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Age-Related Hearing Loss: Contemporary Diagnosis, Hearing Rehabilitation, and Preventive Strategies

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Abstract

Age-related hearing loss (ARHL), commonly known as presbycusis, is a progressive, usually bilateral sensorineural hearing impairment associated with ageing. It is a major cause of communication difficulty among older adults and can adversely affect social participation, emotional well-being, independence, and quality of life. Despite its prevalence, ARHL remains underrecognized and undertreated in many healthcare settings. Contemporary management emphasizes early identification, audiological assessment, individualized hearing rehabilitation, and continuing follow-up rather than regarding hearing impairment as an inevitable and untreatable consequence of ageing.

The pathogenesis of ARHL is multifactorial, involving age-related changes in cochlear sensory cells, auditory neurons, the stria vascularis, and central auditory processing. Genetic susceptibility, cumulative noise exposure, ototoxic medications, vascular and metabolic conditions, and other environmental influences may contribute to its onset and progression. Clinical assessment includes a detailed history, otoscopy, hearing screening, pure-tone audiometry, speech recognition testing, and evaluation for alternative causes when the presentation is asymmetric or atypical.

Hearing aids and other appropriately selected amplification devices remain the principal rehabilitative interventions for most patients with clinically significant ARHL. Assistive listening technologies, communication strategies, auditory rehabilitation, and family education further improve functional outcomes. Cochlear implantation should be considered when appropriately fitted amplification does not provide adequate speech understanding. Preventive strategies include reducing excessive noise exposure, reviewing potentially ototoxic medications, and managing relevant comorbidities, although established age-related cochlear damage cannot currently be reliably reversed.

This narrative review examines the epidemiology, pathophysiology, diagnosis, clinical management, hearing rehabilitation, prevention, and future directions of ARHL from the perspective of contemporary ENT practice. It emphasizes patient-centred care, equitable access to hearing services, and the importance of integrating hearing health into routine care for older adults.

Keywords: Age-related hearing loss, presbycusis, sensorineural hearing loss, pure-tone audiometry, hearing aids, cochlear implantation, auditory rehabilitation, otolaryngology, healthy ageing.

1. Introduction

Age-related hearing loss is one of the most common sensory impairments encountered in older adults. It typically develops gradually, affects both ears, and initially produces difficulty hearing high-frequency sounds and understanding speech in noisy environments. As the condition progresses, patients may experience increasing communication difficulties, reduced participation in social activities, frustration, and dependence on family members or caregivers.

The term *presbycusis* is commonly used to describe age-associated hearing impairment, although hearing loss in older adults is not attributable to ageing alone. Genetic susceptibility, occupational and recreational noise exposure, ototoxic medications, vascular and metabolic disorders, and other environmental factors may contribute to the overall auditory decline. Consequently, the clinical assessment should distinguish typical age-related changes from potentially treatable or otherwise important causes of hearing impairment. [1,2]

Age-related hearing loss is often underdiagnosed because its onset is gradual and patients may adapt by relying on visual cues, increasing television volume, or avoiding difficult listening situations. Family members may recognize the problem before the affected individual seeks medical attention. Hearing impairment may also be incorrectly attributed to cognitive decline or social disengagement, delaying appropriate audiological evaluation.

The American Academy of Otolaryngology–Head and Neck Surgery Foundation published a dedicated clinical practice guideline on ARHL in 2024. The guideline addresses screening, audiometric evaluation, identification of alternative diagnoses, patient education, amplification, cochlear implant assessment, and follow-up. It recommends screening adults aged 50 years and older during healthcare encounters and obtaining an audiogram when screening suggests hearing loss. [1]

Contemporary management extends beyond the prescription of hearing aids. It involves assessment of communication needs, appropriate device fitting, rehabilitation, counselling, consideration of cochlear implantation in selected patients, and evaluation of functional outcomes. Hearing health should be integrated into broader healthy-ageing strategies, with attention to accessibility, affordability, patient preferences, and caregiver involvement.

The present narrative review discusses the clinical significance of ARHL and outlines an evidence-informed approach to diagnosis, management, rehabilitation, and prevention in ENT practice.

