

# Diabetic-Mellitus as an Etiological Factor in Hearing Loss

Jeevan Jyoti<sup>1</sup>, Younus Majeed Dar<sup>1,\*</sup>, Shahnaz Ahmed Mir<sup>2</sup>, Ihsan Ali<sup>1</sup>

<sup>1</sup>Department of ENT & HNS, Government Medical College, Srinagar (J&K), Kashmir University, Srinagar, India

<sup>2</sup>Department of Endocrinology, Government Medical College, Srinagar (J&K), Kashmir University, Srinagar, India

## Email address:

ajitajua636@gmail.com (J. Jyoti), drymd1992@gmail.com (Y. M. Dar)

\*Corresponding author

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**Abstract:** Background: The association of sensorineural hearing loss (SNHL) in diabetes mellitus patients is known since decades, yet there is no clear consensus among previous studies, with respect to the prevalence of SNHL in type 2 diabetes patients and the effect of duration and control of diabetes on hearing acuity. Hence the objectives of this study are to find the prevalence of SNHL in type 2 diabetes patients and to find the effect of duration and control of diabetes on hearing loss. Methods: The present study was conducted on 100 type 2 diabetes patients and age and gender matched 100 non-diabetic controls in the age group of < 50 yrs, selected based on inclusion and exclusion criteria. After detailed history taking and clinical examination, all subjects underwent FBS, PPBS estimation and HbA1c evaluation was done for diabetic patients. All underwent pure tone audiometry, DPOAE and BERA and the findings were recorded and analyzed. Results: Diabetes patients had insidious onset, gradually progressive, bilaterally symmetrical SNHL. SNHL is prevalent in 73% of type 2 diabetes patients compared to 16% of controls. It is aggravated with the increasing age and duration of diabetes. Poor control of diabetes showed increased prevalence of SNHL compared to good control of diabetes. Conclusions: There is increased prevalence of SNHL in type 2 diabetes patients and it is more evident in patients with long duration of diabetes and more pronounced in patients with poor diabetic control.

**Keywords:** Sensorineural Hearing Loss, Diabetes Mellitus, PTA, DPOAE, BERA

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## 1. Introduction

Type 2 diabetes mellitus (DM) is a syndrome of chronic hyperglycemia due to relative deficiency of insulin, resistance to insulin or both [1]. In 2009, an International Expert Committee that included representative of American Diabetic Association (ADA), the International Diabetic Federation (IDF) and the European Association for the Study of Diabetes (EASD) recommended that a threshold of > 48mmol/Lt. (>6.5%) should be used to diagnose diabetes [2]. This recommendation was adopted by the American diabetes association in 2010 [3]. Long term complications from higher blood glucose levels include heart disease, stroke, peripheral neuropathies, diabetic retinopathy which can result in blindness, kidney failure and poor blood flow in limbs which may lead to amputations [4]. Diabetes affects multiple systems of the body including ear, it causes neuropathy of the 8th nerve (vestibulo-cochlear nerve) [5]. The

pathophysiological changes that accompany diabetes may similarly causes injury to vasculature or the neural system of inner ear. So the pathogenic effect of diabetes on the ear can be grouped into neuropathic, angiopathic and combination of the two. The tissue effect of diabetes are thought to be related to polyol pathway, where glucose is reduced to sorbitol. Sorbitol accumulation is implicated in neuropathy by causing a decrease in myoinositol content, abnormal phosphoinositide metabolism and decrease in sodium-potassium ATPase activity [6]. The hearing loss associated with diabetes is sensorineural type and it account for about 90% of patients. The term sensorineural hearing loss (SNHL) used to indicate that there is either a cochlear or retrocochlear lesion. SNHL is more common in diabetics than non-diabetics and severity of hearing loss seemed to correlate with progression of diabetes mellitus [7]. Histopathological evidence of vascular or neurological involvement obtained from autopsied patients with diabetes include sclerosis of

internal auditory artery, thickened vessels of the striavasularis and of the basilar membrane, demyelination of the cochlear nerve and atrophy of spiral ganglion [8]. Loss of outer hair cells also been observed among patients with diabetes [9].

It is thus anticipated that the results of the review will provide an insight into possible relationship between type 2 diabetes mellitus and hearing loss.

## 2. Material and Methods

The present analytical cross – sectional study was conducted in outpatient department of Otorhinolaryngology, Head and Neck Surgery and department of endocrinology, government.

Medical College Srinagar, for period of one year. The study was comprised of two groups, a study group and a control group. Study group included patients who were diagnosed as type 2 DM attending diabetic clinic in Endocrinology OPD while the control group comprised of age and sex matched non-DM individuals. Both groups were subjected to thorough audiological evaluation.

