SENSORINEURAL HEARING IMPAIRMENT (SNHI) IN PATIENTS WITH TYPE 2 DIABETES MELLITUS: A CROSS-SECTIONAL STUDY AT A TERTIARY CARE HOSPITAL IN PAKISTAN

Faheem ul Hassan[1], Sundus Huma[1], Farah Naz Afridi[1], Shahab Zai[1], Adeela Mustafa[2], Abu Huraira[1]

[1]MBBS 4th year student, Khyber Medical College, Peshawar, Pakistan

[2]Department of Community Medicine, Khyber Medical College, Peshawar, Pakistan

ABSTRACT

OBJECTIVE: To assess the prevalence of sensorineural impairment in patients with type 2 diabetes and to explore the relationship between hearing loss and variables such as age, gender, HbA1C, and duration of diabetes.

MATERIALS AND METHODS: This cross-sectional study was conducted from April to August 2025 and included patients with type 2 diabetes mellitus. Data were collected using the Hearing Handicap Inventory for Adults (HHIA) to screen for diabetes among individuals with hearing impairment. A non-probability convenience sampling method was used. Pure-tone audiometry (PTA) was employed to assess hearing. SPSS Statistics version 20 was used for data analysis. The chi-square test was used to assess associations, with results presented as frequencies and percentages.

RESULTS: The study included 195 patients with Type 2 Diabetes mellitus aged 25-65 years. Of these, 7.7% were found to have sensorineural hearing loss, which primarily affects higher frequencies (2-4 kHz) and is usually mild to moderate. Additionally, it was found that sensorineural hearing impairment was significantly ($p<0.005$) associated with diabetes duration, hypertension, poor glycemic control, and chronic kidney disease.

CONCLUSION: In this study, SNHI was found in only a small portion of diabetic patients. HHIA responses showed that most participants faced minimal hearing-related issues, while a significant link was observed between SNI and the duration of diabetes, poor blood sugar control, hypertension, and chronic kidney disease.

KEYWORDS: Pure Tone Audiometry, Sensorineural Hearing Impairment, and Diabetes Mellitus

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INTRODUCTION

There is limited awareness of hearing loss as a comorbid condition associated with type 2 Diabetes. [1] The prevalence of diabetes mellitus is rising at a startling rate. The World Health Organisation (WHO) estimates that the global prevalence was approximately 537 million in 2021 and could rise to 783 million by the end of 2045. [2, 3] About 35% to 60% of people with diabetes have auditory deficits, and chronic hyperglycemia can cause sensorineural hearing loss (SNHL), which is an independent risk factor for the onset of hearing impairment (HI). [4]

According to data from the European Centre for Disease Prevention and Control (ECDC), the World Health Organization (WHO) estimates that 20.3% of people worldwide experience SNHI. People with type 2 diabetes mellitus (T2DM) have a 30% higher prevalence of SNHI than those without the disease. [5, 6] Additionally, according to the American Diabetes Association, SNHI is twice as common in patients with T2DM compared to non-diabetic patients. A Canadian meta-analysis found that the prevalence of SNHI among patients with T2DM ranges from 44% to 69.7%. [8] According to a local study conducted in India, 76.8% of diabetic patients have sensorineural hearing loss (SNHL). [9]

While little is known about SNHI in Pakistan, a study from Southern Punjab found that 46.1% of T2DM patients had the condition, and another study from Lahore with a sample of 325 people found that 36.6% (n=119) had hearing loss across all frequencies, with 30.8% experiencing mild to severe hearing loss at high frequencies. [10, 11]

Therefore, the current study aims to assess the prevalence of sensorineural hearing loss and its association with hypertension, poor glycemic control, and chronic kidney disease among patients with T2DM in our region.

Correspondence
Dr. Adeela Mustafa
Associate Professor
Department of Community Medicine, Khyber Medical College, Peshawar, Pakistan
Cell: +92-345-2909019
Email: adeelaamir17@gmail.com
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Understanding the extent of hearing loss in this group could raise awareness of the importance of regular auditory screening in diabetic patients and encourage earlier interventions to prevent the progression of hearing decline.

