Section: Medicine

Original Research Article

STUDY OF ASSOCIATION BETWEEN TYPE 2 DM WITH SENSORY NEURAL HEARING LOSS AND ITS CORRELATION WITH GLYCEMIC CONTROL AND DURATION OF DIABETES

Divyansh L B K Darbe[1], Esha Singhal[2], Bhumesh Tyagi[2], Abhilasha[1], Sahil Nain[1], Adeshji Kishanji Gadpayle[3]

[1]Post Graduate Resident, Department of Medicine, Sharda Hospital and School of Medical Sciences and Research, Greater Noida, U.P. India
[2]Associate Professor, Department of Medicine, Sharda Hospital and School of Medical Sciences and Research, Greater Noida, U.P. India
[5]Professor and Head, Department of Medicine, Sharda Hospital and School of Medical Sciences and Research, Greater Noida, U.P. India

Received : 11/04/2025
Received in revised form : 29/05/2025
Accepted : 18/06/2025

Keywords:
Type 2 DM, Sensory Neural Hearing Loss, Glycemic Control, Duration of Diabetes.

Corresponding Author:
Dr. Divyansh L B K Darbe,
Email: divyansh.lohit@gmail.com

DOI: 10.47009/jamp.2025.7.3.203

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (3); 1052-1057

ABSTRACT

Background: To examine the relationship between type 2 diabetes and sensory neural hearing loss, as well as how these factors relate to glycaemic control and the length of diabetes. **Materials and Methods:** In the Department of General Medicine & Department of ENT School of Medical Science & Research, Sharda Hospital, Greater Noida, Uttar Pradesh, the current case control study was carried out from May 2023 to November 2024. It involved 50 patients with diabetes mellitus based on ADA 2018 criteria who were either sex-wise older than 35 or younger than 60, and 50 patients who did not have diabetes. **Result:** Diabetic Retinopathy was detected in 50% of the cases as mild, moderate, and severe NPDR, or 34%, 12%, and 2% of the cases in this study, respectively, while fundoscopy results were normal in all control groups. According to PTA, 48% and 74% of the participants in the case and control groups, respectively, reported having normal hearing. In the case and control groups, 16%, 22%, and 6% of the participants, respectively, had mild, moderate, and severe SNHL. This study found a substantial correlation between the degree of hearing loss and HbA1c, meaning that the likelihood of hearing loss getting worse increases as HbA1c rises. **Conclusion:** According to the current study, Type 2 diabetic patients' hearing thresholds were higher than those of the healthy controls. Hearing loss is more likely to occur in people with uncontrolled diabetes and its consequences than in people with adequate glycaemic control. Diabetic microangiopathy of the inner ear may be the cause of the strong association between glycaemic state and hearing loss. Thus, vascular damage and diabetes-related problems can be avoided by maintaining adequate metabolic control.

INTRODUCTION

A growing global health concern, type 2 diabetes mellitus (type 2 DM) affects millions of people worldwide. India's high rate of diabetes has earned it the moniker "diabetes capital of the world".[1] The progressive condition known as type 2 diabetes is caused by the loss of functional β-cells, typically as a result of long-term insulin resistance on a hereditary β-cell susceptibility background.[2] According to the International Diabetes Federation's 10th edition of the Diabetes Atlas, which was published in 2019, 537 million persons aged 20 to 79 have diabetes. By 2030, this is expected to increase to 643 million. In low- and middle-income nations, more than 75% of adults with diabetes reside.[3] 48% of all diabetes-related deaths in 2019 happened before the age of 70, and diabetes was the direct cause of 1.5 million deaths.[4]

