

## CORRELATION OF DURATION AND DEGREE OF HEARING LOSS TO EFFECTIVENESS OF HEARING AID USAGE IN THE ADULT POPULATION.

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### ABSTRACT :

Presbycusis, also known as age-related hearing loss (ARHL), is a prevalent disorder in older persons that is typified by a progressive reduction in hearing sensitivity. Using a retrospective observational approach, this study examined the association between the severity and duration of ARHL and the efficacy of adult hearing aid use. Multiple linear regression, descriptive statistics, and Pearson's correlation coefficient were utilized to examine the data from 50 ARHL participants who wore hearing aids.

According to the International Outcome Inventory for Hearing Aids (IOI-HA), the results showed a substantial negative association between the effectiveness of hearing aids and the length and degree of hearing loss. Participants' satisfaction and benefit from their hearing aids were lower for those with longer and more severe hearing loss. Gender and age did not appear to have a major impact . These findings demonstrate how crucial early detection and individualized rehabilitation techniques are to maximizing the advantages of hearing aids for those with ARHL. To improve clinical interventions and improve the quality of life for individuals affected with ARHL, more study is required to examine other factors influencing the effectiveness of hearing aids

**KEYWORDS :** Presbycusis; Hearing aids; Sensory neural hearing loss; Audiogram; Audiology

### INTRODUCTION :

Presbycusis, also known as age-related hearing loss (ARHL), is a common illness affecting elder persons that is characterised by a progressive decrease of hearing sensitivity in both ears. It is an irreversible, bilateral, symmetrical, progressive sensorineural hearing loss brought on by degeneration of the auditory nerves, inner ear structures, or cochlea. ARHL is one of the most prevalent chronic illnesses in the elderly, with a global prevalence of 17.6% among older persons in 2019—nearly one in five older people were afflicted. In people 80 years of age and beyond, the frequency rises to 100%. [1]

In addition to impairing physical hearing, ARHL has a major negative influence on quality of life. It can result in decreased participation in everyday activities, social isolation, depression, dementia, and communication problems. [2, 3] Beyond personal health, the societal impacts impact healthcare systems, family interactions, and caring responsibilities. The prevalence of ARHL is expected to rise as the world's population ages, increasing the disease's consequences for public health. This emphasises the necessity of efficient management techniques to reduce the adverse impacts of hearing loss in senior citizens.

The main treatment for ARHL is hearing aids, which increase speech perception and hearing sensitivity, increasing communication and quality of life. [4] Their efficacy, however, differs greatly amongst people. The extent and length

of hearing loss, age at first fitting, cognitive function, personal preferences, and lifestyle requirements are some of the factors that affect results. The association between the severity and length of hearing loss and the efficacy of hearing aids is still poorly understood, despite the fact that hearing aids are widely used. This ignorance restricts the ability to customise interventions to meet the needs of each individual and optimise the fitting of hearing aids.

The purpose of this study is to analyse the association between the effectiveness of adult hearing aid use and the length and severity of hearing loss. The goal of this research is to increase physicians' capacity to forecast benefits, tailor interventions, and raise the standard of living for people with ARHL by identifying critical characteristics that impact hearing aid results. This study intends to improve the accuracy of fitting and maintenance techniques for hearing aids by pinpointing particular thresholds or trends that impact their efficacy. Targeted therapies to enhance outcomes and happiness for people with different levels and durations of hearing loss may also be developed as a result of the findings. Individualised rehabilitation plans, sophisticated fitting algorithms, and cutting-edge hearing aid technology catered to particular needs.

By elucidating these associations, the research aims to improve the fitting and prescription procedures for hearing aids, ultimately boosting their efficacy and improving the lives of those who suffer from hearing loss. By offering evidence-based insights to guide clinical practice and policy-making, this research has the potential to significantly advance the discipline of audiology and ultimately improve the hearing health outcomes for the elderly population.

### MATERIALS AND METHODS:

The effectiveness of using hearing aids in an adult population was investigated in this retrospective observational study in relation to the severity and duration of age-related hearing loss (ARHL). Information was taken from the medical records of people with ARHL who wore hearing aids.

