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Original Research Article

A descriptive cross-sectional study of type and severity of hearing loss among diabetic patients in a tertiary care center

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ABSTRACT

Background: Hearing impairment affects communication and quality of life globally. Diabetes mellitus (DM) is linked to sensorineural hearing loss (SNHL) through microangiopathy and neural degeneration. Despite this, audiological screening is not standard in diabetic care. This study assessed hearing loss type and severity among diabetic patients and explored associations with diabetes duration and glycemic control.
Methods: A descriptive cross-sectional study was conducted over 18 months at a tertiary care ENT center. 100 patients with type 2 DM and audiologically confirmed hearing loss were included. Patients with type 1 diabetes, chronic ear disease, or ototoxic drug history were excluded. Demographics, pure tone audiometry findings, and HbA1c levels were recorded. Statistical analysis using SPSS included the Mann-Whitney U test, Kruskal-Wallis test, chi-square test, and Spearman correlation ($p<0.05$ significant).
Results: The 61-70-year age group was most affected (49%), with a mean age of 67.1±8.7 years; 58% were male. Bilateral hearing loss occurred in 85%. SNHL predominated (81% right, 72% left), mostly moderate severity (42% right, 30% left). No significant associations existed between hearing loss severity and diabetes duration ($p=0.752$ right, $p=0.368$ left) or glycemic control ($p=0.70$ right, $p=0.78$ left). Tinnitus was recorded in 26%.
Conclusions: SNHL was common among diabetic patients, primarily bilateral and moderate. Despite no significant correlations with diabetes duration or glycemic control, its frequent occurrence in this cohort supports routine audiological screening for early detection and enhanced quality of life.

Keywords: Diabetes mellitus, Hearing loss, Sensorineural hearing loss, Audiometry, HbA1c, Glycemic control

INTRODUCTION

Hearing impairment is a chronic, disabling condition with associated physical, emotional, and cognitive disability, thus impacting social communication and quality of life. Globally, an estimated 466 million people are affected by disabling hearing loss, and projections indicate that by 2050, one in ten individuals will experience hearing loss; around 80% of these cases occur in low- and middle-income countries.[1] In India, the prevalence of type 2 diabetes has increased sharply, with 72.9 million cases in 2017 projected to rise to 134.3 million by 2045, and urban prevalence climbing from 2% in the 1970s to over 20%.[2] While diabetes is widely recognized for its microvascular complications, such as retinopathy, nephropathy, and neuropathy, its impact on auditory function remains under-recognized.[3] Several mechanisms-such as microangiopathy of cochlear vasculature, neural degeneration, and metabolic dysregulation-have been proposed to explain hearing loss in diabetes. However, the relationship between glycemic control, duration of diabetes, and severity or type of hearing loss remains unclear, with conflicting evidence across studies. Hearing loss grades are defined per ASHA: normal (-10 to 15 dB HL) through profound (>91 dB HL).[4] Given the increasing burden of both conditions, investigating their relationship is essential, yet extant literature lacks consensus on the type, severity, and

contributing factors. This study aims to determine the type and severity of hearing loss among diabetic patients and assess the association between hearing loss and glycemic status or duration of diabetes in a South Indian tertiary care setting.

METHODS

Study design and setting

This descriptive cross-sectional study was conducted over an 18 month period (July 2023 to January 2025) in the Department of Otorhinolaryngology at Southern Railway Headquarters Hospital, Chennai, India.

Inclusion criteria

Adult patients (≥18 years) with type 2 DM diagnosed according to the ADA criteria and hearing loss confirmed by pure tone audiometry (PTA) were included in study.

Exclusion criteria

Type 1 DM, chronic ear disease or history of otological surgery, history of head or ear trauma, current or prior use of ototoxic medications (e.g., aminoglycosides, cisplatin) and significant occupational noise exposure were excluded from study.

Sample size

Based on the finding by Meena et al of a 44.8% prevalence of moderate-to-severe hearing loss, a sample size of 95 was calculated for 95% confidence interval and 10% precision.[6] Accounting for 5% non-participation rate, a final cohort of n=100 patients was recruited.

