

# Correlation between sensorineural hearing loss and HbA1c in diabetes mellitus patients

<sup>1</sup>Rukmini Sharma, <sup>2</sup>Dr. Raghudev Choudhary, <sup>3</sup>Dr. Rajendra K Teharia

<sup>1</sup>Ph.D. Scholar, Department of Physiology, Dr.S.N.Medical College, Jodhpur, Rajasthan, India

<sup>2</sup>Senior Professor, Department of Physiology, Dr.S.N.Medical College, Jodhpur, Rajasthan, India

<sup>3</sup>Assistant Professor, Department of ENT, Gajra Raja Medical College, Gwalior, Madhya Pradesh, India

**Corresponding Author:** Rukmini Sharma (sheetal.matrikripa@gmail.com)

## Abstract

Diabetes mellitus is a non-communicable chronic metabolic disorder. The association between sensorineural hearing loss and diabetes has become an important subject of research. Pathophysiology of hearing loss in diabetes is not still well explained. Usually gradual, bilateral, sensorineural hearing loss at high frequency is seen in diabetes mellitus. Our study aims to know the prevalence of SNHL in DM and its relation to HbA1c. A total of 300 subjects including 150 healthy individuals age and sex matched as control and 150 patients of type 2 diabetes between 10-50 years age group including 78 males and 72 females were included in the study. Fasting blood sugar and HbA1c of all the subjects were taken for the study and after that pure tone audiometry was performed (PTA). By observing the data degree, type and correlation with HbA1c of hearing loss was concluded. 28% diabetic patients suffered with SNHL while 72% were found with normal hearing threshold. Among 42 patients 23 mild, 9 moderate, 9 moderately severe and 1 severe degree hearing loss cases were found in diabetic group. Hearing loss was found on higher frequencies. Association between hearing loss and HbA1c was observed and it was highest in the 10-13.9% range but this correlation was not found significant ( $p$  value  $>0.05$ ) in our study.

**Keywords:** Diabetes mellitus, PTA (Pure Tone Audiometry), SNHL, HbA1C

## Introduction

Hearing loss is one of the major complications of diabetes which diminishes quality of life socially as well as personally. Diabetes mellitus is a very common non-communicable endocrine disorder that is responsible for much impairment in the whole body. Prevalence of diabetes is increasing day by day in all over the world but it is more in India. Prevalence of diabetes in the overall world population is up to 7%<sup>[1, 2]</sup>. India is considered to be the "Diabetic capital of the world" as the number of diabetic patients is around 40.9 million and by 2025 the number is expected to be 69.92 million<sup>[3]</sup>. Many chronic complications can be caused by diabetes including retinopathy, neuropathy, nephropathy and damage to other vascular systems and skin. All these complications decrease the quality of life and considerably cause morbidity and mortality<sup>[4]</sup>. Despite so many studies and pathological findings in the inner ear, an evaluation of the existing literature showed that the relationship between diabetes and hearing loss is still controversial. While some studies revealed an increased risk of hearing loss in diabetic patients, other studies did not find any relation between diabetes mellitus and hearing impairment<sup>[1, 5, 6-16]</sup>. Studies on the prevalence of otological hearing loss with diabetes have not much explored so we have aimed our study to determine the hearing loss in diabetic cases.

## Objectives

Evaluation of sensorineural hearing loss in diabetes mellitus and its association with HbA1c.

## Materials and Methods

Our study was conducted on a total number of 300 subjects from November 2018 to December 2020 in Dr. S. N. Medical College Jodhpur Rajasthan.

