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Original Research Article

ETIOLOGICAL AND AUDIOLOGICAL PROFILE IN PATIENTS WITH TINNITUS: A RETROSPECTIVE STUDY

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ABSTRACT

Background: Tinnitus is a common auditory complaint with diverse otological, systemic, and hearing-related causes. This study evaluated the etiological factors and audiological profile of patients presenting with tinnitus and examined their relationship with demographic and clinical characteristics. **Materials and Methods:** This retrospective study included 81 patients aged ≥18 years who presented with tinnitus and had complete clinical and audiological records. Demographic and clinical details were reviewed. Pure-tone audiometry was used to assess hearing status, type and degree of hearing loss, and high-frequency hearing loss. Correlations and group comparisons were performed using Pearson's correlation, Spearman's correlation, ANOVA, independent t-test, and Chi-square test. Statistical significance was set at $p<0.05$. **Result:** The mean age was 50.36 ± 14.09 years, with males comprising 55.6% (45/81). Noise-induced hearing loss was the most frequent etiology (17.3%), followed by idiopathic tinnitus (14.8%) and diabetes mellitus (12.3%). The mean PTA was 46.58 ± 21.73 dB, and sensorineural hearing loss was present in 59.3% of participants. High-frequency hearing loss was identified in 64.2%, with presbycusis being the commonest subtype (27.2%). Etiology was significantly associated with hearing-loss type ($p<0.001$). PTA differed significantly across etiological groups ($F=56.588$, $p<0.001$). Age correlated positively with PTA ($r=0.872$, $p<0.001$), tinnitus duration ($\rho=0.893$, $p<0.001$), and PTA also correlated with tinnitus duration ($\rho=0.919$, $p<0.001$). **Conclusion:** Tinnitus showed a varied etiological and audiological profile, with sensorineural and high-frequency hearing loss being common. Age, tinnitus duration, and etiology were significantly related to hearing thresholds.

INTRODUCTION

Tinnitus is the perception of sound without an external acoustic source and is a common complaint in ear, nose, and throat clinics. A recent global systematic review and meta-analysis estimated that tinnitus affects more than 740 million adults, with over 120 million experiencing symptoms severe enough to interfere with daily life.[1] Hearing impairment is also widespread, with the World Health Organization reporting that more than 1.5 billion people have some degree of hearing loss. This number is expected to reach 1 in every 4 people by 2050.[2,3] Tinnitus is often linked to changes in the cochlea, auditory nerve, or central auditory pathways. Tinnitus has many possible causes, and more than one factor can be present in the same patient. Noise-induced hearing loss is a major contributor, and global disease-burden estimates show that disability related to occupational noise exposure more than doubled between 1990 and 2021.[4] Age-related hearing loss, or presbycusis, is another common cause and develops with progressive changes in cochlear hair cells and auditory neurons. Systemic diseases such as diabetes mellitus, hypertension, dyslipidemia, and chronic kidney disease have also been linked to sensorineural damage through changes in the blood supply of the inner ear.[5,6] Other causes include middle-ear diseases such as chronic suppurative otitis media and vascular abnormalities such as a high-riding jugular bulb.

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Tinnitus involves changes in both peripheral and central auditory function. One proposed mechanism is an increase in central auditory gain after reduced input from the damaged ear, which can result in abnormal neural activity perceived as sound.[7] This may explain why the severity of tinnitus does not always correspond to the degree of hearing loss measured on audiometry. Pure-tone audiometry (PTA) remains an important part of tinnitus assessment, although it does not capture all aspects of tinnitus.[8] Tinnitus can also affect psychological well-being, with studies reporting links with anxiety, depression, and reduced quality of life. These effects have also been reported to differ between men and women.[9,10]

Tinnitus is common, but its causes and audiological patterns vary between patients, and published studies have used different patient populations and assessment methods.[1,11] This makes it difficult to relate a particular cause of tinnitus to a specific hearing profile. The present retrospective study evaluated the etiological factors and audiological characteristics of patients with tinnitus, examined the relationship between etiology and hearing findings, and assessed the distribution of age and gender in relation to hearing outcomes.