MATERIAL AND METHODS

A descriptive cross-sectional study was carried out at Khyber Teaching Hospital in Peshawar, Pakistan, from April to August 2025. A sample size of 195 was determined using the WHO sample size calculator, with 95% confidence, a 0.05 margin of error, and a prevalence of 21% from a prior study. [12] A total of 195 diabetic patients aged 25 years and older were recruited from both outpatient and inpatient departments. A non-probability convenience sampling method was used. Data was collected using the Hearing Handicap Inventory for Adults (HHIA) along with an audiometric assessment. [13] The questionnaire was initially piloted to assess its reliability, resulting in a Cronbach's alpha of 0.82. Data collection commenced after approval from the Institutional Research and Ethics Board (IREB) at Khyber Teaching Hospital.

Sensorineural hearing loss was assessed using pure-tone audiometry. The Hearing Handicap Inventory for Adults (HHIA) served as a screening tool to identify early hearing impairment and to evaluate the social and emotional impacts of hearing loss in adult patients with type 2 diabetes mellitus. [14] HHIA responses were scored on a three-point scale (Yes = 4, Sometimes = 2, No = 0). Total scores ranged from 0 to 100, with higher scores indicating a greater perceived hearing handicap. Patients aged 25 to 65 with known T2DM were included in the study, while those with congenital hearing impairments, a history of ototoxic drug use, or acute or chronic ear infections were excluded. Data were analyzed using SPSS software version 20. The prevalence of SNHI was calculated, and its association with variables such as age, diabetes duration, and HbA1c was assessed using the chi-square test. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 195 T2 DM patients participated in this cross-sectional study. The participants' average age was 52.25 years (SD = 6.682). Most participants (120; 61.5%) were from rural areas, while 75 (38.5%) were from urban areas. The largest group had no formal education (66.2%; n = 129), followed by those with primary education (16.4%; n = 32), secondary education (10.3%; n = 20), and diploma or higher (7.2%; n = 14). According to 91.3% of participants, there was no noise at their workplace. Six percent reported frequently hearing loud noises.

HHIA responses indicated that most participants experienced minimal hearing-related difficulties, with only a small proportion reporting problems in conversational or noisy environments. Audiometric evaluation showed that 92.3% of participants had normal hearing, while 7.7% had sensorineural hearing impairment (SNHI), mostly bilateral (5.6%). SNHI was identified in 7.2% of right ears and 6.2% of left ears across tested frequencies. Most affected ears experienced mild to moderate hearing loss, with only a small number having severe or profound loss. On chi-square analysis, duration of type 2 diabetes mellitus ($p = 0.006$), poor glycemic control ($p = 0.021$), occupation in a noisy environment ($p = 0.028$), hypertension ($p = 0.014$), and chronic kidney disease ($p = 0.003$) showed a statistically significant association ($p < 0.05$). In contrast, gender ($p = 0.703$), age ($p = 0.738$), residence ($p = 0.526$), education level ($p = 0.853$), occupation ($p = 0.700$), family history of hearing impairment ($p = 0.694$), and heart disease ($p = 0.921$) were not significantly associated ($p > 0.05$).

DISCUSSION

The current study examined the frequency and correlates of sensorineural hearing impairment (SNHI) in patients with type 2 diabetes mellitus (T2DM). It found a general prevalence of 7.7%, with 2.1% having unilateral and 5.6% bilateral SNHI. Compared to various regional and international studies, this prevalence is notably lower. Studies in Eastern and Southern India have shown that diabetic populations tend to have much higher rates of SNHI. In India, research by Mishra et al. and Vybhavi et al. reported prevalence rates of 90.2% and 70.76%, respectively, with significant associations to age, duration of diabetes, and HbA1c levels. [15, 16] Meanwhile, Shafiepour et al. in Iran found a prevalence of 71.3%, linked to age and blood pressure. [17] Esubalew et al. in Ethiopia reported a prevalence of 50.49%, associated with age, hypertension, and hyperlipidemia. [13] In our study, no link with age was observed, but a significant association with hypertension was identified.