Diabetic nephropathy, neuropathy, retinopathy, and atherosclerotic cardiovascular diseases are well-known causes of the morbidity and mortality linked to diabetes mellitus. Complications of diabetes occur in both the macrovascular and microvascular domains. The ear is not an exception; sensorineural hearing loss (SNHL) can result from a number of microvascular and neuropathic abnormalities, including thickening of the basal membrane of the cochlea's stria vascularis capillaries on the lateral wall.[5-7] Coexisting diseases such as weakened immunity, which increases vulnerability to outer, middle, or inner ear infections, may be linked to auditory deficits in diabetic individuals.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Researchers are now interested in the intricate relationship between diabetes and hearing function. The precise etiopathogensis is debatable in the literature, though, because DM typically affects elderly people, making it more difficult to attribute hearing loss to DM or presbycusis. Others, however, proposed that it might be connected to damage at different locations along the auditory pathways, perhaps as a result of cochlear or neurological anomalies, as shown in a prior study.[8]

On the other hand, other research points to a primary effect on low frequencies. Diabetes patients and medical personnel are not well-informed about hearing impairment as a possible concomitant condition, despite the fact that multiple studies have shown a link between type 2 DM and hearing loss.[9] Diabetes is linked to a significant risk of HL, as demonstrated by Kim et al,[10] who found that patients with diabetes had a higher risk of HL if their HbA1c level was higher than 5% when compared to those with prediabetes. In a different investigation, hearing impairment in individuals without diabetes was linked to HbA1c levels.[11] The study's hypothesis about the connection between HL and HbA1c levels was that a higher risk of HL is linked to higher HbA1c levels. We found that there are many studies that show a significant correlation between sensory neuronal hearing loss and type 2 diabetes after examining research articles in related fields. SNHL and the length of diabetes and glycaemic control, however, did not appear to be significantly correlated in these investigations. The link between T2DM and SNHL, as well as its relationship to duration and glycaemic management in diabetic individuals, were established in this study. The aim and objectives of the study are as follows:

Aim: To study the association of Type 2 Diabetes Mellitus with sensory neural hearing loss

Objectives

1. To evaluate occurrence of Sensory neural hearing loss in patients with Type 2 Diabetes aged above 35 and below 60 years.
2. To study the association between the Sensory neural hearing loss and duration of type 2 Diabetes Mellitus.
3. To study the association between the Sensory neural hearing loss and Glycemic control.

MATERIALS AND METHODS

The present cross-sectional study was conducted from May 2023 to November 2024 at Department of General Medicine & Department of ENT, School of Medical Science & Research, Sharda Hospital, Greater Noida, Uttar Pradesh after taking formal approval from Institutional Ethics Committee.

Sample Size Calculation: Sample size calculation was done on the basis of prevalence of diabetes in Indian population, prevalence taken from International Federation of Diabetes: Diabetes Atlas 10th edition 2021. There were 50 cases of Diabetes Mellitus based on ADA 2018 criteria who are patients of either sex age > 35 years and < 60 years and comparing it with 50 Non diabetic patients. Sample Size has been calculated using Cochran□s formula-

$$n_o = \frac{Z^2 pq}{e^2}$$

Where: e is the desired level of precision (margin of error) p is the (estimated) proportion of the population which has the attribute in question, q is 1 – p. Using this formula with Z= 1.96, Prevalence= 9.6 % (According to data published in International Federation of Diabetes: Diabetes Atlas 10th edition 2021) and precision around 6%, total sample size will be of 100 patients.

Inclusion criteria for case

- Diabetes mellitus patients on basis of ADA 2018 Criteria.
- Non Critically ill, T2DM patients of either sex with age >35 years and < 60 years
- Patients who give consent for study.

Inclusion criteria for control

- Age above 35 and below 60 years
- Normal fasting and Postprandial blood sugar and Glycosylated Hemoglobin
- No family history of diabetes mellitus
- No history of hearing impairment

Exclusion criteria for cases

- Age < 35 years and > 60 years
- Patients of Type 1 DM
- Critically ill patients, patients in sepsis
- Patient with Chronic Renal failure, Liver diseases, Pregnancy, Lactation
- History of hearing impairment caused by other disorders like
  - Chronic suppurative otitis media
  - Labyrinthitis
- History of head, Temporal bone fracture, Ear trauma and Ear surgery
- History of ototoxic drugs intake like
  - Gentamycin
  - Tobramycin
  - Cisplatin
  - Carboplatin
  - Furosemide
  - High dose Aspirin
- Critically ill patients, patients in sepsis
- Working environment where exposure to high decibel sound.

