

## EFFECT OF EARLY ONSET TYPE 2 DIABETES MELLITUS ON HEARING

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**ABSTRACT: INTRODUCTION:** Diabetes mellitus is a multifunctional metabolic disorder affecting almost all the systems of the body. There is a strong relation between diabetes mellitus and hearing. The three main theories of pathogenesis of hearing impairment in diabetics are micro angiopathy, neuropathy and combination of both. Even though studies have proved the occurrence of sensorineural hearing loss (SNHL) in diabetes mellitus (DM), disagreement still exists among some about their relation. **DESIGN:** prospective design. **AIM:** Present study aimed 1) To find the prevalence of Sensorineural Hearing Loss in Type 2 Diabetes Mellitus 2) To study the association of hearing loss with the following factors among type 2 DM (a) Duration of Diabetes Mellitus (b) Severity of hyperglycemia. 3) To evaluate the result of our study and to compare our data with similarly published studies. **METHOD:** 75 individuals (150 ears) who have type 2 Diabetes Mellitus participated in the study. **RESULTS:** Prevalence of SNHL in type 2 DM was 80%. There was no association between SNHL and duration of DM but positive association was found between SNHL and severity of hyperglycemia. **DISCUSSION:** Globalization is rapidly transforming India from a developing to a developed country. People have become more health conscious and they expect to add more socially and economically productive years to their life span and hence this disorder which manifests mainly in middle age and older years of life require consideration. Hence this study is the need of the hour.

**KEY WORDS:** SNHL (Sensorineural hearing loss), Type 2 Diabetes Mellitus (DM), angiopathy neuropathy, glucose levels

**INTRODUCTION:** Type II DM, is the predominant form of diabetes worldwide accounting for 90% of cases [1]. It has reached an epidemic status in both developed and developing countries and has become one of the world's most important public health problems [2]. One of the main functions affected by it is hearing. Also incidentally hearing is one of the most important among the five senses gifted to mankind which plays an important role in the development of speech, communication and cognitive, emotional and social development of a human being [3]. Of late the incidence of DM has increased several folds and also though it was disease of old age, several cases are diagnosed in the earlier age sometimes as early as 30 years.

The relation between hearing loss and diabetes mellitus appears as a controversial topic as different studies have given conflicting results. Logically in patients aged above 50 years hearing loss due to DM may be additional to that due to age alone (ageing also causes SNHL). It is not aging of itself that causes the problem rather the effects accumulated from environmental noise toxicity and metabolic/ oxidative stress. Studies have shown it to be almost double. The exact damage because of diabetes cannot be assessed due to various factors. Type 2 DM in the age group of 30 -50 yrs (early onset) cannot be ignored in the present day scenario. Hence an attempt was made in our hospital to assess the increased prevalence of subclinical hearing loss in early onset / non elderly / middle aged (30 -50 years).

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The effect of diabetes mellitus on hearing is known since 1857, when Jordao first showed hearing loss in a patient with incipient diabetic coma [4]. The typical hearing loss in diabetics is progressive, bilateral SNHL affecting the higher frequencies. But rarely, there are incidences where sudden onset, SNHL affecting lower frequencies is also noted. The type of hearing impairment noted, is similar to that of presbycusis, but those affected show a greater decrease in hearing than one would expect at that age.

One of the studies compared the audiometric and clinical history with temporal bone histopathological findings of 8 diabetics and 10 controls matched for age and sex. The group with DM had significantly more hearing loss. The results suggest that diabetic SNHL results from microangiopathic involvement of the endolymphatic sac and basilar membrane vessels. They proposed that the significant vascular insult to the endolymphatic sac may cause the accumulation of toxic metabolic products which may result in hair cell dysfunction [5]. Certain studies state that increase in hearing threshold in diabetics is for low frequencies (500 Hz), but some authors say it is present only in high frequencies (6000Hz and 8000Hz) [6,7].

Lasisi et al (2003) found that the mean hearing thresholds in subjects with diabetes of less than 10 years duration was far better than those with greater than 10 years duration and other studies also supports that threshold becomes poorer as duration of diabetes increases [6, 7, 8], while others state that there is no relation between hearing threshold and diabetes mellitus [3, 4].

