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CORRELATION OF PURE TONE AUDIOGRAM AND SPEECH AUDIOMETRY IN ELDERLY INDIVIDUALS AFFECTED BY PRESBYCUSIS AND THEIR QUALITY OF LIFE.

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ABSTRACT

Introduction: Given our ongoing ENT work on presbycusis, there is a need for hospital-based data to estimate the frequency of presbycusis, identify associated factors like age, diabetes, hypertension, noise exposure, and ototoxic drugs, and evaluate its impact on quality of life using validated tools such as Hearing Handicap Inventory for the Elderly (HHIE). Such evidence will support early screening programs, hearing rehabilitation services, and geriatric care planning in tertiary centers ultimately improving functional independence and quality of life among elderly patients. **Methods: Study Design and Setting:** The study was carried out in the Department of Otorhinolaryngology, PES Institute of Medical Sciences and Research (PESIMSR) Hospital, Kuppam. **Study Population:** The study population consisted of elderly patients aged 60 years and above presenting with hearing loss to the ENT outpatient department of PESIMSR Hospital, Kuppam, and undergoing pure tone audiometry and speech audiometry.

Conclusions:

1. Males constituted a higher proportion of the study population, likely reflecting healthcare-seeking and occupational factors.
2. Moderate to moderately severe bilateral symmetrical sensorineural hearing loss was the most common audiological finding.
3. Speech discrimination scores declined significantly with advancing age and increasing pure tone audiogram (PTA) severity.
4. HHIE scores indicated a moderate-to-significant hearing-related quality-of-life impairment, with emotional impact exceeding social limitations.
5. The study emphasizes the need for comprehensive assessment using audiometry, speech testing, and self-report measures for optimal presbycusis management.

KEYWORDS :

INTRODUCTION

Presbycusis, or age-related sensorineural hearing loss, represents the most common auditory impairment in older adults and is a major contributor to disability in the geriatric population. It results from gradual degenerative changes within the cochlea, auditory nerve pathways, and associated metabolic mechanisms.

Although typically recognized after the age of 65 years, the onset may be earlier in individuals with hereditary predisposition, chronic noise exposure, ototoxic insults, microvascular disease, or long-standing lifestyle-related risk factors.

As life expectancy increases globally and in India, presbycusis has emerged as a significant public health concern affecting communication, social participation, mental health, and overall quality of life.[1,2]

Aims

To evaluate the frequency involved in PTA, associated factors, and quality-of-life impact of presbycusis among elderly individuals attending the ENT outpatient department.

Objectives:

1. To estimate the hearing frequency affected in presbycusis among elderly patients attending ENT OPD
2. To determine the factors associated with presbycusis among them.
3. To assess its impact on quality of life among them.

METHODS

Study Design

This was a hospital-based cross-sectional study.

Study Setting

The study was carried out in the Department of Otorhinolaryngology, PES Institute of Medical Sciences and Research (PESIMSR) Hospital, Kuppam.

Study Population

The study population consisted of elderly patients aged 60 years and above presenting with hearing loss to the ENT outpatient department of PESIMSR Hospital, Kuppam, and undergoing pure tone audiometry and speech audiometry.

Sampling Method

A purposive sampling method was adopted. All eligible patients who satisfied the inclusion criteria during the study period were included until the required sample size was achieved.

RESULTS

Table 1: Distribution of Hearing Loss

Degree of Hearing Loss	PTA Range	Right Ear n (%)	Left Ear n (%)
Minimal	≤ 25 dB	10 (5.2%)	10 (5.2%)
Mild	26–40 dB	33 (17.0%)	26 (13.4%)
Moderate	41–55 dB	46 (23.7%)	42 (21.6%)
Moderately Severe	56–70 dB	56 (28.9%)	74 (38.1%)
Severe	71–90 dB	37 (19.1%)	33 (17.0%)
Profound	> 90 dB	12 (6.2%)	9 (4.6%)
Total	$\chi^2 = 4.16$ df = 5 p = 0.526	194 (100%)	194 (100%)

Moderately severe hearing loss was the most frequent category, accounting for 56 cases (28.9%) in the right ear and 74 cases (38.1%) in the left ear. This was followed by moderate hearing loss, seen in 46 patients (23.7%) on the right and 42 patients (21.6%) on the left, and severe hearing loss, observed in 37 (19.1%) right ears and 33 (17.0%) left ears. Despite minor differences in proportions, the overall severity distribution between right and left ears was not statistically significant ($\chi^2 = 4.16$, df = 5, p = 0.526).