Exclusion criteria for both group was hearing impairment caused by any other disorder, family history of diabetes, history of noise exposure and ototoxic drug intake, Non cooperative subjects and subjects which were not able to communicate. FBS and HbA1c of all subjects were recorded. Age group we have selected was from 10-50 years. Upper age group limit was strictly limited to 50 years to minimize the effect of presbycusis. A through ENT examination was done to exclude any other cause of audiovestibular involvement for hearing loss. Tuning Fork Tests and Pure Tone Audiometry (PTA) were performed for audiological investigations. Average of audiometric thresholds at 500, 1000 and 2000 Hz (PTA-Pure Tone Average) was calculated for air and bone conduction. This calculated PTA was categorized in various degrees (mild, moderate, moderately severe and severe) of hearing loss accordance to WHO. Every diabetic as well as control subject had undergone a hearing assessment by pure tone audiometer [GSI 61], the frequency ranged between 250-8000 Hz. FBS, HbA1C, duration, age, sex, family history and other data was also collected. Statistical analysis for quantitative data was calculated through mean and standard deviation (S.D.). Proportions and percentage were measured for quantitative data. Chi square test was used for analysis.

## Results

In present study, diabetic subjects found to have higher prevalence of hearing loss when compared to control subjects.

**Table 1:** Prevalence of hearing loss among both study groups

Presence of SNHL	Group 1 (control) (n=150) (%)	Group 2 (diabetic) (n=150) (%)
Present	14(9.33%)	42(28%)
Not present	136 (90.67%)	108 (72%)

**Table 2:** Mean PTA comparison in both study groups

S. No.	Study group	Mean PTA $\pm$ SD	P Value
1.	Control group	20.66 $\pm$ 7.334	0.0140
2.	Diabetic group	26.34 $\pm$ 12.385	

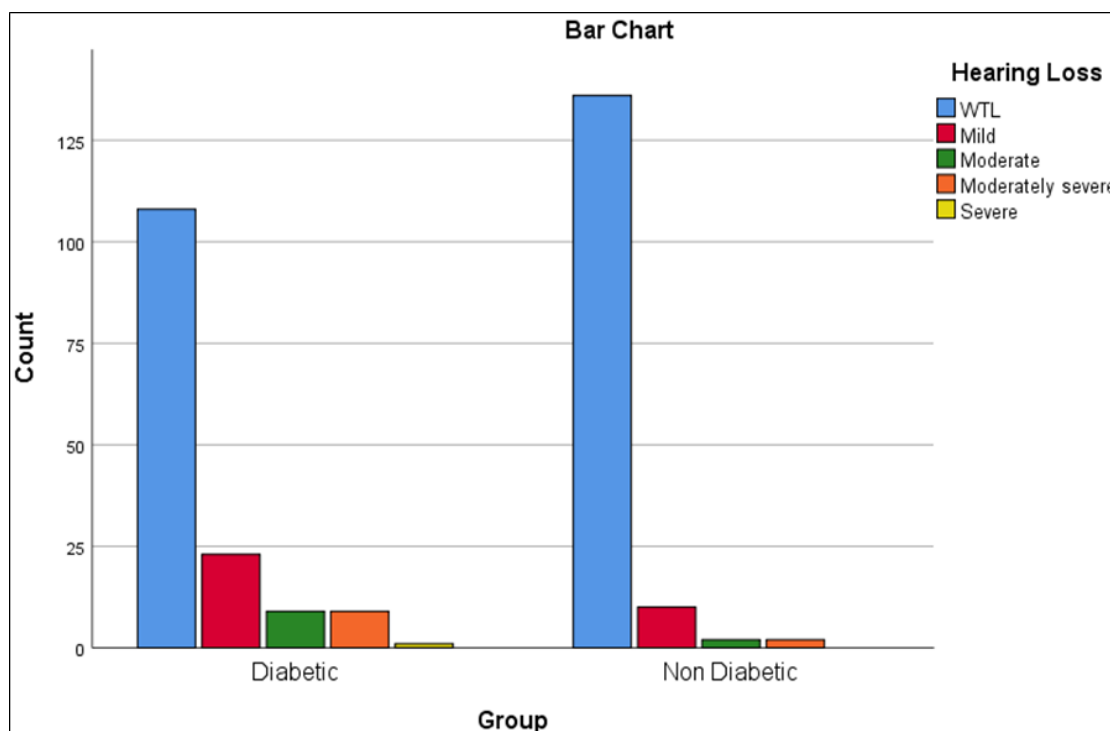
In control group 14(9.33%) subjects who were healthy individuals and 42(28%) patients who had diabetes mellitus from diabetic group (150) suffered from hearing loss (Table 1). Table 2 shows comparison between mean PTA of diabetic and control group, it shows significant *p* value (0.0140) < 0.05. These results show that there is a strong association between diabetes and hearing impairment.