Diagnosis: Diabetics was diagnosed according to ADA 2018 criteria

- HbA1C > 6.5%
- FPG ≥ 126mg/dl (7mmol/l)
- 2-hr Plasma Glucose ≥ 200 mg/dl (11.1/l) during a oral glucose tolerance test or
- In a patient with classic symptoms of hyperglycemia and random plasma glucose ≥200 mg/dL.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Study Procedure: Total of 100 subjects were taken from which 50 were cases and 50 were control. Patients were recruited as per the ADA 2018 criteria of T2DM. All patient□s underwent a detailed history and physical examination. Blood investigation was done in both study groups, along with other relevant routine investigations like CBC with ESR, LFT, KFT, Urine routine and microscopy, Chest XRay, FBS, PP2BS, Lipid profile, ECG, HbA1C, Fundoscopy was done as per proforma attached.

Special Tests to determine Sensory Neural Hearing Loss like Tuning Fork Tests like Rinne test, Weber test**,** and Pure tone audiometry by Interacoustic AD528 device by Hughson – Westlake procedure: Audiometric assessment is conducted in sound proof room with pure tone stimuli to one ear at a time with variable frequencies of 250Hz, 500Hz, 1000Hz, 2000Hz, 4000Hz, 8000Hz at various selected intensities. The reference intensity level is designated by mean value of minimal audible threshold of pure tones in healthy individual as the least intensity of pure tone that is audible to the subjects. The hearing threshold grading is given by:

- 0-25 db- normal hearing
- 26-40 db- mild hearing loss
- 41-55 db- moderate hearing loss
- 56-70 db- moderate to severe hearing loss
- 71-90 db- severe hearing loss
- > 90 db- profound hearing loss.

Investigations were carried out as per Proforma approved for the study as a part of basis workup in a case of T2DM. There was no additional financial burden on the patient by being a part of this study.

Statistical analysis: All the data obtained was analysed statistically using software like Microsoft Excel 2011, IBM SPSSv25. Master chart containing all data including demography and clinical examination and investigations from entire study population were created.Group comparisons for continuously distributed data were made using independent samples □t□ test when comparing two groups, and One Way ANOVA while comparing more than 3 groups, Chi-squared test was used for group comparisons for categorical data. A □p□ value of <0.05 was considered significant.

RESULTS

Males were comparatively more as compared to females in both the groups with a ratio of 1: 1.7 among cases and 1: 1.3 among controls in this study. Mean age in case and control group was 50±6.93 and 44.64±7.13 years respectively. Hence mean age was more in case group as compared to control group with statistically significant difference.

Table 1: Gender and age distribution among the study groups

	Case		Control		p value
	N	%	N	%	
Male	32	64	28	56	
Female	18	36	22	44	0.41
Total	50	100	50	100	

	Case		Control		p value
	Mean	SD	Mean	SD	
Age (in years)	50	6.93	44.64	7.13	0.001*

Mean Hb (g/dl), TLC (10*3/cumm) and RBC (million/cumm) was 11.58±1.75, 7.89±2.63, 4.42±0.78, and12.27±1.78, 6.56±1.82, 4.12±0.76 in case and control group respectively. Mean Total Bilirubin, SGOT (U/L) and SGPT (U/L) value was more in control as compared to case group with statistically significant difference [Table 2].

Table 2: Investigative profile among the study groups.

