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## **Audiometric studies in type 2 diabetes mellitus**

**Dr. Pankaj Kumar**

Associate Professor, Department of Internal Medicine, Index Medical College Hospital & Research Center, Indore

**Dr. Anand Sharma**

Assistant Professor, Department of Otorhinolaryngology, Index Medical College Hospital & Research Center, Indore

**Dr. Navin Agrawal**

Professor & Hod, Department of Otorhinolaryngology, Index Medical College Hospital & Research Center, Indore

**Dr. Sudhir Mourya**

Professor & Hod, Department of Internal Medicine, Index Medical College Hospital & Research Center, Indore

**Dr. Sandeep Gupta**

Pg Resident 3, Department of Internal Medicine, Index Medical College Hospital & Research Center, Indore

**Dr. Shivam Narang\***

Pg Resident 3, Department of Otorhinolaryngology, Index Medical College Hospital & Research Center, Indore

\*Corresponding author:

**Ms. Madhuri Dubey**

Audiologist, Department of Audiology & Speech Therapy, Index Medical College Hospital & Research Center, Indore.

**Abstract**--Introduction: Hearing defects can cause inconvenience in communication which can have prodigious impact on the psychological, social and emotional functions. The increasing incidence of diabetes and profound effect of hearing loss on quality of life mandates the need to study the possible association between the two. Materials and method: An observational study was conducted including 100 participants such that 50 were non-diabetic (group A) and another 50 were diabetic. The participants of two groups were matched for age and gender. The Random Blood Sugar, HbA1c, Pure Tone Audiometry were assessed. The statistical analysis of data was done using SPSS (Statistical Package for Social Sciences) 21.0 version,

IBM, Chicago. Results: The median age of the participants belonging to group A and B was 39.0 years and 40.0 years respectively. No significant association was observed between the presence or absence of diabetes and hearing loss (Chi-square value- 2.1, df-3, p value>.05). Amongst the patients with diabetes, the HbA1c level was found to have no significant association with the severity of hearing loss (Chi-square value- 9.243, df-4, p value>.05). Conclusion: It was concluded that there is no significant difference in hearing loss amongst the persons with and without diabetes. No significant association exists between the HbA1c levels and severity of hearing loss amongst the persons with diabetes.

**Keywords**---Hearing loss, Type 2 Diabetes mellitus type, Glycated Haemoglobin A1c, Pure Tone Audiometry, Incidence.

## Introduction

Hearing loss is a widely spread health condition. <sup>[1]</sup> Hearing defects can cause inconvenience in communication which can have prodigious impact on the psychological, social and emotional functions. <sup>[2]</sup> It increases the risk of falls and injuries, leading to increased functional limitation and subsequent disability, and reduce one's activity and participation, ultimately leading to decrease in quality of life. <sup>[3]</sup>

Various factors known to precipitate hearing loss include age, sex, noise exposure, and genetic predisposition, cardiovascular disease and its antecedents. <sup>[1]</sup> Many researchers have focussed on the association between diabetes and hearing loss. In 1857, Jar Dao for the first time mentioned the association between diabetes and hearing loss. <sup>[4]</sup> A meta-analysis of 18 clinical studies have reported association between diabetes and hearing loss <sup>[5]</sup> whereas many others have found no association between the two conditions. <sup>[6]</sup> Presence of confounding factors and complexity of auditory canal represent the pitfalls in estimating the affect of diabetes on hearing loss. <sup>[6]</sup>

It has been estimated by the International Diabetes Federation that the number of persons with diabetes may increase up to 642 million by 2040. <sup>[7]</sup> The increasing incidence of diabetes and profound effect of hearing loss on quality of life mandates the need to study the possible association between the two.

This study was undertaken with the aim to compare auditory acuity in normoglycemic and hyperglycemic subjects and to find out the effect of hyperglycemia on auditory acuity.