### 2.1. Inclusion Criteria

1. Biochemically proven hyperglycemic patients.
2. Age less than or equal to 50 years.

3. Both genders.

### 2.2. Exclusion Criteria

1. Patients with any other systemic illness or metabolic disorder.
2. Gestational diabetes.
3. Patients on ototoxic drugs or any ear surgery done/occupational exposure to noise.
4. Noise induced hearing loss.
5. Patients with CSOM and CHL.
6. Patients with congenital SNHL.

All these individuals were evaluated with a detailed clinical examination and appropriate investigation.

## 3. Result and Analysis

*Table 1. Gender distribution.*

Gender	No. of Patients	Percentage
Male	31	31.0
Female	69	69.0
Total	100	100.0

Table 1 shows gender distribution of patients having type 2 DM. It consists of 31 males and 69 females, more than two-third patients were females.

*Table 2. Demographic details.*

	Diabetic Group	Non-diabetic Group
Mean age (years)	43.20±6.54	34.61±8.85
Mean fasting blood sugar	133.95±27.83 (range 81-253)	106.08±3.69 (range 100-18)
Mean postprandial blood sugar	173.81±41.19 (range 107-346)	129.68±9.99 (range 108-148)
Mean HbA1c	7.81±0.86 (range 5.4-9.6)	6.003±2.44 (range 5.3-6.5)

Table 2 shows demographic profile of DM group and non-DM group total of 100 patients of DM were taken out of which 31 were are males and 69 were females. The mean age of patients was 43.20, mean fasting blood sugar was 133.95±27.83, mean PP blood sugar was 173.81±41.19 and mean HbA1c was 7.81±0.86.

Control group consists of non-DM patient's total of 100 patients, were taken in control group in which 46 are males and 54 are females. Mean age of patients was 34.61, mean fasting blood sugar was 106.08±3.69, mean post-prandial blood sugar was 129.68±9.99 and mean HbA1c was 6.003±0.244.

Table 3 shows relationship between duration of diabetes

mellitus and SNHL. Patients having less than 5 years of duration of diabetes mellitus had 65.71% prevalence of SNHL whereas patients having duration of diabetes 6-10 years had 86.9% prevalence of SNHL and there are 100% chances of SNHL in patients having duration of diabetes > 10 years.

*Table 3. Relationship between duration of diabetes mellitus and SNHL.*

Duration (years)	Hearing Status		Total
	Normal	SNHL	
<5	24 (34.28%)	46 (65.71%)	70
6-10	3 (13.04%)	20 (86.95%)	23
>10	0	7 (100%)	7
Total	27	73	100

*Table 4. Duration of diabetes mellitus in years.*

SNHL	No. of Patients	Mean Duration of Diabetes in years	SD	Mean difference	P value
Absent	27	2.43	1.92	-2.78	0.002
Present	73	5.22	4.34		

Table 4: In this table it was found that in patients having mean duration of diabetes 2.43 years had no SNHL while patients with mean duration of diabetes 5.22 years shows SNHL with mean difference of 2.78.

Table 5 shows comparison of SNHL among DM and non-

DM group. In DM group only 27 patients had normal hearing and 73 patients had SNHL, in which, 15 had minimal SNHL, 18 had mild SNHL, 23 had moderate SNHL, 5 had severe SNHL and 12 patients had profound hearing loss. In control group 84 patients showed normal

hearing and 16 patients showed SNHL in which 4 had minimal hearing, 7 had mild hearing, 5 had moderate

SNHL. No patient in control group showed severe or profound hearing loss.

**Table 5.** Comparison of SNHL among Diabetic & Non-Diabetic.

PTA	Non-DM	DM	Total
Normal	84	27	111
Minimal SNHL	4	15	19
Mild SNHL	7	18	25
Moderate SNHL	5	23	28
Severe SNHL	0	5	5
Profound SNHL	0	12	12
Total	100	100	200

Table 6 shows comparison of various factors among cases and controls, total of 100 patients were taken in both groups. Mean fasting blood sugar among DM patients was 133.95 as

compared to 106.08 in non-DM, mean blood sugar PP was 173.81 in DM as compared to 129.68 in non-DM, mean HbA<sub>1c</sub> levels in DM was 7.81 as compared to 6.0 in non-DM.

**Table 6.** Comparison of various factors among Diabetic & Non-Diabetic.

Variable	Group	N	Mean	SD	Mean Difference	p Value
Fasting Blood Sugar	Non-Diabetic	100	106.08	3.69	-27.87	<0.001
	Diabetic	100	133.95	27.83		
Post-prandial Blood Sugar	Non-Diabetic	100	129.68	10.00	-44.13	<0.001
	Diabetic	100	173.81	41.19		
HbA <sub>1c</sub>	Non-Diabetic	100	6.00	0.24	-1.81	<0.001
	Diabetic	100	7.81	0.86		