Variables	Case		Control		p value
	Mean	SD	Mean	SD	
Hb (g/dl)	11.58	1.75	12.27	1.78	0.06
TLC (10*^{3}/cumm)	7.89	2.63	6.56	1.82	0.004*
RBC (million/cumm)	4.42	0.78	4.12	0.76	0.054
Total Bilirubin	0.87	0.76	1.36	0.66	0.001*
SGOT(U/L)	31.71	13.22	60.55	18.69	0.004*
SGPT(U/L)	31.06	14.12	64.53	10.05	0.002*
LDL	89.24	45.06	78.02	21.86	0.11
Urea (mg/dl)	33.46	15.14	27.88	11.55	0.041*
Creatinine (mg/dl)	0.88	0.48	0.82	0.31	0.46

All the mean diabetic parameters viz. RBS (mg/dl), FBS (mg/dl), PPBS (mg/dl) and HbA1c% were 243.42±88.93, 187.92±65.92, 242.48±67.90 and 9.58±2.56 among the cases and 167.36±29.08, 116.30±17.80, 157.04±21.59, 5.59±0.24 among the controls in this study which was significantly more in cases as compared to control group as p<0.05 [Table 3].

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 3: Descriptive analysis of diabetic parameters among the study groups.

Variables	Case		Control		p value
	Mean	SD	Mean	SD	
RBS (mg/dl)	243.42	88.93	167.36	29.08	<0.01*
FBS (mg/dl)	187.92	65.92	116.30	17.80	<0.01*
PPBS (mg/dl)	242.48	67.90	157.04	21.59	<0.01*
HbA1c%	9.58	2.56	5.59	0.24	<0.01*

Urine glucose 0, 1+, 2+, 3+ and 4+ was reported among 34%, 8%, 20%, 12% and 26% of the subjects in cases in the study respectively [Figure 1].

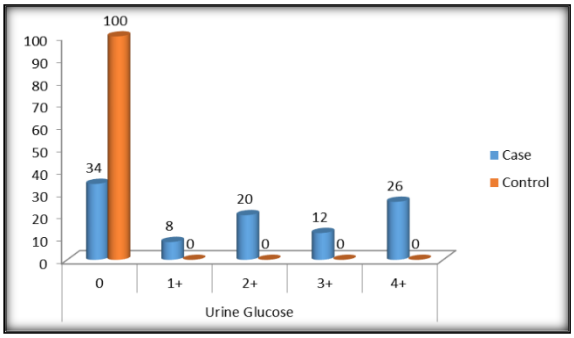

Figure 1: Comparison of urine glucose among the study groups

Fundoscopy findings were normal in all the control groups while Diabetic Retinopathy was found among 50% of the cases as Mild, moderate and severe NPDR i.e 34%, 12% and 2% of the cases in this study respectively (Table 4). RINNE test was found to be normal in all the subjects of case as well as control group. Weber test was found to be normal in 80% and 90% of the subjects in case and control group respectively. As per PTA; normal hearing was reported among 48% and 74% of the subjects in case and control group respectively. Mild, moderate and severe SNHL was revealed in 16%, 22%, 6% and 16%, 10% and 0% of the subjects in case and control group respectively. Hence presence and severity of hearing loss was found more in case as compared to control group with statistically significant difference as p<0.05 [Table 4].

Table 4: Comparison of fundoscopy among the study groups.

Fundoscopy	Case		Control		p value
	N	%	N	%	
Normal	25	50	50	100	<0.01*
Mild NPDR	17	34	0	0	
Mild-Moderate NPDR	1	2	0	0	
Moderate NPDR	6	12	0	0	
Severe NPDR	1	2	0	0	
PTA					
Normal Hearing	24	48	37	74	0.035*
Mild SNHL	8	16	8	16	
Mild-Moderate SNHL	3	6	0	0	
Moderate SNHL	11	22	5	10	
Moderate-Severe SNHL	1	2	0	0	
Severe SNHL	3	6	0	0	
Total	50	100	50	100	

In this study; mean duration of diabetes in mild SNHL, moderate SNHL and severe SNHL was 8.2500±4.59036, 7.4545±4.10764 and 7.6667±2.51661 there was no significant association found between severity of hearing loss and duration of diabetes [Figure 2].