**Table 3:** Comparison of degree wise hearing loss cases in both groups

		Hearing Loss					Total
		WTL	Mild	Moderate	Moderately severe	Severe	
Study Group	Diabetic	108	23	9	9	1	150
	NonDiabetic	136	10	2	2	0	150
Total		244	33	11	11	1	300

Chi-Square Tests			
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	18.243	4	0.001

Likelihood Ratio	19.505	4	0.001
N of Valid Cases	300		



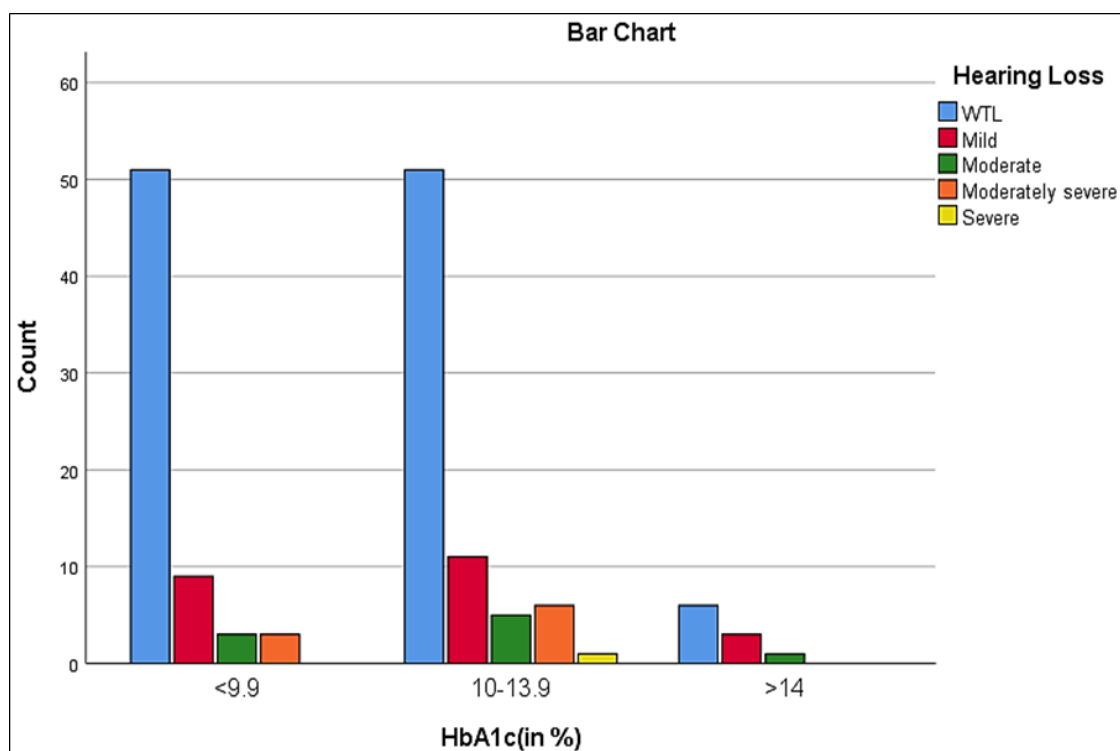
**Chart 1:** Comparison of degree wise hearing loss cases in both groups

Table 3 and chart 1 are showing distribution of subjects according to the degree of hearing loss between diabetic and non-diabetic group. In the non-diabetic group total 14 patients were having hearing loss. Among them 10 were mild, 2 were moderate and 2 were moderately severe and no patient was found in severe category. In diabetic group among 42 patients 23 were mild, 9 were moderate and 9 were moderately severe and 1 patient was from severe group. Chi square test for comparison in both groups was found significant so it shows a strong correlation between hearing loss of different degrees and diabetes. P value is <0.05 so shows it very significant.

