Section: ENT

Original Research Article

PREVALENCE AND PATTERN OF HEARING LOSS IN ASYMPTOMATIC PATIENTS WITH TYPE 2 DIABETES MELLITUS - A CASE CONTROL STUDY

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ABSTRACT

Background: A prevalent metabolic disease, diabetes mellitus is linked to a number of microvascular and neuropathic consequences. Particularly vulnerable to microangiopathic alterations that could cause hearing loss is the cochlea. Asymptomatic diabetic patients may have subclinical auditory impairment since hearing loss frequently goes undetected in its early stages. The present study aimed to evaluate the prevalence and pattern of hearing loss among asymptomatic patients with Type 2 Diabetes Mellitus and compare the audiological profile with non-diabetic controls. In addition, the study sought to establish a link between hearing impairment and age, duration of diabetes, glycaemic control (HbA1c), and serum creatinine levels.

Materials and Methods: Our study was conducted in the Department of Otorhinolaryngology at Sri Lalithambigai Medical College and Hospital. The study included Type 2 Diabetic adults in the age group 20-60 years with no subjective hearing complaints and an age- and sex-matched group of healthy non-diabetic controls. Demographic details, duration of diabetes, HbA1c values, and serum creatinine levels were recorded using a structured proforma. Otoscopic examination and Pure tone audiometry was done to all participants in a sound-treated environment. Hearing thresholds were analysed and compared between the two groups. Statistical analysis was performed using SPSS, with a p-value of <0.05 considered statistically significant.

Results: The mean PTA was higher among diabetic patients (32.18 dB) compared to controls (20.38 dB). Hearing loss was observed in 72% of diabetic patients and 16% of controls ($p < 0.001$). Sensorineural hearing loss was the most common type of hearing impairment among diabetic patients. Mild hearing loss was the predominant severity category. PTA demonstrated significant positive correlations with age, duration of diabetes, HbA1c levels, and serum creatinine levels ($p < 0.001$). HbA1c showed the strongest association with hearing threshold elevation.

Conclusion: Hearing loss is significantly prevalent among asymptomatic patients with Type 2 Diabetes Mellitus than among non-diabetic controls. Poor glycemic control, longer duration of diabetes, increasing age, and higher serum creatinine levels are associated with worsening hearing thresholds. Routine audiological screening may facilitate early detection of subclinical hearing impairment in diabetic patients.

Keywords: Diabetes Mellitus; Hearing Loss; Sensorineural Hearing Loss; Pure Tone Audiometry; HbA1c; Asymptomatic Diabetic Patients.

INTRODUCTION

Diabetes mellitus (DM) is a serious worldwide health issue that has a high morbidity and death rate. The retina, kidneys, peripheral nerves, and possibly the auditory system are among the organ systems affected by microvascular and neuropathic problems brought on by chronic hyperglycemia. The effects of diabetes on hearing are still poorly understood, despite the fact that diabetic retinopathy, nephropathy, and neuropathy are well-known side effects.

Due to the high metabolic demand and delicate microvascular supply, the cochlea is vulnerable to the long-term effects of chronic hyperglycemia, which may lead to both structural and functional auditory impairment. According to multiple studies, sensorineural hearing loss is the most often documented form of hearing loss associated with diabetes mellitus.

The fact that hearing impairment in diabetic individuals frequently develops subtly and may not show any symptoms in the early stages is a serious worry. As a result, even though there are no auditory symptoms, a sizable percentage of diabetics may have subclinical hearing loss. Early detection of these patients may enable prompt intervention and enhance quality of life.

Studies explicitly concentrating on asymptomatic diabetic individuals are still scarce, especially in the Indian community, despite mounting evidence associating diabetes to hearing impairment. Additionally, more research is needed to determine how hearing loss relates to renal function, glycaemic management, and the length of diabetes.