In this study; there was significant association revealed between severity of hearing loss and HbA1c level i.e. with increase in HbA1c; chances of severity of hearing loss also increases [Table 5].

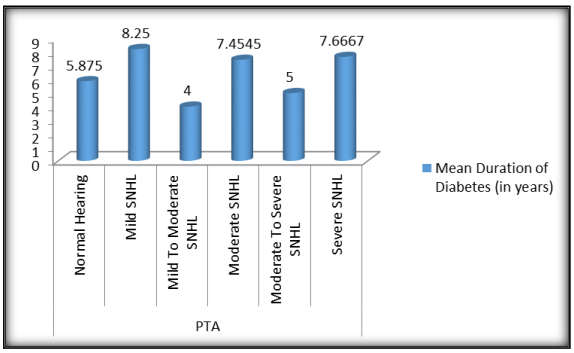

Figure 2: Comparison of PTA according to duration of diabetes

Table 5: Comparison of fundoscopy among the study groups.

PTA	Mean HbA1c%	SD	p value
Normal Hearing	8.617	2.3671	0.006*
Mild SNHL	8.813	1.8027	
Mild To Moderate SNHL	10.467	2.7683	
Moderate SNHL	11.473	2.3682	
Moderate To Severe SNHL	7.200	-	
Severe SNHL	12.267	0.7638	

ISSN (O): 2687-5365; ISSN (P): 2753-6556

DISCUSSION

From May 2023 to November 2024, 50 patients with diabetes mellitus based on ADA 2018 criteria who were either sex-aged >35 or <60 years and 50 non-diabetic patients participated in the current case control study at the Department of General Medicine, School of Medical Science & Research, Sharda Hospital, Greater Noida, Uttar Pradesh. The study's objective was to examine the relationship between type 2 diabetes and sensory neural hearing loss, as well as how these factors relate to glycaemic control and the length of diabetes.

In this study, males were significantly more prevalent than females in both groups, with a ratio of 1: 1.7 among cases and 1: 1.3 among controls. Their respective mean ages were 50±6.93 and 44.64±7.13 years in the case and control groups. Therefore, the case group's mean age was higher than the control group's, with a statistically significant difference of $p<0.05$. Similar gender and age distribution was reported by Sachdeva K et al.[12] The study population in a study by Utkal P. Mishra et al,[13] is 49 years old on average. Comparing Eastern India to other regions of the world, it shows that type 2 diabetes is more common in comparatively younger people.

Hearing loss was more prevalent and severe in the case group than in the control group, with a statistically significant difference ($p<0.05$). Chronic hyperglycemia causes SNHL in diabetics, which in turn causes microvascular damage that results in cochlear microangiopathy. This is supported by the study, which found that high-frequency SNHL, which suggests cochlear microangiopathy, was the most common pattern of hearing loss in the study population. Furthermore, oxidative stress and inflammation linked to diabetes may exacerbate the harm to hair cells and auditory neurones. These mechanisms combine to produce SNHL, which frequently first appears at high frequencies.[13] Therefore, it may be concluded that diabetes essentially speeds up the senile changes that take place at the cochlea level, increasing the likelihood that they will have hearing loss. Thus, Dabrowski coined the term "diabetic otopathy.[14]

According to the research of Al-Rubeaan et al,[15] it is less than 66.2%. Utkal P. Mishra et al,[13] report that 70.4% of people with type 2 diabetes had SNHL. The research population's comparatively severe and chronic diabetes is the cause of this high incidence. Another possible explanation is that most people who currently have hearing issues are willing to have their hearing evaluated. An even more startling frequency of 97.6% among study participants was observed in a previous study on type II DM in coastal India. Additionally, the prevalence of hearing loss was found to be 67.5% in a longitudinal population-based study that included 3,571 adults and examined the relationship between non-insulin-dependent diabetes mellitus (NIDDM) and hearing loss. This suggests that DM contributes to the risk of SNHL.[15]

Mild SNHL was also found to be highly prevalent in the diabetic community in a cross-sectional study carried out in Saudi Arabia.[13] In a similar vein, Sachdeva K et al,[12] observed that there were notable disparities between the case and control groups in a number of auditory measures of both the right and left ears. Among all the hearing-impaired participants, it was found that 72% were in the diabetic group and only 28% were not; this ratio was 2.6:1 ($p=0.00004$), which is highly significant. Additionally, compared to the diabetic patients (42% mild and 30% moderate SNHL), the control group had a lower degree of hearing loss (21% mild and 7% moderate SNHL).

