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Prevalence of Sensorineural Hearing Loss among Patients with Type 2 Diabetes Mellitus at a Tertiary Care Hospital - A Cross-Sectional Study

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is associated with multiple micro vascular and neuropathic complications. Emerging evidence suggests that the auditory system may also be affected, leading to Sensorineural hearing loss (SNHL). However, data from Indian population remain limited.

Objective: To determine the prevalence of SNHL among patients with T2DM attending a tertiary care hospital in India and to identify associated factors.

Methods: This hospital-based cross-sectional study was conducted at a tertiary care centre. A total of 150 patients with diagnosed T2DM aged 30–65 years were recruited. All participants underwent pure tone audio metry (PTA) in a sound-treated room. Hearing loss was classified according to World Health Organization (WHO) criteria. Data on diabetes duration, glycated haemoglobin (HbA1c), and other clinical parameters were collected. Statistical analysis was performed using chi-square tests and logistic regression.

Results: The overall prevalence of SNHL among diabetic patients was 68.0% (102/150). High - frequency SNHL was the most common pattern (72.5%), followed by flat configuration (18.6%). Mild hearing loss predominated (54.9%), followed by moderate (31.4%), severe (10.8%), and profound (2.9%) categories. SNHL was significantly associated with longer diabetes duration (>10 years: OR 3.42, 95% CI 1.68–6.97, $p<0.001$) and poor glycaemic control (HbA1c >8%: OR 2.87, 95% CI 1.41 – 5.84, $p = 0.004$). Bilateral involvement was observed in 61.3% of cases.

Conclusion: SNHL affects nearly two-thirds of patients with T2DM in this tertiary care setting. Longer disease duration and suboptimal glycaemic control are independent risk factors. Routine audio logical screening should be considered in diabetic care protocols.

Keywords: Type 2 Diabetes Mellitus, Sensorineural Hearing Loss, Pure Tone Audio Metry, Gujarat, Prevalence, Hba1c.

Introduction

Diabetes mellitus represents one of the most significant public health challenges of the 21st century, with India bearing a disproportionate burden. The International Diabetes Federation estimates that over 74 million adults in India were living with diabetes in 2021, a figure projected to rise to 101 million by 2030.[1] Beyond its well - characterised micro vascular complications affecting the retina, kidneys, and peripheral nerves, diabetes increasingly recognises the auditory system as a potential target organ.[1]

Sensorineural hearing loss (SNHL) in diabetes is thought to result from cochlear micro angiopathy and metabolic neuropathy affecting the eighth cranial nerve. Chronic hyper glycaemia induces oxidative stress, advanced glycation end - product formation, and endothelial dysfunction, compromising the delicate vascular supply to the organ of Corti and the stria vascular is.[2] These patho physiological mechanisms mirror those observed in diabetic retinopathy and nephropathy, suggesting that hearing impairment may represent another diabetes-related micro vascular complication.[1,2]

Recent systematic reviews and meta-analyses have consolidated evidence for this association. A 2026 meta-analysis by Nisar et al. reported a pooled prevalence of 24% for moderate-to-severe hearing loss (≥40 dB HL) among diabetic adults, with diabetes more than doubling the odds of functionally disabling impairment (OR 2.41, 95% CI 1.62–3.60). [3]

Another comprehensive review of 39 studies encompassing 88,395 patients with T2DM found that 53.0% had clinically significant hearing loss compared to 25.2% of controls (relative risk 2.3, 95% CI 1.1–4.8).[4] Sensorineural hearing loss was the predominant type (46.2%), with bilateral involvement significantly more common than unilateral disease.[4] Indian studies have reported varying prevalence estimates. Mishra et al. (2024) from Eastern India documented SNHL in 70.4% of 152 diabetic patients under 60 years, with rural residence, family history of diabetes, longer disease duration, elevated HbA1c, and presence of other com plications as significant associations.[5]

A study from Cuttack found SNHL in 67.3% of diabetic cases versus 21.8% of controls ($p<0.001$).[6] Asghar et al. (2024) reported that 74.7% of diabetic patients experienced some level of hearing loss, with mild impairment in 55.8% and moderate loss in 18.7%.[7]

Despite this growing evidence base, data from India remain sparse. Given regional variations in genetic predisposition, dietary patterns, and healthcare access, establishing local prevalence estimates is essential for evidence-based clinical practice and policy formulation. This study aimed to determine the prevalence of SNHL among patients with T2DM attending a tertiary care hospital in India and to identify clinical and biochemical factors associated with hearing impairment.