Glycosylated hemoglobin (HbA1C) is also one of the indicators for control of diabetes. But its elevated levels were not systematically associated with increased thresholds of hearing. Thus, direct evidence that poor metabolic control in diabetes causing SNHL remains to be proven [7]. Even though studies have proved the occurrence of SNHL in DM, disagreement still exists among some about their relation [9, 10].

Present study aimed 1) To find the prevalence of SNHL in Type 2 DM 2) To study the association of hearing loss with the following factors among type 2 DM (a) Duration of DM , (b) Severity of hyperglycemia. 3) To evaluate the result of our study and to compare our data with similarly published studies.

**METHOD:** The present study was conducted on diabetic patients selected randomly from our hospital. 75 individuals (150 ears) who have type 2 DM participated in the study. Informed consent was obtained from all the subjects enrolled in the study after explaining to them in detail about the study in their own language.

## **Inclusion criteria**

- Known patients of Type 2 DM
- Aged between 30 to 50 years
- Willing to undergo investigations

## **Exclusion criteria**

- Patients with conductive hearing loss
- Patients with mixed hearing loss
- Sensorineural hearing loss other than due to Type2 Diabetes, trauma due to head injury, congenital causes, family history of deafness, occupational noise exposure and presbycusis in otherwise normal will be excluded.
- Not willing to undergo investigations

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All the participants underwent following investigations:

- a) Thorough ENT examination with case history
  - b) HbA1C level (Glycosylated Hemoglobin) to find out the glycemic control, if patients have HbA1C level between 6-8% they were labeled as controlled and those with HbA1C level > 8% were labeled as poorly controlled.
  - c) Hearing tests like Pure tone audiometry and tympanometry for all patients. For pure tone audiometry, thresholds were obtained by using modified Hughson – Westlake procedure [11], for octave frequencies from 250Hz to 8 KHz for air conduction stimuli and from 250Hz to 4 KHz for bone conduction stimuli. For Tympanometry 226Hz probe tone was used to obtain ipsilateral and contralateral reflexes at 500Hz, 1000Hz, 2000Hz and 4000Hz.
- Once the investigations are done and extent of disease is established, management was planned accordingly.

## RESULTS AND DISCUSSION:

- a) The prevalence of SNHL in diabetic patients was studied under the following parameters:
  - Whether SNHL has taken sudden or gradual onset.
  - whether the degree of SNHL is slight (16 – 25 dB) /mild ( 26 – 40 dB ) /moderate ( 41-55 dB) /severe ( 56 – 70 dB) .
  - Descriptive statistics was done to measure mean and standard deviation. Inferential statistics was also carried out through independent t test to find out P value.

Total no of subjects with type 2 DM	With gradual SNHL	With sudden SNHL	Prevalence
75 cases	57	3	80%

Table 1: prevalence of SNHL among type 2 DM with details of gradual or sudden onset among them.

In our study, 75 aural symptomless type 2 DM patients (patients without symptoms of Hearing loss) underwent pure tone audiometry. Table 1 shows that out of 75 patients 60 had SNHL, that is prevalence of SNHL among type 2 DM is 80% and among SNHL cases, 57 of them developed gradual onset SNHL and 3 developed sudden onset SNHL. Degree of hearing loss among type 2 DM was also taken into account .15 cases had normal hearing, 30 had slight HL, 28 had mild SNHL, 2 cases had moderate SNHL and none of them had severe SNHL. Hearing loss was more common in high frequencies but in few cases there was loss in mid frequencies also. In the present study pure tone average of 500 Hz, 1000Hz and 2000Hz was taken to find out the degree of hearing loss.

Pure tone average	No of subjects with type 2 DM following under each category (%)
Slight hearing loss ( 16 – 25 dB)	30(50%)
Mild SNHL( 26- 40 dB)	28(46.6%)
Moderate SNHL( 41- 55 dB)	2(3.3%)
<b>Mean ± SD</b>	<b>22 ± 4.8</b>

Table 2: Subjects with type 2 DM having different degree of hearing loss with mean and standard deviation

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- Present study followed ASHA classification of hearing loss[12]
- b) Association of hearing loss with the following factors among type 2 DM i) Duration of DM ii) Severity of hyperglycemia was also studied.

