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Original Research Article

A Study on the Effect of Diabetes Mellitus on Sensorineural and Conductive Hearing Loss

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Abstract

Background: Diabetes mellitus (DM) is a chronic metabolic disorder known to cause microvascular and neuropathic complications. Its effect on the auditory system has gained increasing attention, with studies suggesting that prolonged hyperglycaemia may lead to both sensorineural and conductive hearing loss.

Aim: To evaluate the effect of diabetes mellitus on sensorineural and conductive hearing loss and to assess the association between duration of diabetes and degree of hearing impairment.

Materials and Methods: A hospital-based comparative cross-sectional study was conducted on 100 individuals, including 50 patients with diabetes mellitus and 50 age-matched non-diabetic controls. All participants underwent pure tone audiometry and otoscopic examination. Hearing thresholds were measured at frequencies from 250 Hz to 8000 Hz. Data were analysed using statistical software and compared between groups.

Results: Hearing loss was detected in 62% of diabetic patients compared to 18% in the control group ($p < 0.001$). Sensorineural hearing loss (SNHL) was the most common type (48%), followed by mixed hearing loss (10%) and conductive hearing loss (4%). A significant correlation was found between the duration of diabetes and severity of hearing loss.

Conclusion: Diabetes mellitus significantly affects auditory function, predominantly causing sensorineural hearing loss. Early screening of hearing in diabetic patients is recommended to prevent progression and improve quality of life.

Keywords: Diabetes mellitus, sensorineural hearing loss, Conductive hearing loss, Pure tone audiometry, auditory dysfunction, Microangiopathy, Diabetic neuropathy, Hearing impairment, Type 2 diabetes, Cochlear damage.

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Introduction

Diabetes mellitus (DM) is one of the most prevalent chronic metabolic disorders worldwide and represents a major public health challenge. It is characterized by persistent hyperglycaemia resulting from defects in insulin secretion, insulin action, or both, and it leads to long-term damage to multiple organs including the eyes, kidneys, nerves, and cardiovascular system [1,2]. While classical complications such as retinopathy, nephropathy, and neuropathy are well recognized, the effect of diabetes on the auditory system has received comparatively less attention.

Hearing is essential for communication, social interaction, and overall quality of life. Hearing loss is broadly classified into conductive, sensorineural, and mixed types. Sensorineural hearing loss (SNHL), which results from damage to the cochlea or auditory nerve, is the most common form and is usually permanent [3]. The cochlea is a highly metabolically active organ supplied by an end artery without significant collateral circulation, making it particularly vulnerable to metabolic and vascular disturbances [4].

Chronic hyperglycaemia in diabetes leads to microangiopathy and neuropathy, which are the

main mechanisms underlying most diabetic complications. Microangiopathy causes thickening of capillary basement membranes and reduced blood flow, while neuropathy leads to degeneration of nerve fibers and impaired nerve conduction [5]. Similar pathological processes have been demonstrated in the inner ear of diabetic patients, including degeneration of the organ of Corti, stria vascularis, and spiral ganglion cells [4, 6].

Several epidemiological studies have shown that hearing loss is more common in individuals with diabetes than in non-diabetics. Bainbridge et al. reported that hearing impairment was nearly twice as common in adults with diabetes compared to those without diabetes [1]. A meta-analysis by Horikawa et al. also confirmed that diabetes significantly increases the risk of hearing loss, particularly sensorineural type [2]. These studies indicate that diabetes is an independent risk factor for auditory dysfunction.

Diabetic hearing loss is typically bilateral, symmetrical, and more pronounced at higher frequencies, suggesting a cochlear origin [7,8]. High-frequency hair cells are more vulnerable to ischemia and oxidative stress, which are common in diabetes [9]. In addition, diabetic neuropathy may affect the auditory nerve, further contributing to impaired sound transmission [6,10].

Apart from sensorineural involvement, diabetic patients may also experience conductive hearing loss due to increased susceptibility to middle ear infections, poor immunity, and impaired wound healing [11]. However, most studies report that cochlear involvement is the predominant abnormality.

