

Research

Demographic profile and clinical characteristics of patients with age related hearing loss

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ABSTRACT

Background: Age-Related Hearing Loss (ARHL), or presbycusis, is a progressive, bilateral sensorineural hearing loss associated with the aging process. It commonly occurs in individuals over 60 years of age and is often linked to metabolic and cardiovascular disorders. Oxidative stress is a key mechanism contributing to cochlear hair cell damage, thinning of the stria vascularis, and neuronal degeneration. Although ARHL is irreversible, controlling risk factors may help slow its progression. **Purpose:** To determine the demographic profile, clinical characteristics, and the relationship between comorbidities and types of ARHL in patients at Sardjito Hospital, Yogyakarta. **Method:** This retrospective descriptive study used secondary data from the Neurotology Clinic, Department of Otorhinolaryngology–Head and Neck Surgery, Sardjito Hospital, collected from January 2022 to December 2024. A total of 120 patients diagnosed with ARHL were collected. Bivariate analysis was performed using the Chi-Square test and Fisher’s Exact Test. **Result:** Among 120 respondents, most were male (57.5%) and aged 60–74 years (73.3%). The most common chief complaint was hearing loss (72.5%), followed by tinnitus (20.8%) and vertigo (6.7%). Audiogram findings showed that strial presbycusis was the most prevalent type (42.5%), followed by sensory (27.5%), neural (21.7%), and cochlear (8.3%) types. Most patients had moderate hearing loss (49.2%). Cardiovascular comorbidities were present in 51.7% of patients. A significant association was found between cardiovascular comorbidities and ARHL type ($p < 0.05$). **Conclusion:** Strial presbycusis was the most common type of ARHL, and had a correlation with cardiovascular comorbidities.

Keywords: age-related hearing loss, bilateral sensorineural, audiogram, comorbidity.

ABSTRAK

Latar belakang: Age-Related Hearing Loss (ARHL) atau presbikusis merupakan gangguan pendengaran sensorineural bilateral yang bersifat progresif, dan berhubungan dengan proses penuaan. Kondisi ini umumnya terjadi pada individu berusia di atas 60 tahun dan sering dikaitkan dengan gangguan metabolik serta kardiovaskular. Stres oksidatif merupakan salah satu mekanisme utama yang berkontribusi terhadap kerusakan sel rambut koklea, penipisan stria vaskularis, dan degenerasi neuron. Meskipun ARHL bersifat ireversibel, pengendalian faktor risiko dapat membantu memperlambat progresivitas penyakit. **Tujuan:** Mengetahui profil demografi, karakteristik klinis, serta hubungan antara komorbiditas dan tipe ARHL pada pasien di Rumah Sakit Sardjito, Yogyakarta. **Metode:** Penelitian ini merupakan studi deskriptif retrospektif yang menggunakan data sekunder dari Klinik Neurotologi, Departemen Telinga Hidung Tenggorok–Bedah Kepala dan Leher (THT-KL) RS Sardjito, yang dikumpulkan pada periode Januari 2022 hingga Desember 2024. Sebanyak 120 pasien ARHL menjadi subjek pada penelitian ini. Analisis bivariat dilakukan menggunakan uji Chi-Square dan uji Fisher’s Exact. **Hasil:** Dari 120 responden, sebagian besar berjenis kelamin laki-laki

(57,5%) dan berada pada kelompok usia 60–74 tahun (73,3%). Keluhan utama yang paling sering adalah penurunan pendengaran (72,5%), diikuti tinnitus (20,8%) dan vertigo (6,7%). Hasil audiogram menunjukkan bahwa tipe presbikusis strial merupakan tipe yang paling banyak ditemukan (42,5%), diikuti tipe sensorik (27,5%), neural (21,7%), dan koklear (8,3%). Sebagian besar pasien mengalami gangguan pendengaran derajat sedang (49,2%). Komorbiditas kardiovaskular ditemukan pada 51,7% pasien. Terdapat hubungan yang bermakna antara komorbiditas kardiovaskular dan tipe ARHL ($p < 0.05$). **Kesimpulan:** Presbikusis tipe strial merupakan tipe ARHL yang paling sering ditemukan, dan memiliki hubungan dengan komorbiditas kardiovaskular.