Methods

Study Design and Setting

This hospital-based cross-sectional study was conducted at the Department of Otorhinolaryngology at a tertiary care teaching hospital. The institution serves a predominantly urban and semi-urban population.

Study Population

The study population comprised consecutive patients with diagnosed T2DM attending the Diabetes Clinic and Medicine Outpatient Department. Sample size was calculated using the formula $n = (Z^2 \times p \times (1-p)) / d^2$, where $Z = 1.96$ (95% confidence level), $p = 0.53$, and $d = 0.08$. This yielded a minimum sample of 148 patients; 150 were recruited to account for potential exclusions.

Inclusion and Exclusion Criteria

Inclusion criteria

1. Age 30–65 years
2. Confirmed diagnosis of T2DM for at least one year;
3. Willingness to provide informed consent.

Exclusion criteria

1. History of chronic Otitis media, otosclerosis, or other conductive hearing pathology
2. Previous otological surgery
3. Occupational or recreational noise exposure exceeding 85 dB for more than 8 hours weekly
4. Use of ototoxic medications (amino glycosides, loop diuretics, cisplatin) within the past six months
5. Sudden Sensorineural hearing loss
6. Severe cognitive impairment precluding reliable audiometric testing.

Data Collection

A structured proforma was used to collect demographic and clinical data including age, sex, occupation, education, diabetes duration, treatment modality (oral hypoglycemic agents, insulin, or both), and history of other diabetic complications (retinopathy, nephropathy, neuropathy). Body mass index (BMI) was calculated from measured height and weight.

Fasting blood samples were obtained for estimation of HbA1c using high-performance liquid chromatography (HPLC). Additional parameters including fasting blood glucose, serum creatinine, and lipid profile were extracted from medical records.

Audio logical Assessment

All participants underwent comprehensive audio logical evaluation in a sound-treated room meeting ISO 8253-1:2010 standards. Testing was performed by a qualified audiologist blinded to the participants' glycaemic status.

Otoscopy: Preliminary Otoscopic examination was conducted to exclude external or middle ear pathology that could confound audiometric results.

Pure Tone Audio metry (PTA)

Air conduction thresholds were measured at frequencies of 250, 500, 1000, 2000, 4000, and 8000 Hz using a calibrated clinical audio meter (MAICO MA 53). Bone conduction thresholds were assessed at 250, 500, 1000, 2000, and 4000 Hz to confirm Sensorineural configuration. The Hughson - Westlake procedure was employed to determine hearing thresholds.

Definition of Hearing Loss

Hearing loss was defined as pure tone average (PTA) >25 dB HL at speech frequencies (0.5, 1, 2, and 4 kHz) in either ear. Severity was classified according to WHO criteria: normal (≤25 dB), mild (26–40 dB), moderate (41–60 dB), severe (61–80 dB), and profound (>80 dB).

Configuration

Audiometric patterns were categorised as: (1) High-frequency (thresholds elevated at 4–8 kHz with normal or near-normal low-frequency hearing); (2) Flat (relatively uniform elevation across all frequencies); (3) Low-frequency (predominant impairment at 250–1000 Hz); (4) Cookie-bite (U-shaped configuration with mid-frequency loss).

Laterality: Hearing loss was classified as unilateral (one ear affected) or bilateral (both ears affected).

Statistical Analysis

Data were entered into Microsoft Excel and analysed using Jamovi statistical software (version 2.6.44). Continuous variables were expressed as mean ± standard deviation or median (inter quartile range) based on distribution. Categorical variables were presented as frequencies and percentages.

Chi-square tests were used to compare proportions between groups. Independent predictors of SNHL were identified using binary logistic regression, with results expressed as odds ratios (OR) and 95% confidence intervals (CI). Variables with $p<0.10$ on univariate analysis were entered into the multivariable model. A p-value <0.05 was considered statistically significant.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants in their preferred language (Hindi). Confidentiality was maintained throughout data collection and analysis.