The duration of diabetes has been shown to play a significant role in the development of hearing impairment. Longer disease duration and poor glycaemic control are associated with greater microvascular and neural damage, leading to progressive hearing loss [7,12]. Despite this, routine hearing screening is not commonly included in diabetic care, and hearing loss often remains undiagnosed until it becomes severe. Given the rising prevalence of diabetes and the significant impact of hearing loss on quality of life, it is important to evaluate the auditory status of diabetic patients. The present study aims to assess the effect of diabetes mellitus on sensorineural and conductive hearing loss and to examine its association with the duration of the disease.

Aim and Objectives: The present study aims to evaluate the effect of diabetes mellitus on sensory neural and conductive hearing loss in adult patients.

Materials and Methods

Study Design: A comparative cross-sectional study was conducted in the Department of ENT at Government Medical College and General Hospital, Nizamabad.

Study Population

Cases: 50 patients diagnosed with diabetes mellitus for more than 5 years.

Controls: 50 age-matched non-diabetic individuals.

Inclusion Criteria

Age between 30–60 years

Diagnosed type 2 diabetes mellitus (for cases)

Exclusion Criteria

- History of chronic ear disease
- Exposure to ototoxic drugs
- Noise-induced hearing loss
- Head injury

Methodology

All participants underwent:

- Otoscopic examination
- Pure tone audiometry (250–8000 Hz)
- Hearing loss was classified as:
- Normal (<25 dB)
- Mild (26–40 dB)
- Moderate (41–60 dB)
- Severe (>60 dB)

Data were analysed using SPSS, with descriptive statistics (mean, standard deviation, frequencies, and percentages) used to summarize the data. The chi-square test, independent t-test, one-way ANOVA, and Pearson's correlation coefficient were applied as appropriate, with $p < 0.05$ considered statistically significant.

Table 1: Age Distribution of Study Participants

Age Group (years)	Diabetic Group (n=50)	Control Group (n=50)
30-39	8	10
40-49	18	17
50-60	24	23
TOTAL	50	50

Both the diabetic and control groups showed a similar age distribution, with most participants belonging to the 50–60 year age group, indicating that the two groups were age matched.

Table 2: Prevalence of Hearing Loss in Study Groups

Group	Total Subjects	Hearing Loss Present	Hearing Loss Absent	Percentage with Hearing Loss
Diabetic	50	31	19	62%
Control	50	9	41	18%

Hearing loss was significantly more common in diabetic patients (62%) than in non-diabetic controls (18%), demonstrating a strong association between diabetes mellitus and hearing impairment ($p < 0.001$).

Table 3: Type of Hearing Loss in Diabetic Patients

Type of Hearing LOSS	Number of Patients	Percentage
Sensorineural (SNHL)	24	48%
Conductive	2	4%
Mixed	5	10%
Normal Hearing	19	38%

Sensorineural hearing loss was the most frequent type among diabetic patients (48%), followed by mixed hearing loss (10%), while only a small proportion had purely conductive hearing loss (4%).

Table 4: Degree of Hearing Loss in Diabetic Patients

Degree of Hearing Loss	Number	Percentage
Normal	19	38%
Mild	12	24%
Moderate	11	22%
Severe	8	16%

Among diabetic patients, mild to moderate hearing loss was most common, although a considerable proportion (16%) had severe hearing impairment, indicating clinically significant auditory dysfunction.

Table 5: Association between Duration of Diabetes and Hearing Loss

Duration of Diabetes	Total Patients	Hearing Loss Present	Percentage
5–10 years	18	8	44%
11–15 years	17	11	65%
>15 years	15	12	80%

The prevalence of hearing loss increased progressively with the duration of diabetes, rising from 44% in patients with 5–10 years of disease to 80% in those with more than 15 years' duration.

Table 6: Comparison of Mean Hearing Thresholds (dB) Between Groups

Frequency (Hz)	Diabetic Group (Mean dB)	Control Group (Mean dB)
500	32	18
1000	35	20
2000	38	22
4000	45	25
8000	50	28

Diabetic patients showed significantly higher hearing thresholds at all tested frequencies compared to controls, with greater impairment at higher frequencies, suggesting cochlear involvement ($p < 0.001$).