OBJECTIVES

The objectives of this review are:

1. To describe the epidemiology and pathophysiology of age-related hearing loss.

2. To discuss its clinical presentation and differential diagnosis.
3. To outline contemporary screening and audiological assessment methods.
4. To review evidence-based treatment and hearing rehabilitation strategies.
5. To discuss cochlear implantation, assistive technologies, and patient counselling.
6. To highlight preventive measures, limitations of current evidence, and future research priorities.

REVIEW METHODOLOGY

This article is a narrative review drawing on the 2024 AAO-HNSF clinical practice guideline on age-related hearing loss, relevant peer-reviewed reviews, and established literature on auditory ageing, hearing aids, cochlear implantation, and hearing rehabilitation. The discussion prioritizes evidence applicable to adult patients, particularly individuals aged 50 years and older. [1–4]

The literature was selected for clinical relevance to identification, diagnosis, treatment, rehabilitation, and prevention. No prospectively registered protocol, exhaustive reproducible database search, formal risk-of-bias assessment, or quantitative synthesis was undertaken. This article should therefore be interpreted as a narrative clinical review rather than a systematic review or meta-analysis.

EPIDEMIOLOGY AND CLINICAL SIGNIFICANCE

ARHL becomes increasingly common with advancing age, although its severity and rate of progression vary considerably between individuals. Population estimates differ according to age distribution, audiometric thresholds, environmental exposures, and the methods used to define hearing impairment. The World Health Organization recognizes hearing loss as an important contributor to disability and emphasizes the need for accessible hearing care across the life course. [2]

The functional consequences of ARHL extend beyond difficulty detecting sound. Patients may have particular difficulty understanding speech in noisy environments, following group conversations, hearing warning signals, communicating during medical consultations, and maintaining social relationships.

Untreated hearing loss can contribute to loneliness, frustration, reduced participation, and communication barriers. It may also complicate healthcare interactions when patients cannot reliably hear instructions, medication counselling, or explanations of treatment options.

Hearing impairment has been associated with cognitive decline and dementia in observational research. However, association does not establish that hearing loss directly causes dementia or that hearing aids prevent dementia in all patients. The ACHIEVE randomized trial found no significant reduction in three-year cognitive decline in the overall study population, while a prespecified analysis suggested benefit in a subgroup at higher baseline risk. These findings support further research and careful interpretation rather than universal claims of cognitive protection from hearing aids. [5]

Early identification is therefore important for functional and communication reasons, regardless of whether hearing intervention changes long-term cognitive outcomes.

PATHOPHYSIOLOGY OF AGE-RELATED HEARING LOSS

ARHL is a multifactorial degenerative disorder involving peripheral and central auditory structures. Its development reflects interactions among intrinsic ageing processes, genetic susceptibility, cumulative environmental exposure, and systemic health conditions. [1,3]

1. Cochlear sensory cell degeneration

The cochlea contains specialized sensory hair cells responsible for converting mechanical sound vibrations into neural signals. Degeneration of outer hair cells reduces cochlear amplification and frequency selectivity, while damage to inner hair cells may impair sound transduction. High-frequency hearing loss is common because age-related damage frequently affects the basal region of the cochlea.

Mammalian cochlear hair cells have very limited regenerative capacity. Consequently, established sensory cell loss generally cannot be reversed by conventional medication.

2. Auditory neuronal degeneration

Age-related changes may affect spiral ganglion neurons and auditory nerve fibres. Neural degeneration can impair temporal processing and speech understanding, particularly in complex listening environments. Speech recognition may therefore be poorer than expected from pure-tone thresholds alone.

3. Strial and metabolic changes

The stria vascularis maintains the ionic environment and electrical potential necessary for normal cochlear function. Age-related atrophy and metabolic changes in this structure may contribute to hearing impairment by disrupting the physiological environment required for sound transduction.

4. Oxidative stress and mitochondrial dysfunction

Ageing is associated with cellular metabolic changes, mitochondrial dysfunction, and oxidative stress. These processes have been implicated in cochlear degeneration, although their relative contributions in individual patients remain incompletely understood. Proposed molecular mechanisms have not yet translated into a universally effective treatment capable of reversing established ARHL.