Higher prevalence rates have also been observed in Pakistani data. Manzoor et al. reported a 36. 6% prevalence, mainly at higher frequencies, while Asghar et al. reported 74. 7% SNHL, with most cases being mild to moderate. [11, 18] These findings are inconsistent with our study. However, Uddin et al. found that individuals with poor glycemic control had higher rates of hearing loss, aligning with our results. [19] Several methodological and demographic factors may explain the lower frequency observed here. First, thresholds >25 dB at 0. 5–4 kHz were used to define hearing impairment, possibly missing subclinical high-frequency losses. Second, unlike many studies with older participants, the average age in our sample was lower (mean age of 52.25 years). Third, studies reporting higher prevalence often included patients with long- standing diabetes, but only one- third of participants had diabetes for over ten years. Despite the lower overall prevalence, notable correlations emerged: patients with chronic kidney disease (CKD) ($p = 0. 003$), poor glycemic control (HbA 1 c> 7. 7.1%, $p = 0. 021$), noisy occupational exposure ($p = 0. 028$), hypertension ($p = 0. 014$), and longer diabetes duration ($p = 0. 006$) were more likely to have hearing impairment. These findings support the existing literature linking cumulative microvascular and neural damage in diabetes to auditory dysfunction (Gioacchini et al., 2021). [20] A multicenter study from Ethiopia suggested

that CKD and hypertension share microangiopathic pathways that may exacerbate cochlear damage, consistent with our findings of a strong association between hearing impairment and both CKD and hypertension. Although occupational noise exposure affected only 8.7% of participants, it likely increased their susceptibility to diabetic cochlear hearing loss. Moreover, early subjective complaints, such as trouble hearing in noisy environments (21. 5%), highlight the importance of routine auditory screening in diabetic patients, as recommended by Asghar et al. [18] Interestingly, SNHI was not significantly associated with age (p = 0. 738) or gender (p = 0. 703), unlike several studies in India by Vybhavi et al. [16] and Iran by Shafiepour et al. [17], where age was a strong predictor. This difference may be due to our smaller age range (32–60 years). Similarly, cardiovascular disease showed no significant correlation (p = 0. 921), contrasting with a study from Southern Punjab by Majid et al., which linked hearing loss to diabetic retinopathy and other vascular complications. This study has some limitations. Since it is cross-sectional, we cannot determine causation. Additionally, because the study was conducted in a hospital setting, its findings might not apply to the broader diabetic population. However, the study emphasizes the importance of including audiometric screening in diabetes care, especially for those with long-term diabetes, poor glycemic control, or co-existing hypertension and chronic kidney disease.

CONCLUSION

In this study, SNHL was found in only a small percentage of patients with diabetes. HHIA responses showed that most participants experienced minor hearing difficulties, while a significant link was identified between SNI and the duration of diabetes, poor glycemic control, hypertension, and chronic kidney disease.

Table No 1: Frequency Distribution of Hearing Handicap Inventory for Adults (HHIA) Responses

Variables	Response	Frequency	Percentage
Do you Frequently asking others to repeat themselves?	Yes	36	18.5%
	No	159	81.5%
Do you have Trouble when conversations involve more than two people?	Yes	42	21.5%
	No	153	78.5%
Do you think that others are mumbling?	Yes	17	8.7
	No	178	91.3
Do you have Problems hearing in noisy places such as busy restaurants?	Yes	42	21.5
	No	153	78.5
Does your hearing problem make it difficult to listen to TV or radio	Yes	12	6.2
	No	183	93.8
Do you avoid telephone conversation due to hearing difficulties?	Yes	8	4.1
	No	187	95.9
Does your hearing problem make you talk to family members less?	Yes	13	6.7
	No	182	93.3
Which statement best describes your ability to hear with your ear (without a hearing aid)?	Good	154	79
	Little trouble	38	19
	A lot of trouble	03	1.5

Table No 2: Frequency of clinical and biochemical characteristics

Variable	Response	Frequency	Percentage
Duration after being diagnosed with Type 2 Diabetes?	5-1 years	69	35.4
	10-6 years	60	30.8
	More than 10 years	66	34
Have you been diagnosed with hypertension?	Yes	94	48.2
	No	101	51.8
History of heart disease?	Yes	44	22.6
	No	151	77.4
History of chronic kidney disease?	Yes	34	17.4
	No	161	82.6
Glycemic control (HbA1c level if available)	Good (HbA1c<%7)	63	32.3
	Poor (HbA1c>%7.1)	132	67.7