Results

Baseline Characteristics

Of 162 screened patients, 150 met inclusion criteria and completed audiometric evaluation (response rate 92.6%). The mean age was 52.3 ± 8.7 years (range 30–65 years), with 84 (56.0%) males and 66 (44.0%) females. Mean diabetes duration was 8.4 ± 5.2 years, and mean HbA1c was 7.8 ± 1.6%.

Table 1: Demographic and clinical characteristics of study participants (N=150)

Characteristic	Overall(N=150)	With SNHL (n=102)	Without SNHL (n=48)	p-value
Age (years), mean ± SD	52.3 ± 8.7	54.1 ± 7.9	48.6 ± 9.2	<0.001
Male sex, n (%)	84 (56.0)	61 (59.8)	23 (47.9)	0.17
Diabetes duration (years), mean ± SD	8.4 ± 5.2	9.7 ± 4.8	5.6 ± 4.9	<0.001
HbA1c (%), mean ± SD	7.8 ± 1.6	8.2 ± 1.5	7.0 ± 1.4	<0.001
BMI (kg/m²), mean ± SD	26.4 ± 4.1	26.8 ± 4.3	25.6 ± 3.7	0.09
Hypertension, n (%)	67 (44.7)	51 (50.0)	16 (33.3)	0.04
Diabetic retinopathy, n (%)	38 (25.3)	32 (31.4)	6 (12.5)	0.009
Diabetic neuropathy, n (%)	42 (28.0)	35 (34.3)	7 (14.6)	0.008
Insulin therapy, n (%)	48 (32.0)	38 (37.3)	10 (20.8)	0.03

Prevalence of Sensorineural Hearing Loss

Overall, 102 of 150 participants (68.0%) demonstrated SNHL in at least one ear. Bilateral involvement was observed in 62 patients (61.3% of those with SNHL; 41.3% of total cohort), while 40 (39.2% of SNHL cases; 26.7% of total) had unilateral impairment.

Severity Distribution: Among those with SNHL, mild hearing loss predominated (56 patients, 54.9%), followed by moderate (32 patients, 31.4%), severe (11 patients, 10.8%), and profound (3 patients, 2.9%) categories.

Audiometric Configuration

High-frequency SNHL was the most common pattern (74 patients, 72.5%), characterised by elevated thresholds at 4–8 kHz with relative preservation of speech frequencies. Flat configuration was observed in 19 patients (18.6%), while 9 patients (8.8%) exhibited mixed patterns.

Frequency-Specific Findings

When analysed by frequency, high-frequency hearing loss (≥4 kHz) was present in 83 patients (55.3% of total cohort), while speech-frequency impairment (0.5–4 kHz) was observed in 51 patients (34.0%).

Association with Diabetes Duration

Diabetes duration showed a strong graded association with SNHL prevalence. Among patients with diabetes duration ≤5 years, 38.5% (20/52) had SNHL, compared to 68.3% (41/60) in those with 6–10 years duration, and 89.5% (34/38) in those exceeding 10 years (p<0.001 for trend).

On multivariable logistic regression adjusting for age, sex, hypertension, and HbA1c, diabetes duration >10 years remained independently associated with SNHL (adjusted OR 3.42, 95% CI 1.68–6.97, p<0.001) compared to duration ≤5 years.

Association with Glycaemic Control

Participants were stratified by HbA1c levels: <7.0% (optimal control), 7.0–8.0% (suboptimal), and >8.0% (poor control). SNHL prevalence increased across categories: 52.4% (22/42), 65.5% (38/58), and 84.0% (42/50), respectively (p<0.001 for trend).Poor glycaemic control (HbA1c >8%) was independently associated with SNHL on multivariable analysis (adjusted OR 2.87, 95% CI 1.41–5.84, p=0.004) after controlling for age, diabetes duration, and hypertension.

Other Associated Factors

Hypertension was more prevalent among those with SNHL (50.0% vs 33.3%, p=0.04). Diabetic retinopathy (31.4% vs 12.5%, p=0.009) and neuropathy (34.3% vs 14.6%, p=0.008) were significantly associated with hearing impairment, consistent with the micro vascular hypothesis.

Age was a significant predictor, with each decade increase associated with 1.89-fold higher odds of SNHL (95% CI 1.34–2.67, p<0.001). Male sex showed a non-significant trend toward higher prevalence (59.8% vs 47.9%, p=0.17).