5. Genetic and environmental influences

Genetic susceptibility may influence the age at onset, severity, and progression of hearing loss. Environmental factors, particularly cumulative noise exposure and potentially ototoxic medications, may compound age-related changes. Diabetes, hypertension, and other metabolic or vascular conditions may also contribute to auditory dysfunction. [1,3]

These overlapping mechanisms explain why hearing impairment varies substantially between people of similar ages and why comprehensive assessment should consider more than chronological age alone.

CLINICAL PRESENTATION

ARHL usually presents as gradually progressive hearing impairment affecting both ears. The initial difficulty is often understanding speech in restaurants, family gatherings, meetings, or other environments with competing sounds.

Common clinical features

1. **Difficulty understanding speech:** Patients may hear that someone is speaking but struggle to distinguish words, especially when several people are talking.
2. **High-frequency hearing impairment:** Consonants and higher-pitched speech cues may become difficult to perceive.
3. **Increased listening effort:** Patients may experience fatigue after conversations and require repetition.
4. **Tinnitus:** Ringing, buzzing, or other perceived sounds may accompany hearing loss.
5. **Reduced social participation:** Patients may avoid gatherings or telephone conversations because communication becomes difficult.
6. **Increased dependence on visual cues:** Lip-reading and watching the speaker's face may become important compensatory strategies.

Family members may report that the patient frequently asks others to repeat themselves, increases television volume, or misunderstands questions. These observations should prompt assessment rather than be dismissed as a normal part of ageing.

Although typical ARHL is gradual and relatively symmetrical, marked asymmetry, sudden deterioration, persistent unilateral tinnitus, vertigo, ear pain, discharge, or neurological findings require further evaluation. Such features may indicate another condition or an additional cause of hearing impairment.

DIAGNOSTIC EVALUATION

1. History-taking

The ENT specialist should document the onset, progression, laterality, functional impact, and previous evaluation of hearing loss. Important questions include:

- When did the patient first notice difficulty hearing?
- Is hearing loss bilateral and gradual, or sudden or asymmetric?
- Is speech understanding particularly difficult in noisy settings?
- Is tinnitus, vertigo, ear discharge, pain, or a history of ear surgery present?
- Has the patient experienced occupational or recreational noise exposure?
- Are potentially ototoxic medications being used?
- Is there a family history of early or progressive hearing impairment?
- How does hearing difficulty affect communication, independence, work, and social participation?

The medical history should include diabetes, hypertension, vascular disease, neurological disorders, and other conditions that may influence hearing or rehabilitation. Medication review is important, although necessary prescribed medicines should not be stopped without appropriate medical advice.

2. Screening for hearing loss

The 2024 AAO-HNSF guideline recommends screening patients aged 50 years and older for hearing loss during a healthcare encounter. When screening suggests impairment, clinicians should examine the ear canal and tympanic membrane and obtain or refer for a formal audiogram. [1]

Screening may involve structured questions, validated questionnaires, or appropriate hearing-screening procedures. These methods identify patients who may need further assessment but do not replace diagnostic audiometry.

A screening programme should also consider patient preferences, language, affordability, transport, disability, and access to audiology services. Identifying hearing loss has limited practical value if patients cannot access confirmatory testing and treatment.

3. Otoscopy

Otoscopy helps identify cerumen impaction, otitis externa, tympanic membrane abnormalities, and middle-ear disease. These conditions may cause conductive hearing loss or coexist with sensorineural impairment.

Cerumen impaction should be treated when clinically indicated, followed by reassessment if hearing difficulty persists. An apparently normal ear examination does not exclude sensorineural hearing loss.

4. Pure-tone audiometry

Pure-tone audiometry is the principal diagnostic investigation for characterizing hearing impairment. It measures air- and bone-conduction thresholds and establishes the severity, configuration, and type of hearing loss.

Typical ARHL demonstrates bilateral sensorineural impairment, frequently more pronounced at higher frequencies. The audiogram should be interpreted alongside the patient's functional complaints because pure-tone thresholds alone do not fully describe speech understanding in everyday environments.

5. Speech audiometry

Speech recognition testing evaluates the patient's ability to understand spoken material at an appropriate presentation level. Word-recognition scores and, where available, speech-in-noise testing can help identify functional difficulties that may not be adequately captured by pure-tone audiometry.