Table No 3: Audiometric characteristics

Variable	Response	Frequency	Percentage
SNHI	unilateral	4	2.1
	Bilateral	11	5.6
	Normal hearing	180	92.3
Presence of SNHI at 0.5,1,2, and 4kHz in the Right Ear.	Yes	14	7.2
	No	181	92.8
The Severity of SNHI in the right ear.	Mild(40-26dB)	8	57.1
	Moderate(55-41dB)	4	28.6
	Moderately Severe (70-56dB	0	0.0
	Severe(90-71dB)	1	7.1
	Profound(>90dB)	1	7.1
Presence of SNHI at 0.5,1,2, and 4kHz in the Left Ear.	Yes	12	6.2
	No	183	93.8
The Severity of SNHI in the left ear	Mild(40-26dB)	8	66.7
	Moderate(56-41dB)	3	25.0
	Moderately Severe(70-56dB)	1	8.3
	Severe (90-71dB)	0	0
	Profound (>90dB)	0	0

Table No 4: Association of SNHL with Diabetes Mellitus

Variable	Response	Unilateral SNHL	Bilateral SNHL	Normal hearing	P-value
Duration of T2DM	1-5 years	1.4	0.0	98.6	0.006
	6-10 years	5.0	1.7	93.3	
	11-15 years	0.0	11.8	88.2	
	More than 16 years	3.1	15.6	81.3	
Glycemic control (HbA1c)	Good< 7%	0.0	0.0	100	0.02
	Poor >7%	3.8	7.6	88.6	

REFERENCES

1. Hlayisi VG, Petersen L, Ramma L. High prevalence of disabling hearing loss in young to middle-aged adults with diabetes. International Journal of Diabetes in Developing Countries. 2019 Jan 1;39(1):148-53.
2. Sacks DB, Arnold M, Bakris GL, Bruns DE, Horvath AR, Lernmark Å, Metzger BE, Nathan DM, Kirkman MS. Guidelines and recommendations for laboratory analysis in the diagnosis and management of diabetes mellitus. Clinical chemistry. 2023 Aug;69(8):808-68. e151-e199. doi:10.2337/dci23-0036
3. Ogle GD, James S, Dabelea D, Pihoker C, Svennson J, Maniam J, Klatman EL, Patterson CC. Global estimates of incidence of type 1 diabetes in children and adolescents: Results from the International Diabetes Federation Atlas. Diabetes research and clinical practice. 2022 Jan 1;183:109083.
4. Gioacchini FM, Pisani D, Viola P, Astorina A, Scarpa A, Libonati FA, Tulli M, Re M, Chiarella G. Diabetes mellitus and hearing loss: a complex relationship. Medicina. 2023 Jan 30;59(2):269.
5. Haile LM, Kamenov K, Briant PS, Orji AU, Steinmetz JD, Abdoli A, Abdollahi M, Abu-Gharbieh E, Afshin A, Ahmed H, Rashid TA. Hearing loss prevalence and years lived with disability, 1990–2019: findings from the Global Burden of Disease Study 2019. The Lancet. 2021 Mar 13;397(10278):996-1009.
6. De Cormier Plosky W, Ne'eman A, Silverman BC, Strauss DH, Francis LP, Stein MA, Bierer BE. Excluding People With Disabilities From Clinical Research: Eligibility Criteria Lack Clarity And Justification: Study examines factors and practices that exclude people with disabilities from clinical research. Health Affairs. 2022 Oct 1;41(10):1423-32.
7. 7. Schade DS, Lorenzi GM, Braffett BH, Gao X, Bainbridge KE, Barnie A, Cruickshanks KJ, Dalton D, Diminick L, Gubitosi-Klug R, Kramer JR. Hearing impairment and type 1 diabetes in the Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications (DCCT/EDIC) cohort. Diabetes Care. 2018 Dec 1;41(12):2495-501.
8. Tiwari A, Mudhol RS. Prevalence of sensorineural hearing loss among type-II diabetes mellitus patients attending KLES Dr. Prabhakar Kore Hospital and MRC: A cross-sectional study. Indian Journal of Health Sciences and Biomedical Research kleu. 2018 May 1;11(2):165-9.
9. Majeed S, Mumtaz N, Saqulain G. Prevalence of sensorineural hearing loss among patients of diabetes mellitus in Southern Punjab, Pakistan. Journal of Shifa Tameer-e-Millat University. 2018;1(1):32-6 doi:10.32593/jstmu/Vol1.Iss1.36
10. Manzoor H, Akhtar D, Ahmad U, Waheed S, Abbas SS, Naz R, Ali B. Prevalence of Hearing Impairment in Patients with Diabetes Mellitus: Hearing Impairment