Aim: To evaluate the etiological factors and audiological profile in patients presenting with tinnitus.

Objectives

- To identify common causes of tinnitus
- To assess hearing status using audiological tests
- To correlate etiology with audiological findings
- To analyze demographic distribution (age, gender)

MATERIALS AND METHODS

This retrospective study was conducted over a period of 18 months among patients attending or referred to the ENT outpatient or inpatient department with complaints of tinnitus.

Study Population: The study included 81 patients aged ≥18 years who presented with tinnitus, with or without hearing loss, and had complete clinical and audiological records available for review.

Inclusion and Exclusion Criteria

Patients aged ≥18 years with a complaint of tinnitus, with or without hearing loss, were included. Only patients with complete clinical and audiological records were considered eligible. Patients with incomplete medical records, psychiatric illness affecting the reliability of assessment, or objective tinnitus were excluded.

Clinical Assessment: Clinical information was obtained from the available medical records. Demographic details, including age and sex, were recorded. Clinical details included duration and type of tinnitus, associated symptoms such as hearing loss and vertigo, laterality, and the recorded etiological diagnosis. Detailed clinical history and physical examination findings were also reviewed.

Audiological Assessment: PTA was conducted as the only audiological evaluation. PTA was conducted in both air and bone conduction according to the standard audiometric procedures. The average of the pure tones across the speech frequencies (i.e., 500 Hz, 1000 Hz, and 2000 Hz) was calculated in order to determine the hearing status of the patient.

The degree of hearing loss was categorized based on the hearing threshold levels as follows: normal hearing (0-25 dB HL), mild hearing loss (26-40 dB HL), moderate hearing loss (41-55 dB HL), moderately severe hearing loss (56-70 dB HL), severe hearing loss (71-90 dB HL), and profound hearing loss (>90 dB HL).

This study established the type of hearing loss by examining both air and bone conduction thresholds and identifying patients with sensorineural hearing loss (SNHL), conductive hearing loss (CHL), or mixed hearing loss. Further, high-frequency hearing loss was confirmed by elevated hearing thresholds greater than 4 kHz. High-frequency hearing loss was documented, and its clinical presentation was correlated with tinnitus.

Consent: Written consent was obtained from the participants as documented in the study records.

Statistical Analysis: Continuous variables were expressed as mean ± SD or median (Q1–Q3), as appropriate, and categorical variables as frequencies and percentages. Pearson's and Spearman's correlation was used to assess relationships. ANOVA, independent t-test and Chi-square test was used for comparisons, as appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

The study included 81 participants, with a mean age of 50.36 ± 14.09 years. The largest age group was 51–60 years (25, 30.9%), followed by 41–50 years (18, 22.2%). There were 45 males (55.6%) and 36 females (44.4%) [Table 1].

Table 1: Demographic characteristics of the study participants

Characteristic	Category	n (%)
Age group (years)	18–30	8 (9.9%)
	31–40	12 (14.8%)
	41–50	18 (22.2%)
	51–60	25 (30.9%)
	61–70	14 (17.3%)
	>70	4 (4.9%)
Gender	Male	45 (55.6%)
	Female	36 (44.4%)

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The median duration of tinnitus was 8.9 months, with Q1 and Q3 of 3.2 and 40.1 months, respectively. The most common duration category was 1–6 months (22, 27.2%), followed by 1–5 years (20, 24.7%). Tinnitus was bilateral in 28 (34.6%), right-sided unilateral in 28 (34.6%), and left-sided unilateral in 25 (30.9%) participants [Table 2].

Table 2: Clinical characteristics of patients with tinnitus

Clinical characteristic	Category	n (%) / Value
Duration of tinnitus	<1 month	10 (12.3%)
	1–6 months	22 (27.2%)
	6 months–1 year	18 (22.2%)
	1–5 years	20 (24.7%)
	>5 years	11 (13.6%)
Duration of tinnitus (months)	Median	8.9
	Q1	3.2
	Q3	40.1
Laterality	Bilateral	28 (34.6%)
	Unilateral Right	28 (34.6%)
	Unilateral Left	25 (30.9%)

The most frequently reported etiology was noise-induced hearing loss (14, 17.3%), followed by idiopathic tinnitus (12, 14.8%) and diabetes mellitus (10, 12.3%). CSOM (inactive) and systemic hypertension were each reported in 8 (9.9%) participants, while dyslipidemia was present in 6 (7.4%) [Table 3].