**Aim:** To correlate sensorineural hearing loss in diabetes mellitus patients.

**Objective:** To Evaluate sensorineural hearing loss in diabetes mellitus and its association with HbA1c and comparison of it with non-diabetic patients.

## Materials & Methods

### Ethical consideration:

This study was approved by the Ethics Committee of the Index Medical College and Research Center (IMCHRC), Indore (M.P.), India (Registration no.-EC/NEW/INST/2021/1687). Written informed consent was obtained from the participants and confidentiality of their data was maintained.

### Study area:

The Present study was conducted in Department of Otorhinolaryngology and Internal Medicine at Index Medical College Hospital & Research Centre, Indore (M.P.)

### Study population:

This cross-sectional, observational study was conducted in the Department of Otorhinolaryngology & Internal Medicine, IMCRC, Indore, India. The study included 100 patients aged 35-55 years, such that 50 patients were non-diabetic (Group A) and patients were having type 2 diabetes mellitus (Group B) and 50. The sample of both the groups were matched for age and gender.

### Study groups:

GROUP A: 50 (Healthy subjects)

GROUP B: 50 (Diabetic patients)

### Inclusion criteria:

Group A	Group B
Age between 35 – 55 years	Age between 35 – 55 years
Had given consent	Had given consent
Non-Hypertensive	Non-Hypertensive

### Exclusion criteria:

Group A	Group B
Hypertension	Hypertension
Diabetes mellitus	
History of consumption of ototoxic drugs in past three months.	History of consumption of ototoxic drugs in past three months.
History of ear surgeries performed in the past.	History of ear surgeries performed in the past.
History of middle ear infections in the past	History of middle ear infections in the past
History of recent infections in the nose, throat or ear	History of recent infections in the nose, throat or ear
Patients having a noise induced hearing loss	Patients having a noise induced hearing loss

### **Sample size and sampling technique**

The sample size was calculated using G\*Power 3.1.9.7 software. The test family was Chi-square. The sample size was calculated assuming the medium effect size (0.3, according to Cohen). The sample size was calculated to achieve the 80% power of the study. The margin of error was set at 5%. The present study involved 2 groups. Accordingly, the minimum required sample size was 88. However, it was proposed to include 100 patients in the study.

In order to rule the effect of confounders, the patients with hypertension, history of consumption of ototoxic drugs in past three months, history of ear surgeries performed in the past, history of middle ear infections in the past, history of recent infections in the nose, throat or ear, patients having a noise induced hearing loss were excluded from the study.

Diabetes was defined as follows: medical history of diabetes; reported use of medications to treat diabetes; fasting serum glucose  $\geq 7$  mmol/l ( $\geq 126$  mg/dl); glycated haemoglobin (HbA1c) level  $\geq 48$  mmol/mol ( $\geq 6.5\%$ ); or 2-hour oral glucose tolerance test with 75 g of glucose  $\geq 11.1$  mmol/l ( $\geq 200$  mg/dl). [7]

Convenience sampling technique was employed for the enrolment of patients in the study.

### **Methodology**

Pure-tone audiometry (using MAICO MA 42 audiometer) was performed using air conduction at octave frequencies from 250-8,000 Hz and bone conduction at 500-4,000 Hz. The test was performed in a sound proof room. The audiometer was so calibrated that hearing of a normal person, both of air and bone conduction is at 0 db and there is no A-B gap. Method of pure tone audiometry was based on American Society for Speech and Hearing Association [ASHA] 1978 guidelines as mentioned in manual pure tone audiometry (PTA). [8]

### **Statistical analysis**

Data was analysed using SPSS (Statistical Package for Social Sciences) 21.0 version, IBM, Chicago. Data was analysed for normality distribution using Shapiro-wilk test, p value  $< .05$  indicated that the data was not normally distributed and thus, the non-parametric test of significance were applied. Association between the categorical variables was assessed using Chi-square test. P value  $< .05$  was considered statistically significant.