Data collection

Following institutional ethics committee approval and obtaining written informed consent, demographic data (age, sex), DM duration (months), and pharmacological management (oral hypoglycemic agents or insulin) were recorded. The presence and laterality of tinnitus were systematically documented.

Audiological assessment

PTA was performed at frequencies 0.5, 1, 2, 4, and 8 kHz in a soundproof booth by a certified audiologist. Hearing thresholds were classified according to the guidelines of the American speech-language-hearing association (ASHA).[4]

Glycemic control

Glycated hemoglobin (HbA1c) levels were measured within one month of audiological assessment. Glycemic control was categorized as: ideal (HbA1c<7.0%), satisfactory (HbA1c=7.0-7.9%), and unsatisfactory (HbA1c≥8.0%) in accordance with ADA standards.[5]

Statistical analysis

Data were analyzed using SPSS version 20.0. Continuous variables are expressed as mean±SD, and categorical variables as frequencies and percentages. The normality of continuous data was assessed using the Shapiro-Wilk test and examination of Q-Q plots. As the data were not normally distributed, non-parametric tests were applied. Comparisons between hearing loss severity and DM duration, and between severity and HbA1c categories, were performed using the Kruskal-Wallis test. Associations between hearing loss type and HbA1c categories or DM duration were analyzed using the Mann-Whitney U test. Categorical variables were compared using the Chi-square test. Relationships between continuous variables were assessed using Spearman's rank correlation coefficient. All statistical tests were two-tailed, and a $p<0.05$ was considered statistically significant.

RESULTS

The demographic and clinical characteristics of the 100 study participants are summarized in Table 1. The mean age of the cohort was 67.11±8.72 years, and the average diabetes duration of 126.66±85.71 months. The sex distribution was 58% male and 42% female. Tinnitus prevalence and laterality are detailed in Table 2; 26% of participants reported tinnitus, with 8% experiencing it bilaterally, 10% in the left ear, and 8% in the right ear.

The distribution of hearing loss severity across the study population is presented in Figure 1, illustrating that mild and moderate hearing loss were the most prevalent categories in both ears.

The relationship between hearing loss (type and severity) and diabetes duration is detailed in Table 3. SNHL was the predominant type compared to mixed hearing loss in both ears. Notably, the mean duration of diabetes did not significantly differ across hearing loss severity categories for either the right ($p=0.752$) or left ear ($p=0.368$).

Scatter plots with trend lines illustrating the relationship between diabetes duration and hearing loss severity are presented in Figure 2. A weak positive correlation was observed in the right ear ($r=0.193$, $p=0.054$), whereas no significant association was noted for the left ear ($r=0.064$, $p=0.526$).

Mean HbA1c values categorized by hearing loss type and severity are summarized in Table 4. Analysis revealed that mean HbA1c levels did not differ significantly across hearing loss classifications ($p>0.40$). Similarly, scatter plots (Figure 3) demonstrated no significant linear correlation between HbA1c levels and auditory

thresholds in either the right ear (r=0.032, p=0.750) or the left ear (r=-0.108, p=0.285).

The relationship between glycemic control categories (Ideal, satisfactory, unsatisfactory) and the type and severity of hearing loss in both ears is detailed in Table 5. While glycemic control showed no significant association with the type of hearing loss (p=0.540), the distribution of hearing loss severity across these categories is visualized in the grouped stacked bar chart (Figure 4). This chart highlights a trend where participants with unsatisfactory glycemic control (HbA1c≥8.0%) presented higher proportions of moderate-to-severe hearing loss in both ears.

Overall, the consolidated data indicate that while hearing loss severity varies clinically across glycemic control categories, direct statistical correlations with diabetes duration and HbA1c levels did not reach statistical significance (p>0.05) in this cohort.

Table 1: Demographic and clinical profile of study participants, (n=100).

Parameters	N	Min	Max	Mean±SD	Percentage (%)
Age (in years)	100	38	88	67.11±8.72	-
Sex					
Male	58	-	-	-	58.0
Female	42	-	-	-	42.0
Duration of diabetes (months)	100	5	480	126.66±85.71	-

Table 2: Tinnitus prevalence and laterality among participants, (n=100).