In order to compare the results with non-diabetic controls, the current study was conducted to ascertain the prevalence and pattern of hearing loss among asymptomatic individuals with Type 2 Diabetes Mellitus. The study also attempted to assess the connection of hearing loss with age, duration of diabetes, HbA1c levels, and serum creatinine levels.

MATERIALS AND METHODS

Study Design and Setting: A case-control study was conducted in the Department of Otorhinolaryngology at Sri Lalithambigai Medical College and Hospital, Chennai. The study was conducted out over a period of 1 year from January 2025 to January 2026 after gaining approval from the Institutional Ethics Committee.

Study Population: The study included 200 participants comprising 100 patients with Type 2 Diabetes Mellitus (cases) and 100 age- and sex-matched non-diabetic individuals (controls).

Inclusion Criteria

Cases:

1. Patients with Type 2 Diabetes Mellitus of age 20-60 years
2. Patients should be asymptomatic in terms of hearing complaints.
3. Normal otoscopic findings
4. willingness to participate and provide informed consent.

Controls:

1. Age- and sex-matched non-diabetic individuals.
2. individuals without hearing complaints.
3. Individuals willing to provide informed consent.

Exclusion Criteria

1. History of chronic otitis media or other middle ear pathology.
2. Previous ear surgery.
3. History of significant occupational or recreational noise exposure.
4. Use of known ototoxic medications.
5. Congenital hearing loss.
6. History of head injury affecting hearing.
7. Unwillingness to participate in the study.

Data Collection: After obtaining informed written consent, demographic and clinical details were recorded using a structured proforma. The collected data included age, sex, duration of diabetes mellitus, treatment history, glycated hemoglobin (HbA1c) levels, and serum creatinine levels.

Audiological Evaluation: All participants underwent a detailed otoscopic examination followed by pure tone audiometry (PTA) in a sound-treated room using a calibrated audiometer. Air conduction and bone conduction thresholds were assessed at standard frequencies. The pure tone average (PTA) was calculated using thresholds obtained at 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz. The average hearing threshold of both ears was used for analysis.

Hearing loss was classified according to severity as:

Normal hearing	Less than 25 Db
Mild hearing loss	26 to 40 dB
Moderate hearing loss	41 to 55 dB
Moderately severe hearing loss	56 to 70 dB
Severe hearing loss	71 to 90 dB
Profound hearing loss	More than 90 dB

Based on audiometric findings, hearing loss was categorized as sensorineural, conductive, or mixed hearing loss.

Outcome Measures

The primary outcome measure was the prevalence of hearing loss among asymptomatic patients with Type 2 Diabetes Mellitus.

Secondary outcome measures included:

* Pattern and severity of hearing loss.
* Comparison of hearing thresholds between diabetic patients and controls.
* Association of hearing thresholds with age, duration of diabetes, HbA1c levels, and serum creatinine levels.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.

RESULTS

Table 1: Demographic and Clinical Characteristics of the Study Participants

	Cases (n=100)	Controls (n=100)	Test statistic	p-value
Age (years), Mean ± SD	46.09 ± 8.59	43.20 ± 10.73	t = 2.10	0.037*
Male, n (%)	53 (53.0)	61 (61.0)	$\chi^2 = 1.00$	0.317
Female, n (%)	47 (47.0)	39 (39.0)		
Duration of diabetes (years), Mean ± SD	8.78 ± 4.71	NA	—	—
HbA1c (%), Mean ± SD	7.29 ± 1.10	NA	—	—
Serum creatinine (mg/dL), Mean ± SD	1.14 ± 0.24	1.02 ± 0.16	t = 4.02	<0.001*

Values are expressed as Mean ± SD or Number (%). Independent Student's t-test was used for continuous variables and Chi-square test for categorical variables.

*p < 0.05 was considered statistically significant

The mean age of the diabetic group was significantly higher than that of the control group (46.09 ± 8.59 vs 43.20 ± 10.73 years, p = 0.037). Serum creatinine levels were higher among diabetic patients (p < 0.001).