Disproportionately poor speech recognition, particularly when asymmetric, should prompt assessment for alternative pathology and may influence hearing-aid selection or cochlear implant referral.

6. Tympanometry and additional investigations

Tympanometry can help assess middle-ear function and distinguish sensorineural from conductive or mixed hearing impairment. Additional investigations should be guided by the clinical presentation rather than ordered routinely for every older adult.

Significant asymmetry, conductive or mixed loss, poor word recognition, rapid progression, or other atypical findings require further assessment or referral to an appropriate specialist. MRI may be indicated in selected patients when retrocochlear pathology is suspected.

Routine imaging, extensive laboratory panels, and genetic testing are not necessary for every patient with typical bilateral progressive ARHL. The investigation should answer a relevant clinical question and have the potential to change management. [1]

7. Assessment of functional impact

The clinical evaluation should include the patient's communication goals and perceived hearing-related disability. Validated patient-reported measures, such as the Hearing Handicap Inventory for the Elderly, may be useful in selected settings.

Assessment should explore communication in the home, workplace, community, and healthcare environment. Family members or caregivers can provide useful information, with the patient's consent, about practical difficulties and rehabilitation priorities.

EVIDENCE-BASED MANAGEMENT

The main goals of management are to improve communication, support independence, reduce hearing-related disability, and maintain social participation. Treatment should be individualized according to audiological findings, patient preferences, functional needs, and access to rehabilitation services.

1. Patient education and counselling

Patients should be informed that ARHL is commonly progressive and that conventional treatment generally improves access to sound rather than restoring the cochlea to its original biological state.

Counselling should address the benefits and limitations of hearing aids, assistive technologies, communication strategies, and rehabilitation. It should also explain the importance of appropriate fitting, regular use, maintenance, and follow-up.

Family members or care partners can be included when the patient agrees. Their involvement may improve communication and help establish realistic expectations.

2. Hearing aids and amplification

Appropriately fitted amplification is a principal treatment for adults with clinically significant ARHL. The 2024 AAO-HNSF guideline strongly recommends offering amplification or referring patients to a clinician who can provide it. [1]

Hearing aids increase access to sound through individualized amplification and signal processing. Their effectiveness depends on the degree and configuration of hearing loss, speech-recognition ability, fitting accuracy, device use, and the listening environments encountered by the patient.

The selection process should consider:

- Degree and configuration of hearing loss.
- Speech-recognition and speech-in-noise performance.
- Dexterity, vision, and cognitive or functional needs.
- Comfort, device handling, and maintenance requirements.
- Financial resources and access to aftercare.
- Patient preference and communication goals.

Bilateral hearing aids are commonly appropriate for bilateral hearing loss when both ears can benefit. Device choice should be individualized rather than based solely on age or price.

Real-ear verification, when available, can help confirm that the hearing aid delivers appropriate amplification. Follow-up adjustments are often necessary because patients may require time to adapt to amplified sounds and learn how to manage different listening environments.

3. Assistive listening devices and communication strategies

Hearing aids alone may not resolve every communication difficulty, particularly in noisy environments or when the speaker is distant. Assistive listening technologies and practical communication strategies can provide additional benefit. [1,4]

Useful measures include:

- Reducing background noise during conversations.
- Ensuring that the speaker faces the listener and speaks clearly.
- Using good lighting to support visual communication cues.
- Choosing quieter seating arrangements in restaurants or meetings.
- Using captioning, amplified telephones, remote microphones, or compatible streaming devices when appropriate.
- Asking healthcare professionals to provide written instructions or confirm understanding.

These approaches are particularly valuable for patients who cannot afford hearing aids immediately, are awaiting fitting, or continue to experience difficulty despite amplification.

4. Auditory rehabilitation

Auditory rehabilitation supports the patient's ability to use residual hearing effectively. It may include hearing-aid orientation, listening exercises, communication training, counselling, and strategies for managing challenging acoustic environments.

Rehabilitation should be person-centred and directed toward the patient's actual communication needs. For example, a patient whose primary difficulty is understanding family conversations may require different practical strategies from someone who struggles with telephone communication or workplace meetings.

Family participation may be helpful when appropriate, but the patient's preferences, independence, and communication goals should remain central.