Duration of diabetes in years	No. of cases	Cases with SNHL Number	Cases with SNHL Prevalence (%)
0-5	22	19	86.3%
6-10	25	22	88.0%
11-15	19	15	78.9%
16-20	9	4	44.4%

**Table 3: Prevalence of SNHL considering duration of DM as factor**

From the table 3, we can see that there are 22 cases with 0-5 years duration of diabetes, among which 19 (86%) had SNHL. Similarly, among 25 cases with 6-10 years of duration, 22 cases (88.0%) had SNHL but among 19 cases in 11-15 duration of diabetes 15 (78%) of them had SNHL and 9 cases in 16-20 years duration group wherein 4 (44%) had SNHL. It is clearly seen that there is no relation between duration of DM and SNHL. Independent t test shows no association between duration of diabetes and SNHL (P value >0.05).

Glycosylated Hb level	No. of cases	Cases with SNHL	prevelence (%)
Controlled HbA1C (6-8%)	42	33	78.5%
Uncontrolled HbA1C > 8%	28	27	96.4%

**Table 4: Prevalence of SNHL considering severity of DM as factor**

From the table 4, we can infer that among 42 controlled diabetics 33 (78.5%) had SNHL and out of 28 uncontrolled diabetes 27 (96.4%) had SNHL. Independent t test shows association between control of diabetes and SNHL (P value < 0.05) .

**Comparing with other studies:** Most of studies have supported association of SNHL with diabetes. The present study also supports the association of SNHL with diabetes with a prevalence of 80 %. The hearing loss is usually of gradually progressive type. But Shuen Fu in 2005 reported a series of 68 sudden onset of SNHL in diabetes [13]. Our study presents only 3 cases of sudden onset SNHL. So the results of the present study supports gradual onset of hearing loss. The hearing loss is more common in higher frequencies as stated by Kurien M in 1989 and Cullen R in 1993 [3, 4 ]. But Tay in 1995 stated that the hearing loss was in mid and low frequencies while Fangchao MA in 1998 found hearing loss in diabetics only in 500Hz frequency [14, 6]. Our study shows hearing thresholds to be increased in higher frequency but hearing loss in mid frequencies was also seen in few cases. Salvenelli et al (2004) did not find hearing loss in the diabetics included in his study. The results of the present study do not match that of Salvenelli et al [10]. The possible pathophysiological basis for this reduction in auditory acuity may be; microangiopathy of the inner ear, neuropathy of the cochlear nerve, or a combination of both.

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Several studies have attempted to locate the site of any possible pathological processes causing hearing loss in diabetics. Microangiopathy of the small blood vessels to the inner ear has been commonly cited as the causative pathology. Some noted thickened capillaries in the stria vascularis, basilar membrane, and endolymphatic sac [5]. They also proposed that these changes were responsible for diabetic SNHL. Similar microangiopathic mechanisms were proposed by Kakarlapudi et al (2003) [15]; Zelenka et al (1965) who found sensorineural hearing loss in all the frequencies tested in their diabetic subjects [16].

Studies have found that there is no association between duration of diabetes and hearing loss [17, 18, 3, 9]. The present study supports the above conclusion. It can be concluded that not all the diabetic patients have uncontrolled hyperglycemia during their course of the illness. So rather than the duration of illness, the degree of hyperglycemia and the HbA1C levels are more important in determining the auditory acuity.

Occurrence of SNHL in diabetics depends on the control of the disease. Most of the studies have stated that a better control of diabetes delays or prevents the onset of SNHL in that person [3,4, 14 ]. Dalton et al (1998) [18] and Salvaneli et al (2004) [10] both do not show an association between glycosylated hemoglobin levels and hearing loss. Present study contradicts their findings.

**CONCLUSION:** Hearing impairment is an under recognized complication of early onset type 2 DM. The relationship between diabetes and hearing loss is controversial. The present study was undertaken to better understand the disease and its influence on hearing acuity. It was found that there is association of SNHL in type 2 DM and prevalence of SNHL in poorly controlled diabetic patients was 96.4%.

Globalization is rapidly transforming India from a developing to a developed country. People have become more health conscious and they expect to add more socially and economically productive years to their life span. This disorder which was manifesting mainly in older years of life is now manifesting in earlier years hence it is advisable to screen for SNHL in all diabetics. In all type 2 DM while examining them clinically due consideration may be given to hearing tests along with other tests like Fasting and post prandial blood glucose levels (FBS, PPBS) and HbA1C level to find out the glycemic control. Also it is mandatory for necessary follow ups to be done regularly.

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