However, some patients experienced a few anomalous findings, such as high frequency pure tone loss, poor speech discriminating abilities, and abnormally decreased stapedial reflex thresholds, according to research revealing a negative relationship between diabetes and hearing loss. This contrasts with the current study's findings.[16]

The severity of hearing loss and the length of diabetes were not shown to be significantly correlated in this study. In their investigation, Allesandra et al. also found no correlation between hearing loss and the length of diabetes [14]. According to a study conducted in Bangaluru by Thimmasettaiah et al., people with diabetes who have had the disease for more than five years have a higher rate of hearing impairment (79%) than people who have just been diagnosed with the disease (42%).[17] According to Pemmaiah and Srinivas, 29 individuals (61.7%) out of 47 patients with diabetes for more than ten years experienced at least mild hearing loss.[18]

According to a study by Sachdeva K et al,[12] the prevalence and severity of hearing loss both rise with the length of diabetes. But in our study no correlation was found as there are many mechanisms of hearing loss present, with increasing age and with different phenotypes hearing loss varies. This may be because people with T2DM are treated with hypoglycemic drugs to control their blood sugar, which delays the progression of hearing loss. In addition, the sample sizes of these studies were too small, and further exploration is needed to draw firms conclusions.

This study found a substantial correlation between the degree of hearing loss and HbA1c, meaning that the likelihood of hearing loss getting worse increases as HbA1c rises. It illustrates how inadequate glycaemic control leads to more severe damage to cochlear hair cells, which is mainly caused by elevated oxidative stress and inflammation. The cochlea's outer hair cell is responsible for the distortion product otoacoustic emission. In their study, Sachdeva K et al,[12] also demonstrated that the incidence of hearing loss in diabetes individuals rises in proportion to the percentage of glycosylated haemoglobin. The highest percentage of hearing-impaired individuals (51.6%) had HbA1c levels more than 8% ($p=0.00002$), which indicates uncontrolled diabetes mellitus. According to a study by Al-Rubeaan et al,[15] hearing loss was more common in people with poor glycaemic control (HbA1c ≥ 8%)

ISSN (O): 2687-5365; ISSN (P): 2753-6556

than in people with good glycaemic control (HbA1c < 8%). A statistically significant prevalence of SNHL in HbA1c ≥ 8% was also seen in the Utkal P. Mishra et al,[13] investigation.

Limitations: Although this study offers insightful information, it is important to recognise its limits. First, it is unable to demonstrate a clear causal relationship between diabetes and hearing loss because of its cross-sectional nature. More solid data about the temporal relationship between diabetes and the onset of hearing impairment might be provided by a longitudinal approach. Furthermore, recall bias may be introduced by using self-reported audiological symptoms, which could compromise the accuracy of symptom reporting. The results' generalisability to other populations is uncertain due to the study's limited sample size. The majority of the study participants were from rural areas and had lower levels of education.

CONCLUSION

According to the current study, Type 2 diabetic patients' hearing thresholds were higher than those of the healthy controls. Hearing loss is more likely to occur in people with uncontrolled diabetes and its consequences than in people with adequate glycaemic control. Diabetic microangiopathy of the inner ear may be the cause of the strong association between glycaemic state and hearing loss. Thus, vascular damage and diabetes-related problems can be avoided by maintaining adequate metabolic control.