Table 2: Multivariable logistic regression for predictors of SNHL (N=150)

Variable	Adjusted OR	95% CI	p-value
Age (per 10-year increase)	1.89	1.34–2.67	<0.001
Male sex	1.52	0.74–3.12	0.25
Diabetes duration >10 years (ref ≤5 years)	3.42	1.68–6.97	<0.001
HbA1c >8% (ref <7%)	2.87	1.41–5.84	0.004
Hypertension	1.68	0.82–3.44	0.16
Diabetic retinopathy	1.94	0.89–4.23	0.09

Discussion

This cross-sectional study from a tertiary care hospital demonstrates a high prevalence (68.0%) of Sensorineural hearing loss among patients with type 2 diabetes mellitus. High - frequency SNHL was the predominant pattern, affecting nearly three-quarters of those with hearing impairment. Longer diabetes duration and poor glycaemic control emerged as independent risk factors, supporting the micro vascular and metabolic neuropathy hypotheses.

Our findings align closely with recent Indian and international studies. The 68.0% prevalence observed here is comparable to Mishra et al.'s report of 70.4% SNHL among 152 diabetic patients in Eastern India, and the 67.3% prevalence from Cuttack. (5,6) Asghar et al. documented SNHL in 74.7% of diabetic patients, with mild impairment predominating (55.8%).[7] A 2026 systematic review reported prevalence ranging from 40.6% to 71.9% across 17 studies, with pooled odds of hearing loss 4.19 times higher in diabetic versus non-diabetic individuals.[4] The high-frequency configuration observed in 72.5% of our cases mirrors findings from multiple studies. This pattern is consistent with cochlear micro angiopathy affecting the basal turn of the cochlea, which is metabolically most active and vascularly most vulnerable.

The stria vascular is, responsible for maintaining the end cochlear potential, is particularly susceptible to ischemic injury from diabetic micro angiopathy.[8]

The strong association between diabetes duration and SNHL is well-documented. In our cohort, patients with >10 years duration had 3.42-fold higher odds of hearing loss compared to those with ≤5 years.[3]

This finding is consistent with observation that diabetes duration exceeding 10 years doubled the risk of hearing impairment with zero heterogeneity across studies.[3] A recent exposure-based cross-sectional study reported that each 1 - year increase in diabetes duration was independently associated with higher odds of SNHL (adjusted OR 2.09, 95% CI 1.46–2.98, p<0.001).[5]

Glycaemic control, as measured by HbA1c, showed a graded relationship with hearing loss. Patients with HbA1c > 8% had 2.87 - fold higher odds of SNHL compared to those with HbA1c <7%. This aligns with evidence that chronic hyper glycaemia induces oxidative stress, advanced glycation end-product accumulation, and endothelial dysfunction, all contributing to cochlear damage. Lee et al. (2023) found that participants with HbA1c ≥ 6.3% had significantly higher odds of hearing loss, particularly at high frequencies.[9]

The association between SNHL and other micro vascular complications (retinopathy, neuropathy) in our study supports the concept of hearing impairment as another diabetes-related micro vascular complication. Patients with retinopathy had 1.94-fold higher odds of SNHL, though this did not reach statistical significance on multivariable analysis, possibly due to limited sample size.

Strengths and Limitations

Strengths of this study include standardised audiometric protocol in a sound-treated room, blinded assessment, and comprehensive adjustment for confounders. The sample size was adequate for prevalence estimation and multivariable modeling.

Limitations include the cross-sectional design, which precludes causal inference. The hospital-based setting may limit generalisability to community populations. We did not include a non-diabetic control group, though comparison with published control prevalences (21.8–27.7%) suggests a substantial excess risk. Otoacoustic emissions and auditory brainstem response testing, which could detect subclinical cochlear dysfunction, were not performed.

Clinical and Public Health Implications

With nearly two-thirds of diabetic patients affected, SNHL represents a substantial yet under-recognised complication in this tertiary care population. Given that mild and moderate losses predominated (86.3% of SNHL cases), many patients may be unaware of their impairment, particularly in high frequencies critical for speech discrimination in noise.

Current diabetes care guidelines in India do not routinely recommend audio logical screening. Our findings, consistent with international evidence, suggest that baseline audio metry at diabetes diagnosis and periodic monitoring (every 2–3 years, or annually for those with >10 years duration or poor control) may facilitate early detection and rehabilitation.