Variables		N	Percentage (%)
Tinnitus	Present	26	26
	Absent	74	74
Side affected (n=26)			
Side of tinnitus	Both ears	08	08
	Left ear	10	10
	Right ear	08	08

Table 3: Association of DM duration with type and severity of hearing loss, (n=100).

Variables	Right ear	Mean duration±SD (Months)	Left ear	Mean duration±SD (Months)
Type of hearing loss				
SNHL	81	122.25±90.26	72	127.86±93.71
Mixed	19	140.21±62.62	28	120.00±61.62
P value	0.190		0.941	
Severity of hearing loss				
Mild	20	113.80±71.09	23	96.26±63.32
Moderate	42	115.86±102.98	30	138.07±116.53
Moderately severe	22	134.18±66.42	22	129.55±69.35
Severe	14	146.57±75.04	22	130.91±73.31
Profound	2	210.00±42.43	3	160.00±34.64
P value	0.752		0.368	

Table 4: Correlation of mean HbA1c levels with hearing loss type and severity, (n=100).

Clinical parameters	Right ear	Mean HbA1c±SD	Left ear	Mean HbA1c±SD
Type of hearing loss				
SNHL	81	7.80±1.48	72	7.87±1.52
Mixed	19	7.99±1.39	28	7.76±1.31
P value	0.620		0.751	
Severity of hearing loss				
Mild	20	7.82±1.46	23	7.97±1.37
Moderate	42	7.86±1.50	30	7.82±1.51
Moderately severe	22	7.45±1.00	22	7.98±1.53
Severe	14	8.44±1.94	22	7.66±1.54
Profound	2	7.75±0.64	3	7.23±0.84
P value	0.417		0.875	

Table 5: Distribution of hearing loss type and severity across glycemic control categories, (n=100).

Clinical parameters	Ideal (HbA1c<7%)	Satisfactory (HbA1c=7-7.9%)	Unsatisfactory (HbA1c≥8%)
	R/L	R/L	R/L
Type of hearing loss			
SNHL	25/21	30/28	26/23
Mixed	5/9	6/8	8/11
P value	0.540 (R)/0.540 (L)		
Severity of hearing loss			
Mild	7/5	7/11	6/7
Moderate	12/10	14/9	16/11
Moderately severe	8/6	10/9	4/7
Severe	3/7	4/7	7/8
Profound	0/2	1/0	1/1
P value	0.700 (R)/0.780 (L)		

R: Right ear; L: Left ear; HbA1c: Glycated hemoglobin.

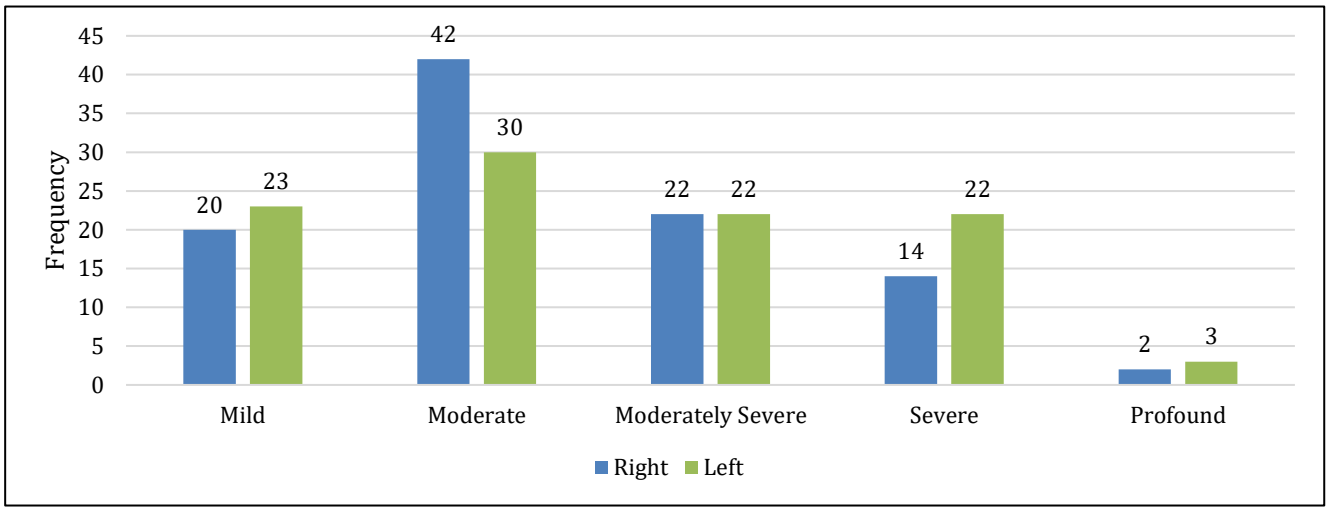

Figure 1: Clustered column showing the distribution of severity of hearing loss on each side in the study population.

