

Original Research Article

The Relationship between Blood Sugar Control and Hearing Impairment in Type 2 Diabetes Patients

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Abstract

Background and Aim: The auditory pathway is the primary target for elevated blood sugar levels. Increased glucose levels in diabetes patients can both physiologically and physically impair the hearing system. The purpose of this study is to look at the relationship between glycemic management and hearing impairment in those who have T2DM before they develop obvious clinical symptoms.

Material and Methods: This was a one-year prospective observational research conducted at Banas medical College and Research Institute, Palanpur, Gujarat from August 2022 to August 2023. The study included 150 people with T2DM who were at least 30 years old and had been living with the disease for at least 5 years. The distortion product otoacoustic emissions and transient induced otoacoustic emissions were used in the evaluation. HbA1c levels equal to or more than 7.5% were set as the criteria for inadequate glycemic control.

Results: A quarter of the subjects, 39 (26%) used insulin to control their blood sugar levels, while the remaining three-quarters, 111 (74%) used oral hypoglycemic medications. Although the observed correlation did not reach statistical significance, the gender-based observation suggested a larger link in females.

Conclusion: Our study's findings show a link between poor blood glucose control and the development of hearing impairment in those with T2DM. These findings emphasise the necessity of maintaining optimum glycemic management as a strategy of preventing hearing loss in this patient population. Further research, using a comprehensive and longitudinal research strategy, is required to substantiate these findings.

Key Words: Blood Sugar, Diabetes Mellitus, Hearing Impairment, Oral Hypoglycaemic Agents,

1. Introduction

Diabetes mellitus (DM) is usually associated with hearing loss, which is most likely caused by microvascular and neuropathic problems affecting the auditory nerve and cochlea.¹ The link between diabetes and inner ear structures is receiving more study.²⁻⁶ A large body of research suggests that hearing loss (HL) may be a disabling consequence of diabetic mellitus (DM).^{7,8} The effects of diabetes on the ear can include difficulty understanding speech, an increased risk of falling, and the formation of tinnitus, with concerns ranging from a lower quality of life to an increase in mortality. Although studies of DM and HL frequently suggest a connection, determining causality is frequently problematic. Due to the unavailability of a suitable DM animal model and access to cochlear tissue in people in vivo, few research addressed the pathogenic relationship between DM and HL.⁹ Noise exposure, ototoxic medication usage, and confounding factors such as age, gender, duration of DM, glycemic management, smoking, and other metabolic and cardiovascular comorbidities frequently bias studies on the putative association between DM and HL.¹⁰

Several mechanisms, including microangiopathy, neuropathy, and oxidative stress damage, have been proposed for the development of hearing loss in diabetes patients.^{11,12} Diabetes can alter the stria vascularis, the basement membrane, and the cochlear hair cells. During hyperglycemia, the cochlea possesses a large number of tiny blood vessels that are vulnerable to microangiopathy.¹³ Furthermore; hyperglycemia causes oxidative stress (OS) and the formation of free radicals, which causes neuronal damage and microglial activation. These changes cause the small blood arteries that feed the atrial-cochlear nerve, which is important for hearing and balance; to degenerate.¹⁴ Bainbridge et al. (2016)¹⁵ investigated risk factors for diabetic hearing loss. Their findings revealed that drinking alcohol, smoking, chronic renal failure, and high triglycerides were all strongly related with hearing loss.¹⁵

Several studies have suggested a link between the duration of coexistence with diabetes and the severity of hearing loss. Alternative investigations, however, have reported contradictory results.^{8,16} The present body of research is gradually demonstrating the importance of maintaining good glycemic management in the development of hearing impairment in people with diabetes.^{8,17}

The use of otoacoustic emissions (OAEs) has been proposed as a potentially effective biomarker for the early detection of hearing impairment in people with diabetes.¹⁸ The auditory responses of the cochlea can be tested objectively, perhaps allowing for the discovery of tiny changes. The findings of a study conducted by Sasso FC et al. show a significant decrease in OAEs in patients with T2DM, highlighting the potential value of OAEs in detecting hearing loss in this population at an early stage.⁶ Further research is needed due to the complex association between diabetes and auditory impairment, as well as the possible impact of many factors such as DM duration, glycemic control, and other medical illnesses. The purpose of this study is to look at the relationship between glycemic management and hearing impairment in those who have T2DM before they develop obvious clinical symptoms.