The 1964 Declaration of Helsinki and its later revisions' ethical guidelines were followed in this investigation. The Institutional Review Board (IRB) of the hospital where the data were gathered gave its approval. The IRB relaxed the informed consent requirement because the study made use of pre-existing medical records. All information was anonymised to protect privacy and confidentiality.

The study population consisted of adults diagnosed with ARHL, with a total of 50 participants included in the analysis.

#### Inclusion Criteria:

- Adults aged 40 years and older. Diagnosis of age-related hearing loss.
- Usage of hearing aids for at least 3 months.

#### Exclusion Criteria:

- History of sudden deafness.
- History of otitis media or otitis externa.
- History of significant hearing disorders other than ARHL, such as Meniere's disease.

Data collection was conducted retrospectively using the medical records of participants who met the inclusion criteria and did not meet any of the exclusion criteria. The following data were extracted and utilised in the study:

1. **Demographic Data:** Age of the participants at the time of data collection. Gender of the participants.
2. **Clinical Data:** Type of hearing aids used by the participants (e.g., behind-the-ear, in-the-ear). Fitting details of the hearing aids (e.g., unilateral or bilateral fitting).
3. **Hearing Loss Data:** Duration of hearing loss, calculated from the time of diagnosis to the time of data collection. Degree of hearing loss, assessed from the audiograms available in the participants' medical records.
4. **Effectiveness of Hearing Aids:** The effectiveness of hearing aids was assessed using the International Outcome Inventory for Hearing Aids (IOI-HA) questionnaire. The IOI-HA is a standardised tool used to measure the outcomes of hearing aid use from the perspective of the user. It includes seven items that assess various aspects of hearing aid effectiveness, including daily use, benefit, residual activity limitations, satisfaction, residual participation restrictions, impact on others, and quality of life. Scores for each participant were recorded.

### DATA ANALYSIS :

To determine the association between the length and severity of hearing loss and the efficacy of wearing hearing aids, the gathered data was examined using the proper statistical techniques. The statistical analyses listed below were carried out:

For every clinical and demographic characteristic, descriptive statistics were calculated. This involved determining the frequencies and percentages for categorical data (e.g., gender, kind of hearing aids, fitting details) and the mean, median, standard deviation, and range for continuous variables (e.g., age, duration of hearing loss, IOI-HA scores). The association between the degree of hearing loss and IOI-HA scores, as well as between the length of hearing loss and IOI-HA scores, was investigated using Pearson's correlation coefficient. Pearson's correlation coefficient ( $r$ ) quantifies the degree and direction of the linear link between two variables. Strong negative correlations and strong positive correlations are indicated by  $r$  values close to 1. Potential confounders such as age and gender were considered.

The combined effect of hearing loss severity and duration on IOI-HA scores was assessed using multiple linear regression analysis. The independent variables in this analysis were the degree and duration of hearing loss, while the dependent variable was the IOI-HA score. Gender and age were considered as possible confounding factors. After adjusting for the effects of age and gender, the regression model made it possible to evaluate the separate and combined impacts of the severity and duration of hearing loss on the efficacy of wearing hearing aids.

The SPSS program (version 25.0; IBM Corp., Armonk, NY, USA) was used for all statistical analyses. For all analyses, a  $p$ -value of less than 0.05 was deemed statistically significant.

### RESULTS :

#### 1. Descriptive Analysis

There were fifty participants in all, twenty-six of whom were men and twenty-four of whom were women. Participants' ages ranged from 40 to more than 85. Participants' hearing loss durations ranged greatly, ranging from less than a year to over ten years. Based on their audiograms, the majority of patients had moderate to severe hearing loss. Forty individuals reported regularly using their hearing aids, indicating a typically high level of satisfaction with them. Among the individuals, diabetes and hypertension were prevalent co-morbidities.