Table 3: Etiological profile of patients with tinnitus

Etiology	n (%)
Noise-Induced Hearing Loss	14 (17.3%)
Idiopathic Tinnitus	12 (14.8%)
Diabetes Mellitus	10 (12.3%)
CSOM (Inactive)	8 (9.9%)
Systemic Hypertension	8 (9.9%)
Dyslipidemia	6 (7.4%)
CKD on Hemodialysis	4 (4.9%)
Otosclerosis	4 (4.9%)
Thyroid Disorders	4 (4.9%)
Others	3 (3.7%)
Head Trauma	2 (2.5%)
High Riding Jugular Bulb	2 (2.5%)
Retrocochlear Lesion	2 (2.5%)
TMJ Disorder	2 (2.5%)

The mean PTA was 46.58 ± 21.73 dB. The most common PTA range was 41–55 dB (22, 27.2%). Sensorineural hearing loss was recorded in 48 (59.3%) participants, followed by normal hearing in 15 (18.5%), conductive hearing loss in 10 (12.3%), and mixed hearing loss in 8 (9.9%). Moderate hearing loss was the most frequent degree, affecting 22 (27.2%) participants. High-frequency hearing loss was present in 52 (64.2%) participants; among these, the most common subtype was presbycusis (22 participants, 42.3% of the HFHL-positive group; 27.2% of the total cohort) [Table 4].

Table 4: Audiological profile of patients with tinnitus

Audiological parameter	Category	n (%)
PTA range (dB)	0–25	15 (18.5%)
	26–40	18 (22.2%)
	41–55	22 (27.2%)
	56–70	14 (17.3%)
	>70	12 (14.8%)
Type of hearing loss	Sensorineural Hearing Loss	48 (59.3%)
	Normal Hearing	15 (18.5%)
	Conductive Hearing Loss	10 (12.3%)
	Mixed Hearing Loss	8 (9.9%)
Degree of hearing loss	Normal	15 (18.5%)
	Mild	18 (22.2%)
	Moderate	22 (27.2%)
	Moderately Severe	14 (17.3%)
	Severe	8 (9.9%)
	Profound	4 (4.9%)
High-Frequency Hearing Loss	Present	52 (64.2%)
	Absent	29 (35.8%)
HFHL subtype	Absent (No HFHL)	29 (35.8%)

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	Presbycusis	22 (27.2%)
	Noise-Induced	14 (17.3%)
	Other/Mixed	12 (14.8%)
	Ototoxicity	4 (4.9%)

Sensorineural hearing loss was recorded in 11 (91.7%) participants with idiopathic tinnitus and 14 (100.0%) with noise-induced hearing loss. Conductive hearing loss was recorded in 4 (100.0%) participants with otosclerosis and 2 (100.0%) with retrocochlear lesions. The reported association had a p-value of <0.001 [Table 5].

Table 5: Association between etiology and type of hearing loss

Etiology	Conductive n (%)	Mixed n (%)	Normal n (%)	Sensorineural n (%)
CKD on Hemodialysis	3 (75.0%)	0 (0.0%)	0 (0.0%)	1 (25.0%)
CSOM (Inactive)	0 (0.0%)	0 (0.0%)	0 (0.0%)	8 (100.0%)
Diabetes Mellitus	0 (0.0%)	0 (0.0%)	0 (0.0%)	10 (100.0%)
Dyslipidemia	0 (0.0%)	0 (0.0%)	0 (0.0%)	6 (100.0%)
Head Trauma	0 (0.0%)	2 (100.0%)	0 (0.0%)	0 (0.0%)
High Riding Jugular Bulb	1 (50.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)
Idiopathic Tinnitus	0 (0.0%)	0 (0.0%)	1 (8.3%)	11 (91.7%)
Noise-Induced Hearing Loss	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)
Others	0 (0.0%)	3 (100.0%)	0 (0.0%)	0 (0.0%)
Otosclerosis	4 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Retrocochlear Lesion	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Systemic Hypertension	0 (0.0%)	0 (0.0%)	0 (0.0%)	8 (100.0%)
Thyroid Disorders	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (100.0%)
TMJ Disorder	0 (0.0%)	2 (100.0%)	0 (0.0%)	0 (0.0%)