2. Material and Methods

This was a one-year prospective observational research conducted at Banas medical College and Research Institute, Palanpur, Gujarat from August 2022 to August 2023. The study included 150 people with T2DM who were at least 30 years old and had been living with the disease for at least 5 years. Patients with a history of noise exposure, ear surgery, or other conditions that could impair their hearing were excluded from the study.

The institutional ethical committee provided ethical approval, and all participants provided signed informed consent.

Measurements

The study investigated hearing loss using OAEs, which are accurate indicators of cochlear function that can detect early changes in hearing before they emerge in clinical settings. All participants' ears were tested for distortion product otoacoustic emissions (DPOAEs) and transient evoked otoacoustic emissions (TEOAEs). The measurements were taken using a portable OAE device, namely the Neuroaudio neuro soft model. DPOAEs were used to evaluate the performance of the cochlear outer hair cells, whereas TEOAEs were utilised to evaluate the overall effectiveness of the cochlear system. For either DPOAEs or TEOAEs, hearing impairment was defined as a signal-to-noise ratio (SNR) less than 6 dB.

The assessment of glycemic control was done using HbA1c readings, which show the average blood glucose levels over the previous three months. An HbA1c value of 7.5% or higher was established as the criterion for insufficient glycemic management. For statistical analysis, the clinical and demographic characteristics of the study individuals were examined using descriptive statistics.

Statistical analysis

The collected data was assembled and input into a spreadsheet programme (Microsoft Excel 2007) before being exported to the data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). The confidence level and level of significance for all tests were set at 95% and 5%, respectively.

3. Results

Individuals in the study were at least 30 years old and had been diagnosed with T2DM for at least 5 years. There were 150 people in the study group. The average age of the study population was 54.5 years, with a range of 28 to 77 years. Among the 150 participants, 88 (58.4%) were males, while the remaining 52 (34.6%) were girls.

DM lasted an average of 9.2 years. A quarter of the subjects, 39 (26%) used insulin to control their blood sugar levels, whereas the remaining three-quarters, 111 (74%) used oral hypoglycemic medications.

When the signal-to-noise ratio (SNR) of either TEOAEs or DPOAEs was less than 6 dB, hearing impairment was found. Twenty-five percent of those who took part in the study were found to have hearing loss. According to the study's findings, persons with HbA1c levels of 7.5% or more had an approximately twofold increased risk of hearing impairment compared to people with good glycemic control (Table 2). According to the study's findings, those with diabetes for at least 10 years had nearly three times the risk of hearing loss as those with diabetes for less than ten years ($p < 0.05$) (Table 3).

The statistical analysis done in the study revealed no statistically significant difference in the likelihood of hearing impairment between male and female participants ($p < 0.05$). The study found no statistically significant difference in the likelihood of hearing damage between individuals who received oral hypoglycemic medications and those who received insulin ($p < 0.05$).

According to the study's findings, there is a link between hearing loss and poor glycemic management (HbA1c 7.5%) and a long duration of diabetes (10 years). Hearing impairment occurs at a higher rate in patients in this category, with 25% reporting hearing impairment.

The statement emphasises the necessity of managing glycemic control and detecting hearing impairment early in order to avoid or manage hearing loss in diabetics. The study discovered a possible link between HbA1c levels and hearing impairment. The study discovered no significant relationship between medication use and HbA1c level and the chance of developing hearing impairment.

Table 1: Gender wise Distribution of study Population

Gender	Number	Percentage (%)
Male	88	58.4
Female	52	34.6
Total	150	100

Table 2: Association between HbA1c levels and hearing impairment

HbA1c Level	N (%) with Hearing Impairment	Odds Ratio (95% CI)
<7.5%	17 (15.31)	1 (Reference)
≥7.5%	22 (30.90)	2.86

Table 3: Association between DM duration and hearing impairment

DM Duration (years)	N (%) with Hearing Impairment	Odds Ratio (95% CI)
<10	12 (14.07)	1 (Reference)
≥10	26 (33.90)	2.49

4. Discussion

Diabetes is also thought to be a risk factor for sensorineural hearing loss (SNHL), while some studies found no link after controlling for age, gender, and hypertension. Major problems of hypertension and diabetes include macro and microvascular insults that induce decreased blood flow, changes in oxygen exchange, and ion transport, all of which can have a direct influence on the sensory and support cells of the cochlea. A healthy lifestyle and a balanced diet can help avoid the onset of DM and SNHL; if necessary, vasodilators can be used to enhance nerve blood flow.