Kata kunci: tuli terkait usia, sensorineural bilateral, audiogram, komorbiditas

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INTRODUCTION

Age-Related Hearing Loss (ARHL), or presbycusis, is a bilateral, progressive, and sensorineural hearing loss that primarily affects high frequencies as individuals age. It typically manifests as a gradual decline in the ability to hear and understand speech, particularly in challenging environments like rooms with background noise or reverberant acoustics.¹⁻³ It occurs frequently in people aged 60 years or older and represents a major public health challenge. The World Health Organization (WHO) estimates that one-third of individuals over 65 years experience disabling hearing loss, and by 2025, approximately 1.2 billion people will be over 60 years old, with more than 500 million affected by ARHL.^{2,4}

ARHL is associated with several comorbidities, including metabolic syndrome and cardiovascular diseases.² As aging progresses, oxidative stress contributes significantly to structural and functional changes within the cochlea. Reduced melatonin levels, as a mediator in limiting reactive oxygen species (ROS), are associated with high-frequency hearing loss in the elderly. Deficiency of superoxide dismutase 1 (SOD1) accelerates cochlear hair cell loss, stria vascularis thinning, and spiral ganglion neuron degeneration. Because the cochlea

has high metabolic demand, excessive mitochondrial ROS production can cause mitochondrial DNA (mtDNA) mutations, and accelerate auditory cellular damage.^{2,5}

The diagnosis of ARHL involves history-taking, physical examination, and supporting tests, particularly speech audiometry, or pure tone audiometry. Based on audiometric patterns, ARHL can be classified into four types based on Schuknecht's theory. The neural type is characterized by involving a progressive loss of cochlear neurons and is often associated with diffuse central nervous system degeneration, leading to neurological and cognitive impairments. The strial type results from dysfunction of the stria vascularis and appears as a flat audiometric curve or low-frequency loss due to diffuse cochlear involvement. The sensory type is associated with hair cell loss beginning at the basal turn of the cochlea, causing a sharp decline in high-frequency thresholds. The cochlear type has descending audiograms without identifiable histopathological changes, and may also be observed in conditions such as otosclerosis and Paget's disease of the temporal bone, leading to a gradual and progressive high-frequency sensorineural hearing loss.^{6,7}

Management of ARHL includes hearing aids, auditory rehabilitation, and prevention

through risk factor control. Controlling comorbidities can slow the progression of hearing loss.^{5,8} This study aimed to determine the demographic profile and clinical characteristics of ARHL patients at Sardjito Hospital, providing essential data for future research and improving prevention and management strategies.

METHOD

This descriptive study used secondary data from the Neurotology Clinic of the Otorhinolaryngology Head and Neck Surgery Department at Sardjito Hospital, Yogyakarta, collected from January 2022 to December 2024. A total of 120 samples that met the inclusion and exclusion criteria were analyzed. The variable data included demographic data and clinical characteristics like: gender, age group, domicile, healthcare insurance, symptoms, ARHL types by audiogram, severity of hearing loss, and comorbidities. Data were presented in univariate and bivariate. Bivariate analysis used Pearson's Chi-Square test with Fisher's Exact Test as an alternative to assess the relationship between comorbidities and ARHL types.

RESULT

This study involved 120 respondents, all experiencing hearing impairment. Most were male (57.5%), while females accounted for 42.5%. According to WHO age classifications, most respondents were in the elderly category (73.3%), followed by older elderly (26.7%), while none were classified as very elderly. Respondents originated from various regions, with 63.3% distributed across several areas within the Yogyakarta Special Region (DIY), and 36.7% residing outside the region. The

majority used government health insurance (85.8%), while 11.7% used no insurance, and 2.5% used private insurance.

The main symptom reported was hearing loss (72.5%), followed by tinnitus (20.8%), and vertigo (6.7%). Audiogram results indicated that strial type ARHL was the most common (42.5%), followed by sensory (27.5%), neural (21.7%), and cochlear (8.3%) types. In terms of severity, 49.2% had moderate SNHL, 20.8% had mild SNHL, 20% had moderately severe SNHL, and 10% had severe SNHL. Regarding comorbidities, 43.3% of respondents had no detected comorbidities, whereas cardiovascular comorbidities were the most common (45%), followed by metabolic disorders (5%), and mix cardiovascular-metabolic (6.6%). (Table 1).

Bivariate analysis using Pearson's Chi-Square test showed a significant association between comorbidities and ARHL types (Chi-Square=23.242; $p=0.004$). Due to four cells having expected counts less than 8 (50%), Fisher's Exact Test was performed and confirmed the significance ($p=0.005$). Likelihood Ratio analysis also showed significant results ($p=0.003$). (Table 2). In the group without comorbidities, the distribution of ARHL types appeared evenly spread across all categories. In patients with cardiovascular comorbidities, most cases were found in the strial type, meanwhile, metabolic comorbidities were more frequently associated with the neural type. These findings indicated that the ARHL type Audiogram relate significantly with varying comorbidity profiles. This suggested that comorbid conditions might play a contributing role in the pattern of ARHL type Audiogram.