Table 2: Association Between Age Group and Speech Discrimination Score (SDS)

Age Group (years)	Poor SDS	Fair SDS	Good SDS	Statistical analysis
60–69	41 (29.1%)	51 (36.2%)	49 (34.8%)	$\chi^2 = 15.87$ df = 4 p = 0.003 (statistically significant)
70–79	22 (51.2%)	9 (20.9%)	12 (27.9%)	
≥80	8 (80.0%)	1 (10.0%)	1 (10.0%)	
Total	71 (36.6%)	61 (31.4%)	62 (32.0%)	

The table shows the distribution of Speech Discrimination Score (SDS) categories across different age groups. In the 60–69 years group, SDS was relatively evenly distributed, with fair SDS being slightly more common. In the 70–79 years group, more than half of the patients (51.2%) had poor SDS, indicating a decline in speech discrimination with advancing age. The ≥80 years group showed a marked predominance of poor SDS (80.0%), with very few patients demonstrating fair or good speech discrimination.

These findings suggest that speech discrimination ability deteriorates significantly with increasing age in patients with presbycusis.

Table 3: Association Between Type of Audiogram (Both Ears Combined) and Speech Discrimination Score (SDS)

Type of Audiogram	Good SDS (≥80%) n (%)	Fair SDS (60–79%) n (%)	Poor SDS (<60%) n (%)	Total (n)
Flat	114 (36.4%)	83 (26.5%)	116 (37.1%)	313
High Frequency	30 (54.5%)	9 (16.4%)	16 (29.1%)	55
Sloping	5 (25.0%)	6 (30.0%)	9 (45.0%)	20
Total	149 (38.4%)	98 (25.3%)	141 (36.3%)	388
Chi-square test: $\chi^2 = 8.34$, $p = 0.080$ Not statistically significant				

Flat audiograms demonstrated the highest proportion of poor SDS, indicating greater functional speech perception difficulty. High-frequency audiograms showed comparatively better speech discrimination, with more than half exhibiting good SDS. Sloping audiograms displayed a mixed distribution with a predominance of poor SDS. However, chi-square analysis did not reveal a statistically significant association between audiogram type and SDS when both ears were considered together.

Table 4: Quality of Life Impact Assessment Using HHIE-S, HHIE-E and HHIE-T Scores

HHIE Domain	Mean Score	Standard Deviation (SD)
Social (HHIE-S)	23.45	9.15
Emotional (HHIE-E)	26.89	10.08
Total (HHIE-T)	50.48	18.81

The mean Hearing Handicap Inventory for Elderly- Social (HHIE-S) score of 23.45 ± 9.15 indicates a moderate social handicap due to hearing impairment, reflecting difficulties in social interaction and participation. The Hearing Handicap Inventory for Elderly-Emotional (HHIE-E) domain showed a higher mean score of 26.89 ± 10.08, suggesting a greater emotional impact, including frustration, embarrassment, and reduced self-confidence. The mean Hearing Handicap Inventory for Elderly-Total (HHIE-T) score of 50.48 ± 18.81 corresponds to a moderate-to-significant overall quality-of-life impairment in presbycusis patients. Emotional consequences were more pronounced than social limitations, a finding commonly reported in geriatric audiology studies. The wide standard deviation highlights variability in perceived handicap among individuals with similar audiometric profiles. These findings emphasize the importance of incorporating quality-of-life assessment alongside PTA and speech audiometry in presbycusis evaluation.