#### 2. Correlation Analysis

##### Degree of Hearing Loss and IOI-HA Scores:

It was determined that there was a -0.73 Pearson association between the IOI-HA scores and the severity of hearing loss. This shows a strong negative association, indicating that the efficiency of hearing aids, as determined by IOI-HA scores, tends to decline as the degree of hearing loss increases. This research demonstrates that the benefits and enjoyment of wearing hearing aids are lower for those with more severe hearing loss.

##### Duration of Hearing Loss and IOI-HA Scores:

Likewise, a strong negative association was established between the IOI-HA scores and the duration of hearing loss, as indicated by the Pearson correlation coefficient of -0.81. This implies that the efficiency of hearing aids tends to decline noticeably as the length of hearing loss rises. As a result, those who have had hearing loss for a longer time tend to report less satisfaction and efficacy with their hearing aids.

#### 3. Regression Analysis

The combined effect of hearing loss severity and duration on IOI-HA scores was assessed using multiple linear regression analysis. Both the length and severity of hearing loss had a significant negative impact on IOI-HA scores, according to the regression model.

In particular, the effectiveness of hearing aids, as measured by IOI-HA scores, declined with the severity and length of hearing loss. Additionally, the research revealed that neither gender nor age significantly affected the association between IOI-HA scores and hearing loss, indicating that these variables did not skew the results.

#### 4. Detailed Breakdown of Hearing Loss and Hearing Aid Satisfaction :

The following tables provide a detailed breakdown of participants based on the duration of hearing loss, the degree of hearing loss, satisfaction levels (Table 1) and the perceived benefit from hearing aids (Table 2).

**Table 1 : Duration of Hearing Loss and Hearing Aid Benefit :**

<b>Duration of Hearing Loss</b>	<b>No. of Participants</b>	<b>Degree of Hearing Loss</b>	<b>Benefit</b>	<b>Satisfaction</b>
<b>Less than 1 year</b>	18	Mild - 11	Excellent - 6, Good - 12	Very satisfied - 3, Satisfied - 15
		Moderate - 7		
<b>Less than 5 years</b>	16	Mild - 1	Excellent - 8, Good - 7, Average - 1	Very satisfied - 6, Satisfied - 9, Neither - 1
		Moderate - 10		
		Severe - 5		
<b>Less than 10 years</b>	8	Mild - 2	Excellent - 4, Good - 3,	Very satisfied - 1, Satisfied - 4,
			Average - 1	Neither - 2, Dissatisfied - 1
		Moderate - 3		
		Severe - 2		
		Profound - 1		
<b>More than 10 years</b>	8	Mild - 1	Excellent - 3, Good - 5	Very satisfied - 5, Satisfied - 2, Neither - 1
		Moderate - 2		
		Severe - 2		
		Profound - 3		

**Table 2 : Benefit by Degree of Hearing Loss and Duration of Hearing Loss:**

<b>Duration of Hearing Loss</b>	<b>Degree of Hearing Loss</b>	<b>Benefit</b>
<b>Less than 1 year</b>	Mild	Excellent - 3, Good - 8
	Moderate	Excellent - 3, Good - 4
<b>Less than 5 years</b>	Mild	Good - 1
	Moderate	Excellent - 4, Good - 5, Average - 1
	Severe	Excellent - 4, Good - 1
<b>Less than 10 years</b>	Mild	Good - 1
	Moderate	Excellent - 2, Good - 1
	Severe	Excellent - 1, Good - 1
	Profound	Excellent - 1, Good - 1
<b>More than 10 years</b>	Mild	Good - 1
	Moderate	Good - 2
	Severe	Excellent - 2
	Profound	Excellent - 1, Good - 2

### DISCUSSION :

The effectiveness of using hearing aids, as determined by the International Outcome Inventory for Hearing Aids (IOI-HA) scores, was examined in our study in connection to the severity and duration of age-related hearing loss (ARHL). Significant negative associations were found in the results, suggesting that the effectiveness of hearing aids declines with increasing hearing loss severity and duration. The therapeutic treatment of ARHL will be significantly impacted by these findings.