Because auditory complaints may be an early sign of upcoming systemic issues, all patients with diabetes mellitus should have regular hearing evaluations in addition to other tests for glycaemic status. In order to prevent these consequences, long-term diabetics should also receive counselling on the importance of maintaining appropriate glycaemic control. In conclusion, the increased incidence of hearing loss in diabetic patients suggests that these patients should be screened for auditory organ involvement as soon as possible.

REFERENCES

1. Mithal A, Majhi D, Shunmugavelu M, et al. Prevalence of dyslipidemia in adult Indian diabetic patients: a cross-sectional study (SOLID). Indian J Endocrinol Metab. 2014; 18: 642-7.
2. Chinnery PF, Elliott C, Green GR, et al. The spectrum of hearing loss due to mitochondrial DNA defects. Brain. 2000; 123(1): 82-92.
3. Global Burden of Diseases Collaborative Network. Global Burden of Study 2019. Results. Institute for Health Metrics and Evaluation. 2020 (http:/vizhub.healthdata.org/gbdresults/).
4. Dall Tm, Yang W, Halder P, et al. the economic burden of elevated blood glucose levels in 2012: diagnosed and undiagnosed diabetes, gestational diabetes mellitus, and prediabetes. Diabetes Care 2014; 3: 3172-9.
5. Nakae S, Tachibana M. The cochlea of the spontaneously diabetic mouse. Arch Otorhinolaryngol 1986; 243: 313– 6.
6. Raynor E, Robison WG, Garrett CG, et al. Consumption of a high-galactose diet induces diabetic-like changes in the inner ear. Otolaryngol Head Neck Surg 1995; 113: 748–54.
7. Fukushima H, Cureoglu S, Schachern PA, et al. Cochlear changes in patients with type 1 diabetes mellitus. Otolaryngol Head Neck Surg 2005; 133: 100– 6.
8. Bainbridge KE, Hoffman HJ, Cowie CC. Risk factors for hearing impairment among U.S. adults with diabetes: National Health and Nutrition Examination Survey 1999-2004. Diabetes Care. 2011; 34: 1540-5.
9. Chen MY, Du YL, Zhu QR, et al. The relationship between type II diabetes mellitus and hearing loss: a meta-analysis. Journal of Clinical Otorhinolaryngology, Head, and Neck Surgery. 2017; 31: 657-63.
10. Kim MB, Zhang Y, Chang Y, et al. Diabetes mellitus and the incidence of hearing loss: a cohort study. International journal of epidemiology. 2017; 46(2): 717-26.
11. Kang SH, Jung DJ, Cho KH, et al. Association between HbA1c level and hearing impairment in a nondiabetic adult population. Metabolic Syndrome and Related Disorders. 2016; 14(2): 129-34.
12. Sachdeva K, Azim S. Sensorineural hearing loss and type II diabetes mellitus. Int J Otorhinolaryngol Head Neck Surg. 2018; 4(2): 499-507.
13. Mishra UP, Behera G, Sahoo AK, et al. The impact of diabetes mellitus on sensorineural hearing loss: a cross-sectional study in Eastern India. Cureus. 2024;16(1).
14. Dabrowski M. Disorders of hearing in diabetes mellitus, 2014. Available at: http://dx.doi.org/10.14496/dia.7105378814.8 in a book. Accessed on 20 January 2016.
15. Al-Rubeaan K, AlMomani M, AlGethami AK, et al. Hearing loss among patients with type 2 diabetes mellitus: a cross-sectional study. Ann Saudi Med 2021; 41: 171– 8.
16. Axelsson A, Sigroth K, Vertes D. Hearing in diabetics. Diabetes and Sensineural hearing Loss. Otology Acta Otolaryngol. 1978; 356: 3– 21.
17. Thimmasettaiah NB, Shankar R, Ravi GC. A one year prospective study of hearing loss in diabetes in general population. Translational Biomedicine. 2012; 3(2).
18. Pemmaiah KD, Srinivas DR. Hearing loss in diabetes mellitus. Int J Collab Res Intern Med Public Health. 2011; 3(10):725– 31.

ISSN (O): 2687-5365; ISSN (P): 2753-6556