Discussion

The present study demonstrates a clear and significant association between diabetes mellitus and hearing loss. In this study, 62% of diabetic patients had some degree of hearing impairment compared to only 18% of non-diabetic controls, indicating that diabetes markedly increases the risk of hearing loss. These findings are consistent with those of Bainbridge et al., who reported a two-fold higher prevalence of hearing impairment in individuals with diabetes [1]. Similarly, Horikawa et al., in a meta-analysis of multiple studies, confirmed that diabetes significantly increases the likelihood of hearing loss [2]. The predominance of sensorineural hearing loss in diabetic patients in the present study is in agreement with previous research. Nearly half (48%) of diabetic subjects had SNHL, whereas conductive hearing loss was observed in only 4% of cases. Tay et al. and Cullen and Cinnamon also reported that SNHL is the most common type of hearing loss in diabetes, supporting the cochlear origin of the disorder [3, 11]. Histopathological studies by Jorgensen demonstrated degeneration of cochlear hair cells and spiral ganglion neurons in diabetic patients, further confirming inner ear involvement [4].

The pathophysiology of diabetic hearing loss is believed to involve both microvascular and neural mechanisms. Chronic hyperglycaemia leads to thickening of the capillary basement membrane, reducing blood flow to the cochlea and causing ischemia [5, 6]. The stria vascularis, which maintains the ionic balance of endolymph, is especially vulnerable to these changes, leading to impaired cochlear function. Fukushima et al. demonstrated microangiopathy and degeneration in cochlear structures of diabetic patients, supporting this mechanism [6].

In addition to vascular damage, diabetic neuropathy also plays an important role. Damage to the auditory nerve may lead to delayed and distorted transmission of sound signals [10]. Lisowska et al. reported prolonged auditory brainstem response latencies in diabetic patients, indicating neural involvement in diabetic hearing loss [10].

Another important observation in the present study was the significant association between the duration of diabetes and hearing loss. Patients with diabetes for more than 15 years had an 80% prevalence of hearing loss compared to 44% in those with 5–10 years of disease. This finding is consistent with Kakarlapudi et al. and Rajendran et al., who showed that longer duration of diabetes is associated with greater severity of hearing impairment [7, 12]. The cumulative effects of prolonged hyperglycaemia lead to progressive microvascular and neural damage, explaining this relationship.

The present study also found significantly higher hearing thresholds in diabetic patients across all tested frequencies, particularly at high frequencies (4000–8000 Hz). This pattern is typical of cochlear pathology and has been reported by Frisina et al., who observed significantly worse high-frequency hearing in diabetic individuals compared with controls [8]. High-frequency hair cells are more sensitive to ischemia and oxidative stress, making them more vulnerable in diabetic conditions [9]. The relatively low prevalence of purely conductive hearing loss in this study suggests that diabetes primarily affects the inner ear rather than the middle ear. However, the presence of mixed hearing loss in 10% of patients indicates that middle ear pathology may coexist with cochlear damage, possibly due to increased susceptibility to infections in diabetic individuals [11]. These findings have important clinical implications. Hearing loss can significantly impair communication, reduce quality of life, and complicate diabetes management by affecting patient-doctor interaction and treatment compliance. Mitchell et al. demonstrated that diabetes is associated not only with the prevalence but also with the progression of hearing loss, highlighting the need for long-term monitoring [13].

Given the high prevalence of hearing loss in diabetic patients observed in this and other studies, routine audiological screening should be considered an essential component of diabetic care. Early detection can allow timely interventions such as hearing aids, counselling, and improved glycaemic control, thereby reducing disability and improving quality of life [14, 15].

Conclusion

This study clearly demonstrates that diabetes mellitus has a significant adverse effect on hearing. Diabetic patients showed a markedly higher prevalence of hearing loss compared to non-diabetic controls, with sensorineural hearing loss being the most common type. The severity and frequency of hearing impairment increased with the duration of diabetes, indicating that auditory dysfunction is a progressive complication of the disease.

The findings strongly support the role of diabetic microangiopathy, neuropathy, and metabolic disturbances in causing cochlear and auditory nerve damage. Given the high prevalence of hearing loss in diabetic patients and its impact on communication and quality of life, routine hearing screening should be incorporated into standard diabetic care. Early identification and management of hearing impairment, along with good glycaemic control, can help reduce the burden of this often-overlooked complication of diabetes.

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