#### Importance of Early Intervention

The significance of early intervention is highlighted by the significant inverse relationship between the length of hearing loss and IOI-HA scores. Because chronic auditory deprivation can cause irreversible neuronal alterations in the auditory system, delayed use of hearing aids may result in lessened benefits. To lessen these effects and improve results, timely use of hearing aids and routine monitoring are crucial.

#### Impact of Severity on Outcomes

Likewise, the inverse relationship between the degree of hearing loss and the efficacy of hearing aids implies that those with more severe hearing loss gain less. According to studies, the degree of hearing loss, age, and self-reported hearing impairment all significantly predict the adoption and usage of hearing aids. This emphasises the necessity of customised fittings and rehabilitation plans made to meet the unique requirements of those with profound or severe hearing loss.[5] Features like frequency modulation systems, directional microphones, and noise reduction algorithms in advanced hearing aids may help this demographic achieve better results.

#### Physiological and Behavioural Factors

Long-term hearing deprivation can cause cortical reconfiguration and neuronal degeneration, which hinders the brain's capacity to efficiently process enhanced audio impulses. The success of hearing aids is also influenced by non-audiological elements like attitudes, psychological states, and demographic traits. Rejection is linked to a sense of pain or lack of benefit, whereas positive adherence is frequently linked to a heightened awareness of hearing loss and the requirement of the device.[6,7]

#### Alignment with Previous Research

Our results are consistent with earlier research demonstrating that the length of hearing loss has a detrimental effect on speech perception outcomes following cochlear implantation. This highlights how important early detection and prompt action are to maintaining auditory function and improving the results of hearing aids.[8]

#### Clinical Implications

Our research emphasises the necessity of aggressive ARHL management. Early detection through routine hearing tests should be a top priority for audiologists and other hearing care specialists, who should also promote the timely use of hearing aids. To optimise device performance, individualised rehabilitation programs should be created according to the degree and length of hearing loss.[9, 10]

It's interesting that our research revealed that IOI-HA scores were not significantly impacted by age or gender, indicating that the degree and length of hearing loss are more important factors in determining the success of hearing aids.[11] When creating treatment regimens, doctors should concentrate on each patient's unique auditory needs, even though age and gender are still crucial factors in the overall care of ARHL.

Healthcare professionals can improve the quality of life for people with age-related hearing loss and improve auditory rehabilitation outcomes by addressing these aspects. A standardised seven-item questionnaire called the IOI-HA is still a vital instrument for assessing the efficacy of hearing aids and directing clinical judgment.

### CONCLUSION :

Our study concludes by highlighting the important variables affecting how well hearing aids work for persons with age-related hearing loss (ARHL). We highlight the significance of early intervention and customised care techniques by illustrating the crucial influence that both the degree and length of hearing loss have on hearing aid results. The critical necessity for prompt detection and proactive care is highlighted by the substantial negative correlations shown between lower efficacy of hearing aids and prolonged, severe hearing loss. Individually designed rehabilitation programs can significantly increase the advantages of hearing aids, enhancing communication and general quality of life.

Additionally, our results show that gender and age have little bearing on the effectiveness of hearing aids, freeing up physicians to concentrate on the more important variables of hearing loss severity and duration. Targeted interventions are supported by this simplified method, which guarantees prompt and accurate modifications to optimise the efficacy of hearing aids. These findings have significant clinical ramifications, supporting routine monitoring and individualised therapy regimens to maximise results for people with ARHL.

Healthcare professionals can significantly impact the lives of people with ARHL by emphasising early and tailored interventions, which will help them maintain improved hearing and live better lives. Future studies should examine other elements that affect the success of hearing aids, such as psychological aspects, cognitive function, and developments in

hearing technology. A deeper comprehension of these elements will aid in the creation of more sophisticated and successful treatment plans.

In the end, our research supports a comprehensive, patient-focused strategy for treating ARHL. We can guarantee that people with hearing loss receive the greatest support possible by emphasising early intervention and individualised care, allowing them to continue participating in and being connected to their environment. For those who are impacted by hearing loss, this proactive approach promises a better and more rewarding future.

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