Mean PTA ranged from 18.29 ± 4.39 dB among participants with noise-induced hearing loss to 85.00 ± 11.31 dB among those with a high-riding jugular bulb. Mean PTA was 29.58 ± 6.58 dB for idiopathic tinnitus, 37.40 ± 9.18 dB for diabetes mellitus, 45.88 ± 5.54 dB for systemic hypertension, and 47.00 ± 3.38 dB for CSOM (inactive). The overall comparison showed F = 56.588, p <0.001 [Table 6].

Table 6: Mean pure-tone average according to etiology

Etiology	n	Mean ± SD (PTA dB)
Noise-Induced Hearing Loss	14	18.29 ± 4.39
Idiopathic Tinnitus	12	29.58 ± 6.58
Diabetes Mellitus	10	37.40 ± 9.18
Systemic Hypertension	8	45.88 ± 5.54
CSOM (Inactive)	8	47.00 ± 3.38
Dyslipidemia	6	58.17 ± 8.89
CKD on Hemodialysis	4	64.50 ± 4.51
Thyroid Disorders	4	67.25 ± 3.20
Otosclerosis	4	69.50 ± 14.82
Retrocochlear Lesion	2	74.50 ± 0.71
TMJ Disorder	2	77.50 ± 4.95
Others	3	83.00 ± 6.00
Head Trauma	2	84.00 ± 1.41
High Riding Jugular Bulb	2	85.00 ± 11.31

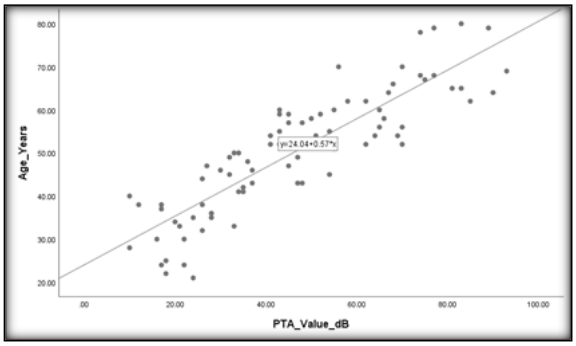

Figure 1: Scatter plot showing the relationship between age and PTA-value

Further correlation and comparative analyses were performed to evaluate the relationships between age, tinnitus duration, hearing threshold severity, and gender. Age was positively correlated with PTA (r = 0.872, p <0.001) [Figure 1]. Age was also correlated with duration of tinnitus (Spearman's ρ = 0.893, p <0.001), while PTA showed a correlation with tinnitus duration (Spearman's ρ = 0.919, p <0.001). PTA differed across age groups (F = 79.851, p <0.001). Mean PTA was 31.16 ± 12.07 dB in males and 65.86 ± 14.42 dB in females, with a mean difference of −34.71 dB (p <0.001).

DISCUSSION

Tinnitus is a common auditory symptom that can arise from various otological, systemic, and hearing-related conditions and may occur with different degrees of hearing impairment. This study evaluated the etiological and audiological profile of patients with tinnitus and examined the relationship between

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clinical and demographic factors and hearing status. Noise-induced hearing loss was the leading aetiology, while sensorineural and high-frequency hearing loss were common audiological findings. Age, tinnitus duration, and PTA showed significant relationships, with hearing thresholds also varying across age groups and between sexes.