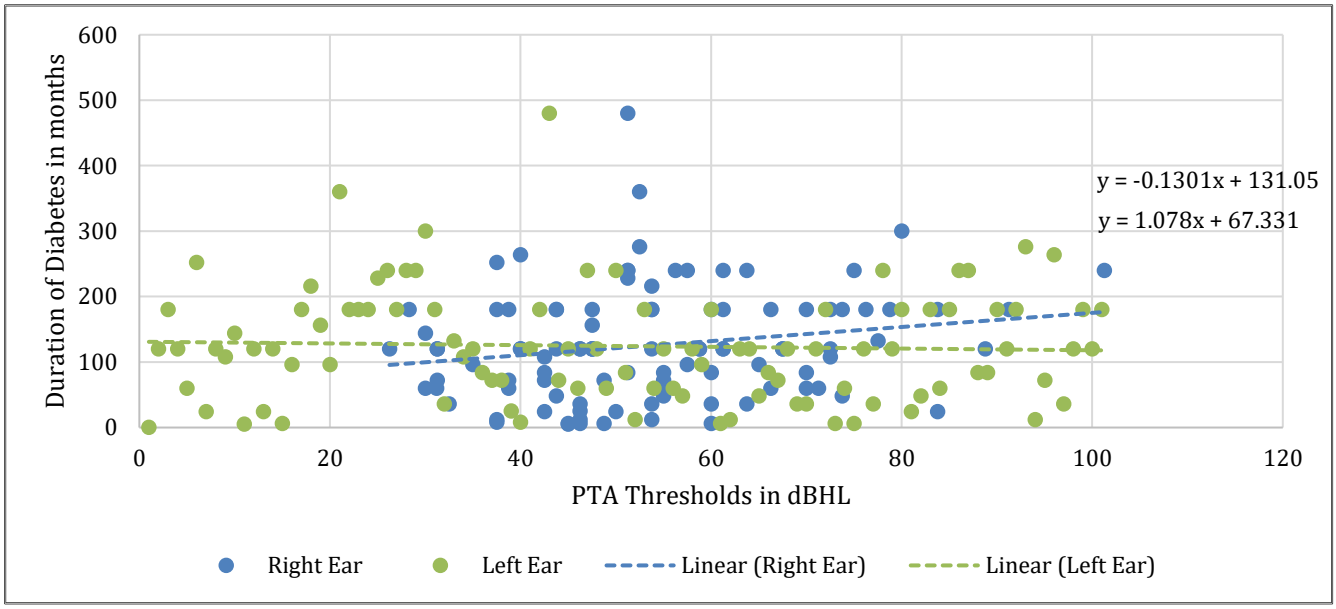

Figure 2: Scatter plot with trend line showing the correlation between diabetes duration and hearing loss severity in the right and left ears.

*with a correlation coefficient=0.193, p=0.054 on right side and a correlation coefficient r=0.064, p=0.526 on left side.