## Observations

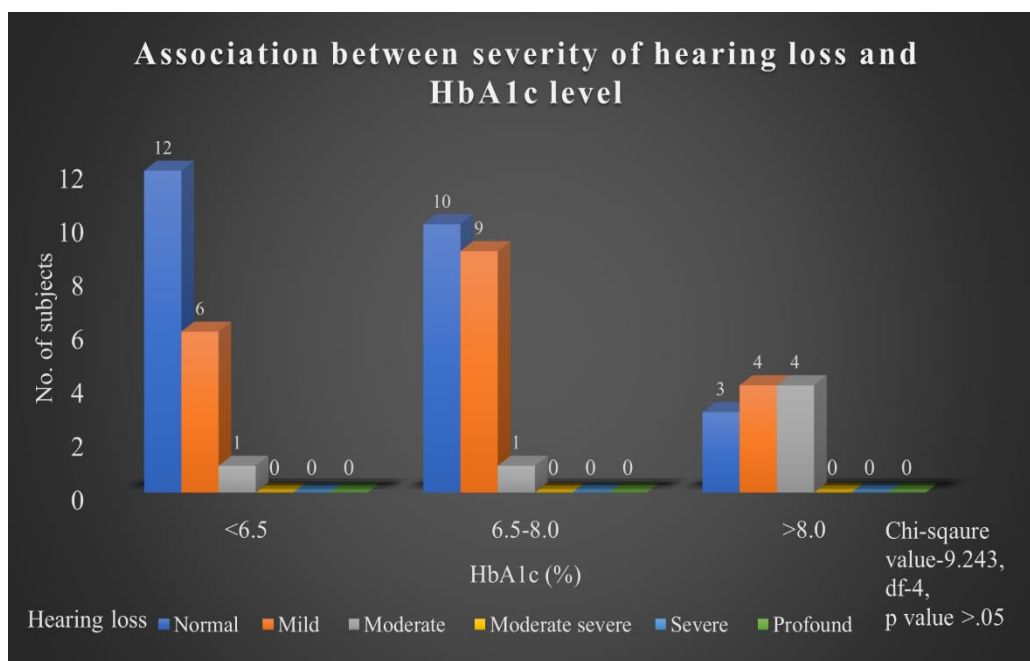


Figure 1. Association between severity of hearing loss and HbA1c levels amongst patients belonging to group B.

Table 1. Comparison of various parameters amongst the participants belonging to group A and group B

		Group A	Group B	Z value	P value <sup>a</sup>
Age (years)	Median	39.0	40.0	-.520	>.05
	Inter-quartile range	36.0-45.0	36.0-45.25		
RBS (mg/dl)	Median	103.0	276.0	-8.618	<.05*
	Inter-quartile range	94.25-118.5	212.5-293.5		
Serum Creatinine (mg/dl)	Median	0.945	.965	-1.128	>.05
	Inter-quartile range	.80-1.04	.8175-1.1775		
HbA1c (%)	Median	-	7.0	-	-
	Inter-quartile range	-	5.625-8.0		
Duration of diabetes (months)	Median	-	24.0	-	-
	Inter-quartile range	-	12.0-51.0		

<sup>a</sup>Man-whitney U test. \*p value<.05 was considered statistically significant.

Table 2. Association between diabetes and PTA

Pure Tone Audiometry	Group A (non-diabetic)	Group B (Diabetic)	Chi-square value	df	P value <sup>Ω</sup>
Normal	25 (50.0%)	25 (50.0%)	2.1	3	>.05
Mild	21 (42.0%)	19 (38.0%)			
Moderate	3 (6.0%)	6 (12.0%)			
Moderate severe	1 (2.0%)	0 (0.0%)			
Severe	0 (0.0%)	0 (0.0%)			
Profound	0 (0.0%)	0 (0.0%)			
Total	50 (100.0%)	50 (100.0%)			