Table 1. Patient characteristics

Variable	Category	n (%)
Gender	Male	69 (57,5%)
	Female	51 (42,5%)
Age Groups	Elderly (60–74)	88 (73,3%)
	Older Elderly (75–90)	32 (26,7%)
	Very Elderly (>90)	0 (0%)
Domicile	Yogyakarta City	23 (19,3%)
	Sleman	22 (18,3%)
	Bantul	17 (14,2%)
	Kulon Progo	10 (8,3%)
	Gunung Kidul	4 (3,3%)
	Outside DIY	44 (36,7%)
Healthcare Insurance	Government Insurance	103 (85,8%)
	No Insurance	14 (11,7%)
	Private Insurance	3 (2,5%)
Symptoms	Hearing Loss	87 (72,5%)
	Hearing Loss + Tinnitus	25 (20,8%)
	Hearing Loss + Vertigo	8 (6,7%)
ARHL Types by Audiogram	Strial	51 (42,5%)
	Sensory	33 (27,5%)
	Neural	26 (21,7%)
	Cochlea	10 (8,3%)
Severity of Hearing Loss	Mild	25 (20,8%)
	Moderate	59 (49,2%)
	Moderate–Severe	24 (20%)
	Severe	12 (10%)
	None	52 (43,3%)
Comorbidities	Cardiovascular	54 (45%)
	Metabolic	6 (5%)
	Cardiovascular + Metabolic	8 (6,6%)

Table 2. Bivariate analysis of ARHL type of audiogram with comorbidities

	Strial	Sensory	Neural	Cochlea	Sig ($p < 0.05$)
None	15	15	16	13	0.005*
Cardiovascular	26	18	6	6	
Metabolic	0	0	4	1	
Cardiovascular + Metabolic	3	3	2	0	

* Fisher's Exact Test

DISCUSSION

This study found that most ARHL patients at Sardjito Hospital were male, and between 60–74 years old. This aligned with studies by Parham et al.⁹ and Tsai Do et al.¹⁰, which reported that ARHL increased with age and was more common in males due to greater exposure to environmental risk factors, such as noise and cardiovascular disease. In contrast, females might benefit from the protective effect of estrogen on cochlear structures.

The most common type of ARHL was stria presbycusis (42.5%). This type linking stria vascularis degeneration with impaired cochlear microcirculation in hypertension, leading to functional impairment and hearing loss. Strial presbycusis has been described as resulting from stria vascularis atrophy and potential endocochlear decrease, affecting all frequencies.⁶ Another studies, among others by Nawaz et al.¹¹ comparing participants with and without hypertension found that the hypertension group had significantly higher mean hearing thresholds on audiometry compared to the non- hypertension group.¹²

Cardiovascular comorbidities were observed in 45% of patients, followed by metabolic disorders (5%) and mix cardiovascular-metabolic (6.6%). Prior studies by Nawaz et al.¹¹, Tsai Do et al.¹⁰, and Soren et al.⁸ showed that hypertension, diabetes mellitus, and hypercholesterolemia had been identified as intrinsic risk factors that accelerate cochlear degeneration through mechanisms such as microangiopathy, chronic

inflammation, neuropathy, and metabolic dysfunction, leading to progressive ARHL.

Pathophysiologically, ARHL involves hair cell loss, stria vascularis dysfunction, and spiral ganglion degeneration. According to Loughrey¹², vascular mechanisms analogous to microangiopathic changes in the brain, might underlie the association between ARHL, cognitive decline, and dementia. Beyond simple volume, ARHL is also defined by declines in central auditory processing, specifically the ability to perceive speech in noisy environments, which highlights the complex interplay between the auditory and cognitive systems. In addition, social isolation and diminished cognitive reserve resulting from hearing impairment might further amplify this risk.

Clinically, the most common complaints are hearing loss with or without tinnitus. Tinnitus prevalence increases significantly with age and is closely associated with cochlear degeneration and synaptic imbalance. These findings emphasize the importance of multidisciplinary management and aggressive control of systemic risk factors to prevent rapid progression of ARHL. WHO and Healthy People 2020 recommend early screening starting at age 50 and integrated management of sensory impairments to preserve cognitive function and improve the quality of life.¹⁰

This study included 120 respondents with hearing impairment, consisting of 69 males (57.5%) and 51 females (42.5%). Most respondents were elderly (73.3%) and lived in various regions, predominantly outside the

Yogyakarta Special Region (36.7%). Most used Government Insurance for healthcare coverage (85.8%). Hearing loss was the most common complaint (72.5%). Audiogram findings showed that strial presbycusis was the most common ARHL type (42.5%), followed by sensory (27.5%), neural (21.7%), and cochlear (8.3%). Although nearly half of the respondents had no detected comorbidities, cardiovascular was the most common comorbid (51.7%).

Bivariate analysis revealed a significant association between ARHL type and comorbidities ($p=0.005$). In patients without comorbid conditions, the distribution of ARHL types was relatively even across all categories. However, among patients with cardiovascular comorbidities, the strial type was the most common, whereas metabolic comorbidities were more frequently associated with the neural type. These findings suggested that comorbid conditions might influence the pattern of ARHL, highlighting the potential role of underlying health condition in shaping audiometric profiles.

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