can we say that hearing aids are viable protection against cognitive decline? Not so fast. A recent French epidemiological study made headlines in 2015 when data of over 3,000 subjects indicated that elderly adults with self-reported hearing loss who used hearing aids had similar rates of cognitive decline as those with no hearing impairment (Amieva et al, 2015). This led some to assert that hearing aids slowed the rate of cognitive decline. What did not make the headlines was that once factors of depression, social network size, comorbidities, and independent activities of daily living were controlled for, cognitive decline in persons with self-reported hearing loss was no longer significant.

Deal and colleagues conducted a pilot study within the ARIC (Atherosclerosis Risk in Communities) Study in 2015, addressing the hypothesis that older aged persons with hearing loss who use hearing aids have slower rates of cognitive decline than older aged persons with hearing loss who do not use hearing aids. In the study, older persons with moderate-to-severe hearing loss (>40 dB HL)

had poorer performance on memory tasks and global cognitive function compared to individuals without hearing loss. Participants with moderate-to-severe hearing loss, on average, showed decline on cognitive tasks over the 20-year period; however, the greatest decline was noted in the cohort who did not use hearing aids. Conversely, persons with moderate-to-severe hearing loss who used hearing aids showed global cognitive decline only slightly greater than the decline in persons with normal hearing (Deal et al, 2015).

While research has shown significant improvement in global cognitive function following cochlear implantation in elderly populations, more research is needed to explore hearing aid intervention as a viable protection against or decelerator for cognitive decline (Mosnier et al, 2015). Evidence consistently supports participating in cognitively-stimulating environments as an intervention for management of dementia, and hearing aids allow cognitive and interpersonal stimulation and engagement. Further, by decreasing the listening effort required with hearing loss, hearing aids allow patients to feel less exhausted after socializing, allowing more energy for further engagement with family and friends. No, we cannot yet definitively say that hearing aids prevent, delay, or slow cognitive decline. However, we can say that well-fit hearing aids allow for cognitively-engaging behaviors, which are known to prevent, delay, or slow cognitive decline.

Audiologists' Role

As audiologists, our role is to help older adults maintain good communication and remain socially engaged. Since communication difficulties are one of the earliest signs of dementia, we are poised to make timely and appropriate referrals when necessary, which can improve long-term outcomes by allowing earlier diagnosis and management of cognitive decline. It is within our scope of practice to administer screening tools such as the MoCA (Montreal Cognitive Assessment), MMSE (Mini Mental State Examination), or Mini-Cog and refer to primary care physicians and geriatricians with concerning results.

Physicians may likewise incorporate basic hearing screenings, conduct brief screening questionnaires such as the HHIE (Hearing Handicap Inventory for the Elderly), or they may simply ask questions about patient perception and family perception of hearing ability. Any of these measures can generate the information necessary to garner a referral to an audiologist. Since these hearing care measures are not currently included in routine Medicare

visits, we have a responsibility to educate physicians about the unintended consequences of untreated hearing loss and these quick and easy tools they can use for referrals. Physicians should also be encouraged to perform otoscopy to address what is possibly the most treatable form of hearing loss prevalent in aging populations—cerumen impactions; and to use amplification such as pocket talkers in administering cognitive screening assessments verbally in order to avoid overestimation of dementia.

Conclusion

We know that the population of people with comorbidities of hearing loss and cognitive decline is large and growing. We know that there are positive correlations between severity of hearing loss and the incidence of cognitive decline, severity of cognitive decline, and rate of cognitive decline. While we cannot advise our patients that hearing aids will prevent, delay, or slow cognitive decline; we can inform them that the cognitive and social engagement that hearing aids allow are known to be protective against cognitive decline. Hearing aids reduce depressive symptoms, boost social engagement, and reduce caregiver burden; all of which are critical factors for positive health outcomes and improved quality of life.

By diagnosing and treating hearing loss early with appropriately fitted hearing aids, we audiologists work to ensure that auditory temporal cortical activity remains fully engaged and retained so that patients can fully enjoy the practical function of social engagement and interaction. Audiologists and physicians should work together for proper and early diagnosis and treatment of hearing loss and cognitive decline, working toward the common goal of improving independence, overall health, and quality of life throughout the aging journey.

More research is needed to ascertain that hearing aids truly have a protective neurobiological function against cognitive decline. Still, we do have compelling evidence today that can be used in counseling patients and physicians on the negative synergy of the two conditions, and the positive health benefits of amplification. 📌

Grace Gore Sturdivant, AuD, is an assistant professor and the vice chief of audiology at the University of Mississippi Medical Center in Jackson, Mississippi.

References

- Amieva, Ouvrard C, Giulioli C, Meillon C, Rullier L, Dartigues JF. (2015) Self-reported hearing loss, hearing aids and cognitive decline in the elderly: a 25-Year Study. *J Am Geriatr Soc* 63(10):2099–2104.
- Campbell J, Sharma A. (2014) Cross-modal re-organization in adults with early stage hearing loss. *PLoS ONE* 9, e90594.
- Campbell J, Sharma A. (2013) Compensatory changes in cortical resource allocation in adults with hearing loss. *Front Syst Neurosci* 7.
- Deal JA, Sharrett AR, Albert MS, Coresh J, Mosley TH, Knopman D, Wruck LM, Lin FR. (2015) Hearing impairment and cognitive decline: a pilot study conducted within the atherosclerosis risk in communities neurocognitive study. *Am J Epidemiol* 181(9):680–690.
- Herbert LE, Weuve J, Scherr PA, Evans DA. (2013) Alzheimer disease in the United States (2010–2050) estimated using the 2010 census. *Neurology* 80(19):1778–1783.
- Lin FR, Yaffe K, Xia J, Xue Q-L, Harris TB, Purchase-Helzner E, Satterfield S, Ayonayon HN, Ferrucci L, Simonsick E. (2013) Hearing loss and cognitive decline in older adults. *JAMA Intern Med* 173(4):293–299.
- Lin FR, Metter EJ, O'Brien RJ, Resnick SM, Zondervan AB, Ferrucci L. (2011) Hearing loss and incident dementia. *Arch Neurol* 68, 214–220.
- Mosnier I, Bebear J, Marx M, Fraysse B, Truy E, Lina-Granade G, Mondain M, Sterkers-Artières F, Bordure P, Robier A, Godey B, Meyer B, Frachet B, Poncet-Wallet C, Bouccara D, Sterkers O. (2015) Improvement of cognitive function after cochlear implantation in elderly patients. *JAMA Otolaryngol Head Neck Surg* 141:442–450.