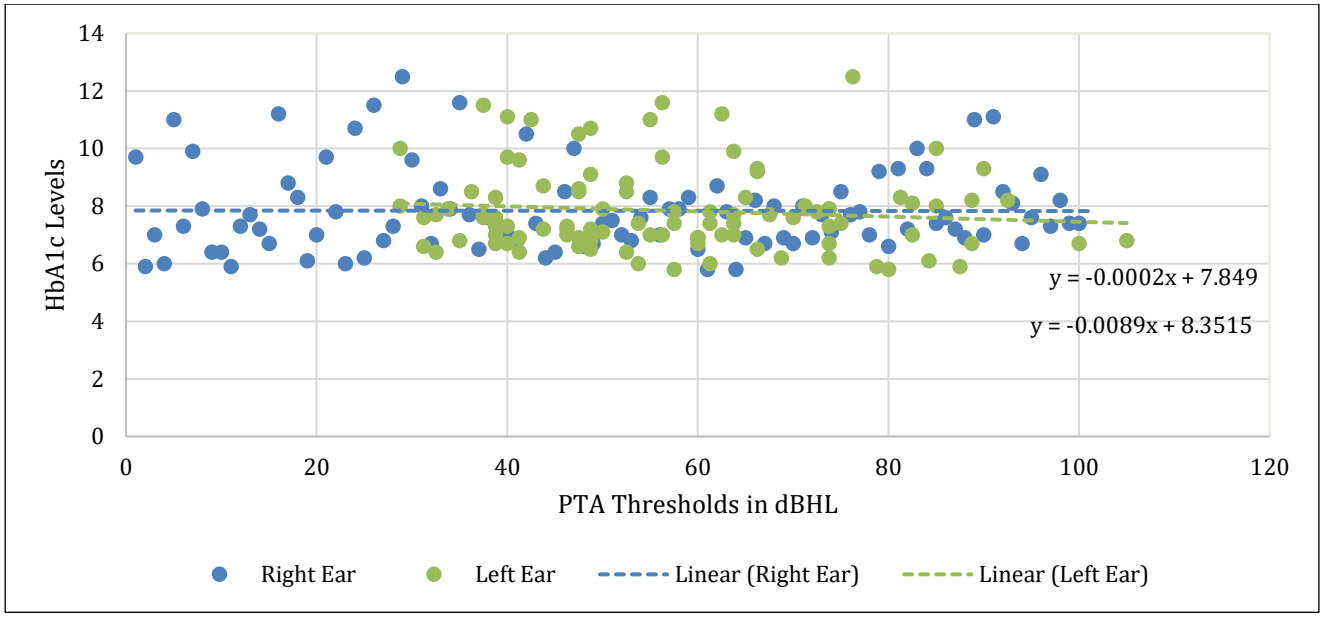

Figure 3: Scatter plot with trend line showing the correlation between HbA1c levels and hearing loss severity in the right and left ears.

*With a correlation coefficient r=0.0323, p=0.75 on right side and a correlation coefficient r=-0.108, p=0.285 on left side.