Table 2: Audiological Findings Between Cases and Controls

	Cases (n=100)	Controls (n=100)	Test statistic	p-value
Mean PTA (dB), Mean ± SD	32.18 ± 10.99	20.38 ± 6.04	t = 9.41	<0.001*
Hearing loss present, n (%)	72 (72.0)	16 (15.0)	$\chi^2 = 61.38$	<0.001*
Normal hearing, n (%)	28 (28.0)	84 (84.0)		

PTA = Pure Tone Average. *p < 0.05 was considered statistically significant.

The mean PTA was significantly higher among diabetic patients than among controls (32.18 ± 10.99 vs 20.38 ± 6.04 dB, p < 0.001). Hearing loss was identified in 72% of diabetic patients compared with 16% of controls (p < 0.001).

Table 3: Distribution of Types of Hearing Loss

Type of Hearing Loss	Cases n (%)	Controls n (%)	χ^2	p-value
Normal	27 (27.0)	85 (85.0)		
Sensorineural	31 (31.0)	8 (8.0)		
Conductive	17 (17.0)	6 (6.0)		
Mixed	25 (25.0)	1 (1.0)	$\chi^2 = 70.16$	<0.001*

*p < 0.05 was considered statistically significant.

Sensorineural hearing loss was observed among diabetic patients (31%), followed by mixed (25%) and conductive hearing loss (17%). In contrast, the majority of controls had normal hearing (85%), and the distribution of hearing loss types differed significantly between the groups (p < 0.001).

Table 4: Severity of Hearing Loss Among Diabetic Patients

Severity	Number	Percentage
Normal	28	28.0
Mild	46	46.0
Moderate	22	22.0
Moderately Severe	3	3.0
Severe	1	1.0
Profound	0	0.0

Table 5: Correlation of Pure Tone Average with Clinical Variables in Diabetic Patients

Variable	Pearson's r	p-value
Age	0.575	<0.001*
Duration of diabetes	0.517	<0.001*
HbA1c	0.652	<0.001*
Serum creatinine	0.512	<0.001*

Pearson correlation analysis was performed. *p < 0.05 was considered statistically significant.

Pure tone average showed significant positive correlations with age (r = 0.575), duration of

diabetes (r = 0.517), HbA1c levels (r = 0.652), and serum creatinine levels (r = 0.512),indicating that worsening glycemic control and longer disease duration were associated with poorer hearing thresholds.

DISCUSSION

The current hospital-based case-control study compared the results with age- and sex-matched non-diabetic controls in order to assess the prevalence and pattern of hearing loss in asymptomatic patients with Type 2 Diabetes Mellitus. Despite the lack of subjective auditory problems, diabetes individuals had a much higher rate of hearing loss than controls. Furthermore, the mean pure tone average (PTA) thresholds of diabetes patients were considerably higher, indicating a lower level of hearing sensitivity. These results imply that people with Type 2 Diabetes Mellitus frequently experience subclinical auditory impairment, which may go undiagnosed unless a routine audiological evaluation is carried out.

This current study found that 72% of diabetic patients had hearing loss, which is similar to the results published by Mishra et al,[1] who found that 70.4% of patients with Type 2 Diabetes Mellitus had hearing loss. Similarly, Shafiepour et al.[2] highlighted diabetes as a significant risk factor for auditory dysfunction and reported a high prevalence of hearing impairment among diabetics. Similar findings have also been found by Bainbridge et al4. and Horikawa et al10 whose research showed that those with diabetes had a markedly higher risk of hearing impairment than the general population. The evidence for a link between diabetes mellitus and hearing loss is strengthened by the data' consistency across various populations.