In our study, tinnitus was observed across a broad range of adult age groups, with greater representation among middle-aged and older participants. Males were slightly more represented than females. Both unilateral and bilateral tinnitus were commonly observed, with considerable variation in symptom duration, reflecting the heterogeneous clinical presentation of tinnitus. Khoza-Shangase and Mkhize reported a mean age of 51.9 years among patients with tinnitus, similar to our findings, with females accounting for 76% of their sample.[12] Haro-Hernandez et al. studied 434 patients with chronic tinnitus and reported a younger age group ranging from 19–53 years, with a mean age of 44.77 ± 7.33 years.[13] This similarity in age distribution indicates that tinnitus commonly affects middle-aged and older adults, while sex distribution may vary across different study populations.

Our findings showed that noise-induced hearing loss was the most frequent etiology, followed by idiopathic tinnitus and systemic conditions. Sensorineural hearing loss was the predominant audiological finding, while high-frequency hearing loss was also commonly observed, with presbycusis being the most frequent subtype. Kang et al. compared 248 patients with chronic tinnitus, including 111 with noise-induced hearing loss and 137 with presbycusis. Hearing thresholds were higher at all frequencies in the noise-induced group, while TEOAE values were lower at 1.5, 2, 3, and 4 kHz.[14] Khoza-Shangase and Mkhize reported hearing loss in 78% of ears, with sensorineural hearing loss being the main type. Hypertension and diabetes were reported in 32% and 9% of patients, respectively. Our study also showed a predominance of sensorineural hearing loss, with systemic hypertension and diabetes mellitus among the reported causes.[12] Carrera et al. analysed 6,000 medical records and reported significant links between tinnitus and unilateral or bilateral sensorineural and conductive hearing loss, similar to the range of hearing patterns seen in our patients.[15] The similar predominance of sensorineural and high-frequency hearing loss supports a close relationship between tinnitus and underlying auditory impairment from different causes.

The present analysis demonstrated that hearing-loss patterns and PTA values varied across the different etiological groups. This variation indicates differences in the audiological profile according to the underlying cause of tinnitus. Ramatsoma and Patrick reported an extended high-frequency PTA of 44.1 ± 19.2 dB in hypertensive adults compared with 20.0 ± 18.3 dB in non-hypertensive controls. Tinnitus was also more frequent among hypertensive adults (41.5% vs 22.8%, p = 0.008).[16] Asghar et al. studied 396 patients with type 2 diabetes in Pakistan and reported greater hearing impairment at low and high frequencies, with a sex-based difference at 4 kHz (p = 0.004).[17] The findings indicate that systemic conditions such as hypertension and diabetes can accompany tinnitus with varying degrees of hearing impairment across affected patients.

Our correlation analysis indicated that age, tinnitus duration, and PTA were related to one another. PTA also differed across age groups and between males and females, showing variation in hearing thresholds according to demographic and clinical characteristics. Khoza-Shangase and Mkhize reported poorer hearing thresholds in older adults than younger adults, with mean values of 50.6 dB and 42.1 dB, respectively (p = 0.01). Their sample was predominantly female, but hearing-loss severity did not differ significantly between males and females.[12] Chen et al. studied 418 older adults with age-related hearing loss and reported an independent association between tinnitus and lower hearing thresholds (β = −5.07; 95% CI −9.32 to −0.81; p = 0.020), which remained significant among males (β = −6.96; 95% CI −12.70 to −1.22; p = 0.018).18 These findings indicate that age and tinnitus duration are important factors related to hearing thresholds, with hearing impairment varying across demographic groups.

Overall, the study showed a varied etiological and audiological profile of tinnitus, with noise-induced hearing loss and sensorineural hearing loss being common. Age, tinnitus duration, and PTA were also related, indicating variation in hearing status across patients.

CONCLUSION

Pure-tone audiometry is an important part of the assessment of patients with tinnitus. In our study, sensorineural and high-frequency hearing loss were common audiological findings, with noise-induced hearing loss, idiopathic tinnitus, and systemic conditions among the frequently recorded etiologies. Hearing thresholds also varied according to age, gender, tinnitus duration, and etiology. Audiological assessment therefore helps define the hearing profile and supports the evaluation of possible causes in patients presenting with tinnitus.

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