5. Cochlear implantation

Cochlear implantation should be considered when appropriately fitted amplification fails to provide adequate functional hearing, particularly when speech understanding remains poor.

The AAO-HNSF guideline recommends referral for cochlear implant candidacy evaluation in patients who continue to experience significant hearing difficulty and poor speech understanding despite appropriate amplification. [1]

Cochlear implants bypass damaged cochlear sensory structures by electrically stimulating the auditory nerve. Candidacy depends on audiological findings, speech recognition, medical suitability, expected benefit, rehabilitation needs, and the applicable implant programme criteria.

Age alone should not automatically exclude an otherwise suitable patient. Assessment should consider general health, cognitive and functional status, patient goals, support systems, and willingness to participate in postoperative rehabilitation.

A cochlear implant evaluation does not guarantee that implantation will be recommended. It provides a specialist assessment of whether the expected benefits justify the risks and treatment burden.

6. Management of associated tinnitus

Tinnitus may accompany ARHL and can cause substantial distress even when hearing impairment is mild or moderate. Management should assess its effect on sleep, concentration, mood, and daily functioning.

Hearing aids may reduce tinnitus awareness for some patients by improving access to environmental sound, although benefit is variable. Counselling, sound-based strategies, and appropriate psychological interventions may also be considered. Persistent unilateral tinnitus or tinnitus accompanied by asymmetric hearing loss warrants assessment for other causes.

7. Follow-up and monitoring

Treatment should be evaluated according to functional outcomes rather than device provision alone. The AAO-HNSF guideline recommends reassessing whether communication goals have been achieved and whether hearing-related quality of life has improved at a subsequent encounter or within one year. It also states that hearing should be reassessed at least every three years in patients with known hearing loss or concerns about changing hearing, as an option within the guideline. [1]

Earlier reassessment is appropriate when symptoms worsen, devices become ineffective, new ear symptoms develop, or communication needs change. Follow-up may include audiometry, device verification, review of wear time, troubleshooting, and adjustment of rehabilitation strategies.

PREVENTION AND HEARING PRESERVATION

Established age-related cochlear degeneration cannot currently be reliably reversed, but additional preventable auditory injury should be minimized.

1. Noise exposure reduction

Excessive occupational and recreational noise may compound age-related hearing loss. Appropriate hearing protection, exposure reduction, and adherence to workplace hearing conservation measures are important. Patients should be counselled about safe listening practices, particularly when using personal audio devices or working in noisy environments.

2. Medication review

Certain medications can damage the auditory or vestibular systems, depending on the agent, dose, duration, renal function, and other clinical factors. Medication review is particularly important for patients receiving known ototoxic drugs. Necessary treatments should not be discontinued without consultation with the prescribing clinician.

3. Management of systemic conditions

Diabetes, hypertension, and other chronic conditions should be managed according to established clinical guidance. Although the relationship between individual risk factors and ARHL is complex, comprehensive health management supports overall well-being and may reduce additional contributors to auditory dysfunction.

4. Avoidance of unproven treatments

No vitamin, antioxidant, herbal preparation, or medication has been established as a universal treatment capable of reversing typical ARHL. Patients should be advised against relying on unproven remedies in place of audiological assessment and effective rehabilitation.

5. Accessible hearing healthcare

Preventive and rehabilitative services should address barriers related to cost, geographical access, stigma, disability, and limited awareness. Screening is most useful when linked to timely diagnostic testing, counselling, and practical access to appropriate hearing care.

DISCUSSION

Age-related hearing loss is an important but frequently overlooked component of healthy ageing. Its gradual onset, variable severity, and adaptation by patients and families can delay diagnosis until communication difficulties become substantial. The 2024 AAO-HNSF guideline provides a practical framework for improving identification and management by recommending screening from age 50, diagnostic audiometry following a positive screen, appropriate amplification, patient education, and follow-up. [1]

The diagnostic approach must distinguish typical ARHL from other causes of hearing impairment. Although bilateral, progressive, high-frequency sensorineural loss is characteristic, asymmetry, sudden deterioration, conductive components, and disproportionately poor speech recognition require additional assessment. This distinction is important because attributing every hearing complaint in an older adult to ageing may delay the diagnosis of a treatable or clinically significant condition.