<sup>Ω</sup>Chi-square test, df- degree of freedom

## Results

The difference in the age and serum creatinine level of patients and ratio of male: female participants belonging to two groups was non-significant (p value >.05). The two groups were significantly different with respect to Random Blood Sugar level (p value<.05). [Table 1] No significant association was observed between the presence or absence of diabetes and hearing loss. [Table 2] Amongst the patients with diabetes, the HbA1c level was found to have no significant association with the severity of hearing loss. [Figure 1]

## Discussion

Present study included patients aged 35-55 years. The median age of the patients in groups A and B was 39.0 (36.0-45.0) years and 40.0 (36.0-45.25) years. This age was chosen so as to avoid the effect of aging on the hearing capacity. Gradual hearing loss has been reported in almost every individual as they grow old. [9] In India, the prevalence of hearing loss was reported to be 25%-50% amongst elderly aged 60 years or more. [10] Progressive hearing loss in old age occurs due to progressive sensorial, neural, and strial hearing loss, reduced cochlear cell support and depressed central neural processing as a normal part of aging. [11] The pattern of hearing loss with aging has been found to differ between men and women,[12] thus in the present study attention was paid to maintain two groups similar with respect to the distribution of males and females.

In the present study, in both the groups the number of patients with normal hearing capacity was found to be equal (50%). In the study done by Yikawe SS et al. (2017), among the type 2 DM (Diabetes Mellitus) participants, 28.2% were found to have normal hearing thresholds. This difference in the finding of two studies can be attributed to the fact that their study included older patients as compared to the present study. [13]

The number of patients with mild, moderate and moderately severe hearing loss was non-significantly different between the groups. None of the patients in both the groups was found to have severe or profound hearing loss. Indicating no significant difference in the hearing capacity of the patients of two groups. Similarly, Rajendran *et al.* and Ologe and Okoro also did not find any association

between hearing loss and type II diabetes mellitus. [14,15] In contrast to the present study, Gupta G et al., 2019 found that type 2 diabetes has significant association with a modestly higher risk of moderate or worse hearing loss. However, this association was seen in patients having diabetes for 8 years or more. [16]

This could be attributed to the fact that in the present study the median duration of diabetes was 2 years, which was probably an insufficient duration for the development and exhibition of chronic complication such as hearing loss. [17] Diabetes mellitus (DM) is a group of metabolic disorders sharing common phenotype of hyperglycaemia. The complications of diabetes can be chronic and acute. It has been reported that chronic complications of diabetes have direct link with the duration of hyperglycaemia. Such complications usually appear after 10 years of hyperglycaemic state. [17] This agrees with the pattern observed with other microvascular complications of diabetes [13] Over time, high blood sugar levels lead to damage to small blood vessels and nerves in the inner ear, however, low blood sugar over time can cause damage to the transfer of nerve signals from the inner ear to your brain. Both types of nerve damage can lead to hearing loss. [18] The damage to the nerve observed in the patients with diabetes is the result of increased polyol flux, deposition of glycated end products, oxidative stress, Protein Kinase C (PKC) activity, pro-inflammatory process in the nerves. [19] Knowing the impact of hearing loss on the quality of life, further research should be done to identify the risk factors for hearing loss. Studies should be conducted, also including participants having diabetes for duration of 10 years or more, so correct association between diabetes and hearing loss can be established.

### **Conclusion**

Based on the results of the study we fail to reject the null hypothesis stating that there is no significant difference in hearing loss amongst the persons with and without diabetes. However, in the present study the median duration of diabetes was 2 years, which was probably an insufficient duration for the development and exhibition of chronic complication such as hearing loss. Therefore, no significant association was found between the HbA1c levels and severity of hearing loss amongst the persons with diabetes in present study. A larger study specimen is needed to determine the association between type 2 diabetes and audiometric changes.

**Conflict of Interest:** Nil

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