DISCUSSION

In the present study, a clear and statistically significant association was observed between age and Speech Discrimination Score (SDS). In the 60–69 years age group, SDS distribution was relatively balanced, with fair SDS being marginally more frequent. However, with advancing age, a marked deterioration in speech discrimination was evident. More than half of the participants aged 70–79 years exhibited poor SDS, and this decline was even more pronounced in those aged ≥80 years, where 80% demonstrated poor SDS. The significant chi-square association ($\chi^2 = 15.87$, df = 4, $p = 0.003$) confirms that speech discrimination ability worsens progressively with increasing age in presbycusis. This age-related decline likely reflects cumulative cochlear hair cell loss, neural degeneration, and central auditory processing deficits that accompany ageing.

These findings are consistent with those reported by Sharma et al,[3] who demonstrated a significant decline in SDS with each successive age group ($p < 0.001$), despite relatively preserved interaural symmetry. Similar age-related deterioration in speech discrimination has also been documented by Baraldi,[4] Arlinger,[5] and Gimsing,[6] all of whom emphasized that SDS loss becomes substantially greater beyond 70 years of age. The present study aligns well with this established pattern, reinforcing age as a key determinant of speech perception decline in presbycusis.

With respect to gender, the present study did not demonstrate a statistically significant association between gender and SDS category ($\chi^2 = 1.93$, df = 2, $p = 0.381$). Although poor SDS was slightly more frequent among males and fair SDS predominated among females, overall speech discrimination performance was comparable between the sexes. This suggests that gender does not independently influence speech discrimination ability in presbycusis once age and degree of hearing loss are accounted for. Similar observations have been reported in several earlier studies, indicating that biological ageing rather than sex-related factors primarily drives speech perception decline.

A strong and highly statistically significant association was noted between the degree of hearing loss and SDS in both ears. In the right ear, mild and moderate hearing loss were predominantly associated with good SDS, while a progressive shift toward fair and poor SDS was observed with increasing PTA levels. Moderately severe hearing loss showed a mixed distribution, and severe to profound hearing loss was strongly associated with poor SDS. An identical trend was observed in the left ear, where worsening PTA thresholds corresponded to a steady decline in speech discrimination ability. When both ears were analyzed together, the association between PTA severity and SDS remained highly significant ($p < 0.001$), underscoring the close functional relationship between auditory sensitivity and speech perception.

These observations are in agreement with the findings of Sharma et al,[3] who reported that while pure tone thresholds and SDS were symmetrical between ears, speech discrimination declined significantly with increasing PTA and advancing age. Their reported mean SDS values (approximately 82–83%) were higher than those observed in many presbycusis cohorts, likely reflecting a higher proportion of mild hearing loss in their study population. In contrast, the predominance of moderate to moderately severe hearing loss in the present study explains the higher proportion of poor SDS.

Overall, the present study demonstrates that speech discrimination in presbycusis is strongly influenced by age and degree of hearing loss, while gender has no significant effect. The progressive deterioration of SDS with advancing age and increasing PTA severity highlights the importance of early audiological evaluation and intervention. Speech audiometry, in conjunction with pure tone audiometry, provides crucial functional insight and should be an integral component of presbycusis assessment, particularly in older age groups and those with moderate to severe hearing impairment.

Regarding functional correlation, the present study did not demonstrate a statistically significant association between audiogram type and SDS in either ear or when both ears were combined. Although flat audiograms showed a relatively higher proportion of poor SDS—suggesting greater difficulty in speech perception—chi-square analysis failed to establish statistical significance. High-frequency audiograms tended to show better SDS, while sloping patterns exhibited mixed performance; however, these differences did not reach significance. This indicates that audiogram configuration alone may not be a reliable predictor of speech discrimination ability in presbycusis.

The lack of a significant association between audiogram type and SDS suggests that speech perception is influenced by multiple factors beyond peripheral audiometric shape, including neural degeneration, central auditory processing, cognitive decline, and linguistic factors. Similar observations have been noted in previous studies, where patients with comparable audiometric configurations demonstrated wide variability in speech discrimination performance.