Hearing aids remain a central intervention because they improve access to speech and can reduce hearing-related communication difficulties. Evidence synthesized in the Cochrane review supports benefits for hearing-specific quality of life and listening ability in adults with mild to moderate hearing loss. However, outcomes depend on appropriate fitting, consistent use, individual expectations, and access to ongoing support. [4]

Hearing rehabilitation should not be limited to the provision of a device. Communication strategies, assistive listening technologies, counselling, and family involvement can address difficulties that persist in noisy or complex environments. A person-centred approach is particularly important for older adults with impaired vision, reduced dexterity, limited mobility, or financial barriers.

Cochlear implantation provides an important option for selected patients whose speech understanding remains inadequate despite appropriately fitted amplification. Timely referral for candidacy assessment can prevent patients with substantial residual disability from remaining on an ineffective treatment pathway. Decisions should incorporate audiological findings, medical suitability, communication goals, and the patient's willingness to undertake rehabilitation. [1]

The relationship between hearing loss and cognitive health has received considerable attention. Observational studies demonstrate associations between hearing impairment and cognitive decline, but these findings should not be interpreted as proof that hearing loss directly causes dementia. The ACHIEVE trial found no significant reduction in cognitive decline in its overall study population over three years, although a prespecified higher-risk subgroup showed evidence of benefit. Hearing rehabilitation should

therefore be recommended for its established communication and functional benefits without promising dementia prevention. [5]

Prevention remains important because age-related changes may be compounded by avoidable noise exposure and other auditory insults. Public health measures should emphasize hearing conservation, rational medication review, recognition of early symptoms, and accessible diagnostic and rehabilitative services. At the same time, clinicians should avoid promoting unproven supplements or treatments as methods of reversing established cochlear degeneration.

Important challenges include the cost of hearing aids, limited access to audiology services, stigma, inadequate follow-up, and unequal availability of cochlear implantation. These issues may be especially relevant in resource-constrained settings. Integrating hearing screening into routine primary and geriatric care, strengthening referral pathways, and improving access to affordable amplification may help reduce the burden of untreated hearing loss.

Overall, contemporary ENT practice should treat ARHL as a manageable health condition rather than an inevitable consequence of ageing. Early identification, accurate audiological assessment, individualized amplification, rehabilitation, and ongoing review provide the foundation for improved communication and quality of life.

LIMITATIONS OF THE REVIEW

This article is a narrative review rather than a systematic review or meta-analysis. The literature was selected for clinical relevance, without a prospectively registered protocol, exhaustive reproducible database search, formal risk-of-bias assessment, or quantitative synthesis.

Studies of ARHL vary in their definitions of hearing impairment, participant characteristics, outcome measures, intervention protocols, and duration of follow-up. Findings from individual populations may not be directly generalizable to all older adults, particularly where access to hearing healthcare differs substantially.

The association between hearing loss and cognitive outcomes remains an evolving area of research. Although hearing intervention has established functional benefits, its effects on long-term cognitive outcomes are not uniform across populations. Similarly, the benefits of specific hearing technologies depend on patient selection, fitting, rehabilitation, and continued use.

These limitations should be considered when interpreting the review. The recommendations are intended to support clinical understanding and do not replace individualized assessment or current specialty guidance.

Conclusion

Age-related hearing loss is a common, progressive sensory disorder that can significantly affect communication, social participation, independence, and quality of life. Early identification and accurate audiological assessment are essential to distinguish typical presbycusis from alternative causes of hearing impairment and to facilitate timely intervention.

Appropriately fitted hearing aids, assistive listening technologies, communication strategies, and auditory rehabilitation form the foundation of contemporary management. Cochlear implantation should be considered for selected patients who continue to experience significant hearing difficulty and poor speech understanding despite appropriate amplification.

Prevention of additional auditory injury, patient education, family support, and regular assessment of functional outcomes are equally important. Integrating hearing healthcare into routine care for older adults can improve access to treatment and reduce the consequences of untreated hearing loss.

Future research should focus on improved prediction of disease progression, equitable access to hearing technologies, long-term functional outcomes, and the relationship between hearing intervention and cognitive health. The central objective of ENT care is to support effective communication, preserve independence, and improve quality of life throughout ageing.

DECLARATION BY AUTHORS

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