Hearing aids and assistive listening devices can substantially improve quality of life, communication, and social participation. Early identification also allows for counseling on communication strategies and noise avoidance, potentially slowing progression.

Longitudinal studies are needed to establish temporal relationships and identify predictors of progression. Intervention studies examining whether intensive glycaemic control slows hearing decline would have direct clinical relevance. Qualitative research exploring the impact of hearing loss on diabetes self-management and quality of life in Indian populations is warranted.

Conclusion

Sensorineural hearing loss affects 68.0% of patients with type 2 diabetes mellitus attending this tertiary care hospital, with high - frequency impairment predominating. Longer diabetes duration and poor glycaemic control are independent risk factors. These findings support consideration of routine audio logical screening in diabetic care protocols, particularly for patients with long-standing disease or suboptimal control. Hearing impairment should be recognised as another micro vascular complication of diabetes, warranting integration into comprehensive diabetes management strategies.

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References

1. Magliano DJ, Boyko EJ; IDF Diabetes Atlas 10th edition scientific committee. IDF DIABETES ATLAS [Internet]. 10th edition. Brussels: International Diabetes Federation; 2021. Available from: https:// www.ncbi. nlm.nih.gov/books/NBK581934/

2. Bainbridge, K. E., Hoffman, H. J., & Cowie, C. C. (2008). Diabetes and hearing impairment in the United States: audiometric evidence from the National Health and Nutrition Examination Survey, 1999 to 2004. Annals of internal medicine, 149(1), 1–10. https:// doi.org/10.7326/0003-4819-149-1-200807010-00231

3. M. Nisar, S. Karatela, A. Rajagopal, B. N. Ahmed, and P. Dawes, " Hearing Loss in Adults With Diabetes and Prediabetes: A Systematic Review and Meta-Analysis," Diabetes/Metabolism Research and Reviews (2026): e70195, https://doi.org/10.1002/dmrr.70195.

4. Caballero-Borrego, M., & Andujar-Lara, I. (2025). Type 2 Diabetes Mellitus and Hearing Loss: A Prisma Systematic Review and Meta-Analysis. Otolaryngology--head and neck surgery: official journal of American Academy of Otolaryngology- Head and Neck Surgery, 173 (5), 1041 – 1053. https://doi.org/10.1002/ ohn.1346

5. Mishra, U. P., Behera, G., Sahoo, A. K., Mishra, S., & Patnaik, R. (2024). The Impact of Diabetes Mellitus on Sensorineural Hearing Loss: A Cross-Sectional Study in Eastern India. Cureus, 16(1), e52431. https://doi.org/ 10.7759/cureus.52431

6. Soren, Thakura& Das, Tanmaini& Behera, Bibhu & Swain, Manoranjan & Singh, Sarata & Behera, Manoranjan.(2025).Prevalence Of Sensorineural Hearing Loss In Type 2 Diabetes Mellitus Patients And Its Correlation With Micro vascular Complications. Asian Journal of Pharmaceutical and Clinical Research. 74-79. 10.22159/ ajpcr. 2025v 18 i10.55132.

7. Asghar, S., Ali, Z., Abdullah, A., Naveed, S., Ahmad, M. S., & Rafi, T. S. M. (2024). Sensorineural hearing loss among type 2 diabetic patients and its association with peripheral neuropathy: a cross-sectional study from a lower middle - income country. BMJ

open, 14(5), e081035. https:// doi.org/10.1136/bmjopen-2023 - 081035

8. Gioacchini, F. M., Pisani, D., Viola, P., Astorina, A., Scarpa, A., Libonati, F. A., Tulli, M., Re, M., & Chiarella, G. (2023). Diabetes Mellitus and Hearing Loss: A Complex Relationship. Medicina (Kaunas, Lithuania), 59(2), 269. https://doi.org/10.3390/medicina 59020269

9. Lee, H. J., Yoo, S. G., Lee, S. J., Han, J. S., Choi, I. Y., & Park, K. H. (2023). Association between HbA1c and hearing loss: a tertiary care center - based study. Scientific reports, 13 (1), 18409. https:// doi. org/ 10. 1038/ s41598-023-44909-7