**Table 4:** Correlation between HbA1c and degree of hearing loss in diabetic group

Correlation between HbA1c (in %) in and degree of hearing loss							
		Hearing Loss					Total
		WTL	Mild	Moderate	Moderately severe	Severe	
HbA1c (in %)	<9.9	51	9	3	3	0	66
	10-13.9	51	11	5	6	1	74
	>14	6	3	1	0	0	10
Total		108	23	9	9	1	150

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.068	8	0.750
Likelihood Ratio	5.697	8	0.681
Linear-by-Linear Association	1.383	1	0.240
N of Valid Cases	150		



**Chart 2:** Correlation between HbA1c and degree of hearing loss in diabetic group

Table 4 and chart 2 show HbA1c measurement indicates which indicates the control of diabetes. In present study maximum 23 (76.19%) subjects of hearing loss were found in 10-13.9% group followed by 12 (28.57%) in <9.9 % group and minimum 4 (9.5%) patients of HL were found in >14% group of HbA1c%. Our study does not show any correlation between HbA1c and SNHL in DM ( $p > 0.05$ ).

## Discussion

Our study results matched with the study of Somogyi A *et al.* (34%)<sup>[17]</sup>, Saini *et al.* (30%)<sup>[18]</sup>, Sachdeva *et al.* (33.7%)<sup>[19]</sup>. Our study results were low in comparison of Taylor and Irwin 1978 (70%)<sup>[20]</sup>, Friedman *et al.* 1975 (55%)<sup>[21]</sup>, Chamyale *et al.* 1997 (66.6%)<sup>[22]</sup> and very lower in comparison to Rajendran S *et al.* 2011 (73%)<sup>[23]</sup> and Rozanska-Kudelska M *et al.* (95%). However Kakarlapudiet *al.* (13.1%)<sup>[5]</sup> Found lower results in comparison to our study. Results of individual study are dependent on the inclusion and exclusion criteria, period of study, sample size and heterogeneity of particular population. However there are some authors Axelson *et al.* 1968<sup>[24]</sup>, Cullen<sup>[25]</sup>, Kurien M *et al.* (1989)<sup>[26]</sup> and Harner SG<sup>[8]</sup> who did not found any correlation between diabetes and hearing loss and completely deny this relationship.

In our study we categorized HbA1c % in three categories <9.9, 10-13.9 and >14 and found out of total 66 patients in first group, 15 (9 mild, 3 moderate and 3 moderately severe) were having hearing loss, among 74 patients in second category, 23 (11 mild, 5 moderate, 6 moderately severe and 1 severe degree of HL) were having hearing loss and in last category out of 10 patients, 4 (3 mild and 1 moderate) patients were having HL (table 17). In our study result it is clearly visible that higher range of HbA1c (>14) {means lower glycemic control} had high percentage (40%) of HL patients and lower category of HbA1c (<9.9) {higher glycemic control} had lower percentage (22.7%) of HL patients and middle range of HbA1c (10-13.9) were having 31% of HL but there was no association found between HbA1c and hearing loss ( $p$  value  $> 0.005$ ). Our studies were found similar to Dalton SD *et al.* (1998) and Salvenelli F *et al.* (2004), Kakarlapudi V *et al.* 2003 who also did not found any correlation between glycemic control and hearing loss.

In contrary to our study Kurien M *et al.* (1989)<sup>[26]</sup>, Tay HL *et al.* (1995)<sup>[27]</sup>, Panchuet *al.*<sup>[28]</sup>,

Srinivas *et al.* (2016)<sup>[29]</sup>, found a significant association between HbA1c and HL. They found poorly controlled diabetes means higher HbA1c level have significant hearing loss.

### Conclusion

In present study we concluded that there is a strong association between type 2 diabetes mellitus and hearing loss. In diabetes, hearing loss was found of sensorineural, bilateral, mild to severe degree and involves high frequency thresholds. Prevalence of SNHL was found 28% in our study. HbA1c were found to have no significant association in this study.

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**Conflict of interest:** None declared.

**Ethical approval:** The study was approved by Institutional ethical committee, Dr. S.N. Medical College, Jodhpur, Rajasthan, India.

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