The most common form of hearing impairment in the current study was sensorineural hearing loss, which was followed by conductive and mixed hearing loss. This finding is in line with other research by Mishra et al1., Kakarlapudiet al6, and Frisina et al7, which found that sensorineural hearing loss was the most common audiological impairment in patients with diabetes. Numerous pathological processes linked to diabetes, such as microvascular compromise of the cochlear circulation, degeneration of sensory hair cells, neural involvement of the auditory pathway, and oxidative stress-mediated tissue injury, are probably responsible for the predominance of sensorineural hearing loss seen in this study. Fukushima et al.5s histopathological research revealed structural changes in the cochlea in diabetic patients, confirming the theory that long-term hyperglycemia negatively impacts the auditory system's neuronal and vascular components.

Significant positive relationships between hearing thresholds and age, the length of diabetes, HbA1c levels, and serum creatinine levels were also shown in this investigation. Although ageing has long been known to be an independent factor in hearing impairment, the higher deterioration seen in people with diabetes raises the possibility that diabetes may hasten age-related cochlear degeneration. Additionally, long-term exposure to chronic hyperglycemia may cause gradual cochlear damage, as seen by the positive correlation between the length of diabetes and hearing thresholds. Mishra et al1. and Vaughan et al8. have obtained similar results, who found that hearing thresholds deteriorated as diabetes duration increased. The significance of maintaining good glycaemic control to lower the risk of diabetes-related auditory problems is reinforced by similar relationships between elevated HbA1c levels and hearing impairment reported by Mishra et al.[1] and Akinpelu et al.[11] in their systematic review.

The current investigation also found a favourable correlation between hearing thresholds and serum creatinine levels. Patients with comparatively greater creatinine levels had worse hearing thresholds, even though serum creatinine values stayed mostly within the normal range. Given that renal and cochlear tissues have similar vascular architecture and are vulnerable to diabetes-related endothelial damage, the observed connection may be explained by common microvascular changes affecting both tissues. Thus, early renal dysfunction and cochlear damage may be caused concurrently by diabetic microangiopathy. The current findings imply that serum creatinine may function as an additional clinical predictor of the risk of auditory impairment in individuals with diabetes, even if the association between renal function and hearing loss has not been consistently shown across all investigations.

The current finding has significant clinical implications. Although a significant percentage of the diabetes patients in this study showed detectable hearing damage on pure tone audiometry, surprisingly had no subjective hearing complaints. This implies that relying primarily on symptoms may delay the diagnosis of hearing impairment. These results encourage the regular clinical follow-up of patients with Type 2 Diabetes Mellitus to include periodic hearing evaluation, especially for those with long-term disease or poor glycaemic management.

The strengths of the study would be inclusion of age- and sex-matched controls, objective audiometric evaluation of each participant, and assessment of clinical factors linked to hearing loss. However, the results may not be as broadly applicable as the study was only carried out at one tertiary care facility. Also, it is a cross-sectional study, hence a causal link between diabetes and hearing loss cannot be established. Moreover, no other objective audiological tests were carried out, such as auditory brainstem responses or otoacoustic emissions.

CONCLUSION

This study demonstrated that asymptomatic patients with Type 2 Diabetes Mellitus had a significantly higher prevalence of hearing loss than non-diabetic controls, with sensorineural hearing loss being the predominant pattern. significant associations was observed with age, longer duration of diabetes, poor glycaemic control, and elevated serum creatinine levels, indicating that these could be contributory factors for auditory dysfunction. The findings highlight the importance of considering hearing assessment as part of the comprehensive evaluation of individuals with Type 2 Diabetes Mellitus, particularly those at higher risk thereby improving long-term communication and quality of life.