in Patients with Diabetes Mellitus. Pakistan Journal of Health Sciences. 2022 Dec 31:142-5.doi:10.54393/pjhs.v3i07.428

11. Sullivan KM, Dean A, Soe MM. On academics: OpenEpi: a web-based epidemiologic and statistical calculator for public health. Public health reports. 2009 May;124(3):471-4.doi:10.1177/003335490912400320
12. Esubalew D, Melese M, Belete M, Ambelu A, Mulat B, Adane T, Wondie WT, Diress M. Prevalence and Associated Factors of Sensorineural Hearing Impairment Among Patients with T2DM in Amhara Region, Northwest Ethiopia, 2022: A Multi-Centered Cross-Sectional Study. Diabetes, Metabolic Syndrome and Obesity. 2024 Dec 31:1821-32.doi:10.2147/DMSO.S455164
13. Newman CW, Weinstein BE, Jacobson GP, Hug GA. The Hearing Handicap Inventory for Adults: psychometric adequacy and audiometric correlates. Ear and hearing. 1990 Dec 1;11(6):430-3. doi:10.1097/00003446-199012000-00007.
14. Mishra UP, Behera G, Sahoo AK, Mishra S, Patnaik R, SAHOO AK. The impact of diabetes mellitus on sensorineural hearing loss: a cross-sectional study in eastern India. Cureus. 2024 Jan 17;16(1). doi:10.7759/cureus.52431
15. Muddaiah d, prashanth v, srinivas v, lavanya m, vybhavi mk. Endoscopic transcanal transtympanic pop through technique of myringoplasty using tragal perichondrium graft.doi:10.18203/issn.2454-5929.ijohns20243506
16. 17. Shafiepour M, Bamdad Z, Radman M. Prevalence of hearing loss among patients with type 2 diabetes. Journal of Medicine and Life. 2022 Jun;15(6):772. doi:10.25122/jml-2021-0300
17. 18. Asghar S, Ali Z, Abdullah A, Naveed S, Ahmad MS, Rafi TS. 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. 2024 May 1;14(5):e081035. doi:10.1136/bmjopen-2023-081035
18. 19. Uddin SF, Waheed K, Noor N, Warsi J, Zain S. Effects Of Increased Serum Glucose Level On Hearing Capabilities Of Hyderabad Sindh Residence. Khyber Journal of Medical Sciences. 2023;16(04):198-202.doi:10.70520/kjms.v16i04.478
19. 20. Gioacchini FM, Pisani D, Viola P, Astorina A, Scarpa A, Libonati FA, Tulli M, Re M, Chiarella G. Diabetes mellitus and hearing loss: a complex relationship. Medicina. 2023 Jan 30;59(2):269.

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Authors Contribution:

Following authors have made substantial contributions to the manuscript as under

Authors	Conceived & designed the analysis	Collected the data	Contributed data or analysis tools	Performed the analysis	Wrote the paper	Other contribution
Hassan FU	✓	✓	×	×	✓	×
Huma S	✓	×	✓	✓	✓	×
Afridi FN	✓	✓	×	×	×	✓
Zaib S	✓	×	✓	✓	✓	×
Mustafa A	✓	✓	×	×	×	✓
Huraira A	✓	×	✓	✓	✓	×

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethical Approval:

This study was approved by the Institutional Ethical Review Board of Khyber Medical College, Peshawar, Pakistan Vide No. 662/DME/KMC, Dated; 04/01/2024