The demographic characteristics of the study participants are consistent with prior research findings that males have a higher prevalence of T2DM than females.¹⁹ This gap could be linked to lifestyle factors such as males' higher incidence of tobacco and alcohol intake. The individuals' long duration of prediabetes emphasizes its chronic nature, which often need long-term care. The use of oral hypoglycemic drugs by a significant proportion of individuals implies their efficacy in glycemic management, which is consistent with the American Diabetes Association's 2021 guidelines favouring the use of oral hypoglycemic agents.^{20,21} The current study's findings on the frequency of hearing impairment among participants are consistent with prior research indicating a higher incidence of hearing impairment in people with diabetes. A meta-analysis of research undertaken by Horikawa C et al revealed that people with diabetes were considerably more likely to have hearing impairment than those who did not have diabetes.¹⁷

The new investigation discovered evidence of a link between poor glycemic control and an increased vulnerability to hearing loss, which supports the findings of a previous study

conducted by Srinivas CV et al. in 2016.²² The study found a link between uncontrolled diabetes (HbA1c > 8) and sensorineural hearing loss, implying that high blood glucose levels may increase the likelihood of experiencing hearing loss. Diabetes risk variables were investigated by Bainbridge et al¹⁵ (2016). Alcohol intake, smoking, chronic renal failure, and high triglyceride levels were found to be significantly linked with hearing loss in diabetes patients. Furthermore, low poverty was mentioned as a possible cause of hearing impairment. The study found that patients with DM for a longer period of time had a considerably higher odds ratio for hearing impairment than those with DM for a shorter period of time. The current conclusion is consistent with previous research by Oh et al and Agrawal et al, which found a link between diabetes duration and greater vulnerability to hearing impairment.^{23,24} The current study also looked into the relationship between pharmaceutical use and auditory dysfunction and discovered that there was no discernible difference in the likelihood of auditory dysfunction between subjects who were given oral hypoglycemic agents and those who were given insulin. The current study findings are consistent with previous research by Asma et al, who found no significant link between medication use and hearing impairment in diabetics.²⁵

The current study looked into the relationship between gender, medication use, and HbA1c levels and the chance of having hearing loss. Female participants with HbA1c levels equal to or greater than 7.5% had a higher chances ratio of acquiring hearing impairment, according to the study. This difference, however, did not achieve statistical significance. These findings are consistent with a study published in 2022²⁶ by Wang et al., which revealed a possible link between gender, medication use, HbA1c levels, and the chance of hearing loss in people with diabetes mellitus. Mashhadi et al. (2015)²⁷ investigated the link between diabetes and hearing loss. There was no significant link between diabetes and hearing loss based on audiometric data at different frequencies in diabetic and control groups. However, the link between hearing frequencies and patient age was stronger. Furthermore, diabetes duration, gender, microvascular problems, and macrovascular complications were not associated with hearing loss in diabetic patients.²⁷ Consistent with our findings, Zivkovic-Marinkov et al. (2016)²⁸ discovered that the hearing threshold in diabetes patients was considerably greater than in healthy controls. Moreover, there was no difference among the patients in hearing loss in terms of different types of medications.

The study's cross-sectional design makes it difficult to prove a causal link between hearing impairment and diabetic control. The study's limited sample size may reduce generalizability and raise type II errors.

5. Conclusion

The current investigation found a link between poor glycemic control and an increased risk of hearing impairment in those with type 2 diabetes. Those with diabetes for a longer period of time and HbA1c values above 7.5% are at a higher risk. OAEs may be useful as a biomarker for auditory impairment in persons with diabetes. The study found no statistically significant link between medication use and the development of hearing impairment.

6. References

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