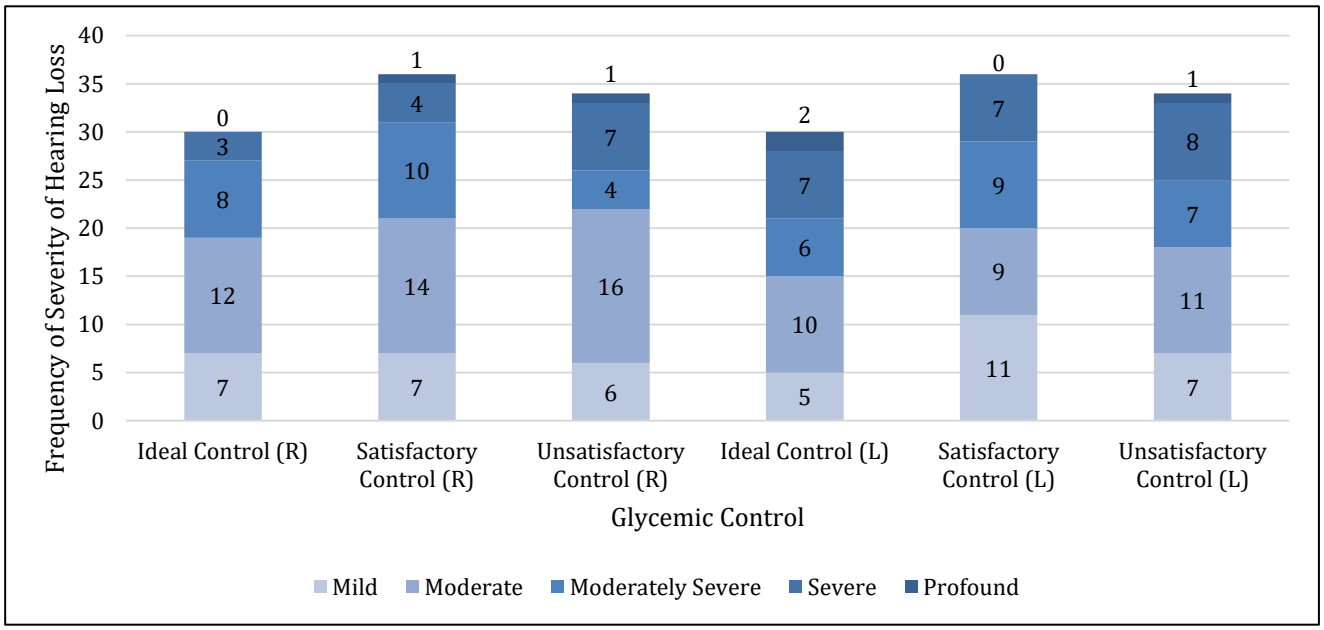

Figure 4: Grouped stacked bar chart of the distribution of hearing loss severity across glycemic control categories in each ear among diabetic patients.

DISCUSSION

This cross-sectional study assessed the type and severity of hearing loss among patients with type 2 DM and examined its association with glycemic control and duration of diabetes. The findings indicate a predominance of bilateral symmetrical SNHL, most commonly of moderate grade. No statistically significant association was found between the severity or type of hearing loss and either HbA1c levels or duration of diabetes.

Age and gender observations

The mean age of participants was 67.1 years, with the majority in the sixth decade of life. This aligns with findings by Rajamani et al and Tiwari et al who also reported increased incidence of SNHL in older individuals with diabetes.[7,8] A male predominance (58%) was observed, in agreement with Sachdeva et al and Meena et al.[6,9] This pattern may reflect differences in biological susceptibility, healthcare-seeking behavior, or occupational exposures between genders.

Pattern and severity of hearing loss

SNHL was the most common type of hearing loss, affecting 81% of right ears and 72% of left ears. These proportions are broadly consistent with observations by Dosemane et al (90.2%), Srinivas et al (66%), and Jyothi et al (67.44%).[10-12] Its bilateral and symmetrical pattern supports the hypothesis that diabetic microangiopathy and neuropathy may produce uniform cochlear involvement. In contrast to several studies (e. g., Singh et al and Jyothi et al) which reported higher proportions of mild hearing loss, our study group more frequently demonstrated moderate loss.[12,13] This may be attributable to the older mean age and longer average diabetes duration of our participants.

Glycemic control and diabetes duration

Although participants with HbA1c≥8% and those with diabetes duration>10 years appeared numerically more frequent among cases of moderate-to-severe SNHL, these differences were not statistically significant. Similar results were reported by Dosemane et al and Sharma et al while Mishra et al and Sachdeva et al demonstrated significant associations.[9,10,14,15] Variations across studies may be due to differences in sample size, demographic characteristics, or methods of audiometric assessment. Pathophysiologically, chronic hyperglycemia may compromise cochlear microvascular supply and auditory nerve function; however, such changes may not result in uniform measurable impairment across all diabetic populations.

Additional observations

Tinnitus was reported by 26% of participants, suggesting possible inner ear involvement. While tinnitus has been described in diabetic cohorts, data regarding its prevalence, and mechanisms remain limited and underexplored.

Strengths and limitations

A notable strength of this study is its conduct in a tertiary-care ENT clinic at the Southern Railway Headquarters Hospital, Chennai, ensuring access to a stable and outpatient diabetic population. Limitations include its single-center setting and modest sample size. Potential confounders such as hypertension, dyslipidemia were not specifically excluded or stratified. Additionally, the cross-sectional design prevents causal inference.

CONCLUSION

This study identified a predominance of bilateral SNHL, most often of moderate severity, among patients with type 2 DM. While clinical trends showed a higher proportion of hearing loss in those with longer diabetes duration and poor glycemic control, no statistically significant associations were found. These findings underscore the importance of integrating routine audiological screening into comprehensive diabetic care, to facilitate early detection. Future multi-centre longitudinal studies are warranted to clarify causal mechanisms and to develop targeted screening and preventive strategies.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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