REFERENCES

1. Mishra UP, Behera G, Sahoo AK, Mishra S, Patnaik R. The impact of diabetes mellitus on sensorineural hearing loss: A cross-sectional study in Eastern India. Cureus. 2024;16(1):e52431. doi:10.7759/cureus.52431.
2. Shafiepour M, Bamdad Z, Radman M. Prevalence of hearing loss among patients with type 2 diabetes. J Med Life. 2022;15(6):772-777. doi:10.25122/jml-2021-0300.
3. Samocha-Bonet D, Wu B, Ryugo DK. Diabetes mellitus and hearing loss: A review. Ageing Res Rev. 2021;71:101423. doi:10.1016/j.arr.2021.101423.
4. Bainbridge KE, Hoffman HJ, Cowie CC. Diabetes and hearing impairment in the United States: Audiometric evidence from the National Health and Nutrition Examination Survey, 1999-2004. Ann Intern Med. 2008;149(1):1-10.
5. Fukushima H, Cureoglu S, Schachern PA, Paparella MM, Harada T, Oktay MF. Effects of type 2 diabetes mellitus on cochlear structure in humans. Arch Otolaryngol Head Neck Surg. 2006;132(9):934-938.
6. Kakarlapudi V, Sawyer R, Staecker H. The effect of diabetes on sensorineural hearing loss. Otol Neurotol. 2003;24(3):382-386.
7. Frisina ST, Mapes F, Kim S, Frisina DR, Frisina RD. Characterization of hearing loss in aged type II diabetics. Hear Res. 2006;211(1-2):103-113.
8. Vaughan N, James K, McDermott D, Griest S, Fausti S. A 5-year prospective study of diabetes and hearing loss in a veteran population. Otol Neurotol. 2006;27(1):37-43.
9. Dalton DS, Cruickshanks KJ, Klein R, Klein BEK, Wiley TL. Association of NIDDM and hearing loss. Diabetes Care. 1998;21(9):1540-1544.
10. Horikawa C, Kodama S, Tanaka S, Fujihara K, Hirasawa R, Yachi Y, et al. Diabetes and risk of hearing impairment in adults: A meta-analysis. J Clin Endocrinol Metab. 2013;98(1):51-58. doi:10.1210/jc.2012-2119.
11. Akinpelu OV, Mujica-Mota M, Daniel SJ. Is type 2 diabetes mellitus associated with alterations in hearing? A systematic review and meta-analysis. Laryngoscope. 2014;124(3):767-776. doi:10.1002/lary.24354.
12. Cheng YJ, Gregg EW, Saaddine JB, Imperatore G, Zhang X, Albright AL. Three decade change in the prevalence of hearing impairment and its association with diabetes in the United States. Prev Med. 2009;49(5):360-364.
13. Jorgensen MB, Buch NH. Studies on inner-ear function and cranial nerves in diabetes mellitus. Acta Otolaryngol. 1961;53:350-364.
14. Makishima K, Tanaka K. Pathological changes of the inner ear and central auditory pathway in diabetes mellitus. Ann Otol Rhinol Laryngol. 1971;80(2):218-228.
15. Maia CAS, Campos CAH. Diabetes mellitus as etiological factor of hearing loss. Rev Bras Otorrinolaringol. 2005;71(2):208-214.
16. Lisowska G, Namysłowski G, Morawski K, Strojek K. Early identification of hearing impairment in patients with type 1 and type 2 diabetes mellitus. Otol Neurotol. 2001;22(3):316-320.
17. Austin DF, Konrad-Martin D, Griest S, McMillan GP, McDermott D, Fausti SA. Diabetes-related changes in hearing. Semin Hear. 2009;30(3):242-252.
18. Ferrer JP, Biurrun O, Lorente J, Conget JI, de España R, Esmatjes E, et al. Auditory function in young patients with type 1 diabetes mellitus. Diabetes Res Clin Pract. 1991;11(1):17-22.
19. American Diabetes Association Professional Practice Committee. Standards of care in diabetes—2024. Diabetes Care. 2024;47(Suppl 1):S1-S350.
20. Caballero-Borrego M, Andujar-Lara I. Type 2 diabetes mellitus and hearing loss: A PRISMA systematic review and meta-analysis. Otolaryngol Head Neck Surg. 2025;173(6):1041-1053. doi:10.1002/ohn.1346.