## 4. Discussion

**Age and Sex Distribution** In the present study total of 200 subjects were studied, out of which 100 were diabetic and 100 were non-diabetic. Mean age of DM group was 43.20 years whereas mean age of non-DM was 34.61 years. All the patients were under 50 years of age. Out of 100 DM, 31 were males and 69 were females. All the patients were less than 50 years of age which exclude possibility of presbycusis and also they had no other otological or metabolic disease. The cases were already diagnosed with DM. Minimum age of the patients under study was 23 year and maximum age was 50 years. Study by Ashish AC et al (2013) conducted on diabetic patients consisting of similar age group between 18-50 years of age. It was found in their study that majority of them had minimal hearing loss followed by mild hearing loss. 30% of patients had normal hearing in both ears. Rajendran S et al (2011) [10] conducted a similar study in the age group 40-50 years and found that number of people affected with SNHL among the diabetes is 73.3% when compared to that of controls.

### 4.1. Demographic Details

The mean age of DM were 43.20 (SD 6.54) and that of non-DM were 34.61 (SD 8.85) with minimum age of participant was 23 years and maximum age was 50 years. The mean fasting blood sugar levels of DM group was 133.95±27.83 and it was ranging from 81 to 253 whereas mean fasting blood sugar levels of non-DM group was 106.08±3.69 and it was ranging from 100 to 118. The mean

post prandial blood sugar levels of DM group was 173.81±41.19 and it was ranging from 107 to 346 whereas mean post prandial blood sugar levels of non-DM group was 129.68±9.99 and it was ranging from 108 to 148. The mean HbA<sub>1c</sub> of DM group was 7.81± 0.86 and it was ranging from 5.4 to 9.6 whereas in non – DM mean HbA<sub>1c</sub> was 6.00±.244 and it was ranging from 5.3 to 6.5. The years of diagnosis of diabetes ranging from 3 days to 20 YEARS.

### 4.2. Duration of Diabetes

In the present study, it was shown that SNHL increases in diabetic patients with increase in duration of diabetes. Patients of DM were divided into three groups on the basis of duration of diabetes, in the first group patients of DM had 5 years of duration, second group consists of patients having duration of DM between 6-10 years and third group consists of duration of DM more than 10 years. It was found that pts. having 5 years of duration of DM had 65% prevalence of SNHL, whereas patients having 6-10 years of duration had 86.95% of SNHL and there was 100% chances of SNHL in patients having duration more than 10years. Also it was found that in patients having mean duration of DM 2.43 years had no SNHL while patients with, mean duration of dm 5.22 years had more chances of SNHL with mean difference of -2.78. Our study concluded that prevalence of SNHL increases with increase in duration of DM.

This study corresponds with the study conducted by Chhaya B et al (2017) [11], in which it was found that duration of DM may play significant important role in the occurrence of hearing loss and patients may suffer from hearing impairment sooner or later, however, if detected

early further deterioration in auditory function can be prevented. Akinpelu OV et al (2014) [12] did a meta-analysis on hearing functions in DM patients and found that duration of diabetes play an important role in occurrence of DM related hearing loss. Hussain RT et al (2018) [13] conducted a study and found that there was an association between hearing loss and duration of DM. Srinivas CV (2016) [6] conducted a study and found that there was a significant association between older age, longer duration and uncontrolled DM with that of SNHL. In patients having duration of DM more than 10 years, prevalence of SNHL is > 85% which is statistically significant.

Thus these studies had similar result as that of ours and it was found that duration of DM had significant effect on hearing loss.

#### 4.3. PTA Threshold

In the present study, after PTA evaluation, it was found that in the study group only 27 patients had normal hearing whereas 73 patients had SNHL. In control group following result was found; 84 had normal hearing whereas 16 patients had SNHL. This study corresponds to the study conducted by Ashish AC et. Al [10] who had similar results as of our's study. In his study he found only 30% of patients had normal hearing and 70% had SNHL. Sunkun AJK et al (2013) [14] conducted a similar study on DM patients and found in his study that 82% had SNHL. Rajendran S et al [10] conducted a similar study on DM patients and in his results 73.3% of DM patients had SNHL as compared to 6.7% of that of non-DM patients.

Thus these studies had similar results as of present study and it shows that DM had effect on hearing.

## 5. Conclusion

The observations in this study suggest that there is increased prevalence of SNHL in type 2 diabetes mellitus patients as compared to age and gender matched non-diabetic controls. Prevalence of SNHL is more evident in patients with history of longer duration of diabetes mellitus. The results of study suggest that diabetes mellitus have a definite and adverse effect on all constituent of auditory system. The cochlear and retrocochlear auditory system needs regular evaluation in patients of diabetes.

Thus this study concludes that the diabetics are at definite risk of developing auditory dysfunction, therefore it is recommended that all newly diagnosed diabetic patients should undergo a complete audiological evaluation at the time of diagnosis and a regular half yearly or yearly follow up is warranted for early detection of damage to auditory functions.

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