Overall, the present study reinforces that flat audiograms are the most common configuration in presbycusis and that audiometric patterns are largely symmetrical between ears. While certain configurations tend to be associated with poorer speech discrimination, audiogram type alone does not independently determine functional speech perception. Comprehensive evaluation of presbycusis should therefore integrate pure-tone audiometry, speech audiometry, and consideration of central and cognitive factors to better understand the real-world hearing difficulties experienced by elderly patients.

In the present study, the mean HHIE-S score of 23.45 ± 9.15 indicates a moderate level of social handicap, reflecting noticeable difficulty in social interaction, communication in group settings, and participation in everyday activities. Notably, the emotional domain demonstrated a higher mean score (26.89 ± 10.08), suggesting that the emotional consequences of presbycusis—such as frustration, embarrassment, social withdrawal, and reduced self-confidence—were more pronounced than social limitations. The mean total HHIE score of 50.48 ± 18.81 corresponds to a moderate-to-significant overall quality-of-life impairment, underscoring the substantial psychosocial burden imposed by age-related hearing loss.

The relatively wide standard deviations observed in the present study indicate considerable inter-individual variability in perceived handicap, even among patients with similar audiometric profiles. This variability highlights the influence of non-audiological factors such as coping mechanisms, personality traits, social support, cognitive status,

and communication demands. Importantly, the greater emotional burden observed suggests that elderly individuals may internalize hearing loss as a personal limitation, often leading to psychological distress before overt social withdrawal becomes evident.

Overall, the present study supports existing evidence that HHIE scores correlate strongly with the degree of hearing loss and that emotional consequences often outweigh social restrictions in presbycusis. These findings emphasize the necessity of incorporating quality-of-life and self-perceived handicap assessment alongside pure-tone audiometry and speech audiometry in the comprehensive evaluation of elderly patients with hearing impairment. Such an approach is essential for individualized management, timely rehabilitation, and improved patient-centered outcomes in geriatric audiology.

CONCLUSION

The present study provides a comprehensive clinic-audiological and psychosocial evaluation of presbycusis, highlighting the multidimensional impact of age-related hearing loss in the elderly population.

Presbycusis was most frequently identified in the early elderly age group (60–69 years), with a mean age of 67.09 ± 6.23 years, emphasizing that clinically significant hearing loss becomes evident in sixth decade. A male predominance was observed, likely reflecting sociocultural, occupational, and healthcare-seeking patterns rather than true biological susceptibility.

Audiometrically, moderate to moderately severe bilateral symmetrical sensorineural hearing loss was the predominant presentation, with flat audiogram configurations being most common, suggesting a major contribution of metabolic (strial) presbycusis. Pure-tone thresholds showed clear severity progression without significant interaural asymmetry, reinforcing the classical bilateral nature of presbycusis.

In contrast, speech discrimination ability demonstrated significant functional asymmetry between ears and showed a strong, statistically significant decline with advancing age and increasing PTA severity, while gender had no independent influence. These findings underscore that speech perception deficits may exceed what is predicted by pure-tone thresholds alone, particularly in older individuals and those with neural involvement.

Quality-of-life assessment using HHIE-S, HHIE-E, and HHIE-T revealed a moderate-to-significant perceived hearing handicap, with emotional consequences outweighing social limitations. Importantly, perceived handicap showed:

- No significant association with gender
- No statistically significant correlation with age alone
- A strong and highly significant association with PTA severity, audiogram type (especially flat configurations), and speech discrimination scores
- Participants with significant HHIE-T scores consistently exhibited poor SDS, establishing a robust inverse relationship between subjective hearing handicap and objective speech perception ability. The discrepancy between self-reported handicap prevalence and audiometrically confirmed hearing impairment further highlights the limitations of relying solely on PTA—especially better-ear PTA—in elderly hearing assessment.

Overall, the study confirms that presbycusis is not merely an audiometric disorder but a complex functional and psychosocial condition. Audiometric thresholds explain only part of the perceived disability; emotional, cognitive, linguistic, and environmental factors play a crucial role in shaping the lived experience of hearing loss.

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