

## ORIGINAL RESEARCH

# Comparative Analysis of Hearing Threshold Levels Among Adult Diabetes Mellitus Patients: An Institutional Based Study

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### ABSTRACT

**Background:** The present study was conducted for comparing the hearing threshold levels among adult diabetes mellitus patients in a known region. **Materials & Methods:** A total of 200 subjects with presence of type 2 diabetes mellitus were enrolled. Complete demographic and clinical details of all the patients were obtained. All the subjects were evaluated for pure tone average (PTA), speech discrimination score (SDS), and speech reception threshold (SRT) tests. The patient's blood pressure was checked. Blood samples were obtained and renal profile was evaluated. In addition, a physical examination of both ears was performed using an otoscope. Patients underwent audiometric testing using the PTA, SDS, and SRT tests. All the results were recorded in Microsoft excel sheet followed by statistical analysis using SPSS software. **Results:** Significant results were obtained while comparing the hearing threshold among subjects of diabetic group and control group. Normal PTA findings were seen in 51 percent of the patients of the diabetic group and in 98 percent of the patients of the control group. On comparing the PTA findings among diabetic group and control group, significant results were obtained. While comparing the hearing thresholds at different frequencies among diabetic group and control group, significant results were obtained. **Conclusion:** Patients with diabetes have a significant prevalence of hearing loss, primarily sensorineural hearing loss.

**Key words:** Diabetes, Hearing.

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### INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia. It may be due to impaired insulin secretion, resistance to peripheral actions of insulin, or both. According to the International Diabetes Federation (IDF), approximately 415 million adults between the ages of 20 to 79 years had diabetes mellitus in 2015. DM is proving to be a global public health burden as this number is expected to rise to another 200 million by 2040.<sup>1, 2</sup>

T2DM risk factors include a complex combination of genetic, metabolic and environmental factors that interact with one another contributing to its prevalence. Although individual predisposition to T2DM due to non-modifiable risk factors (ethnicity and family history/genetic predisposition) has a strong

genetic basis, evidence from epidemiological studies suggests that many cases of T2DM can be prevented by improving the main modifiable risk factors (obesity, low physical activity and an unhealthy diet).<sup>3- 5</sup> The auditory apparatus is one of the vulnerable end organs in DM due to ischemic cochlear damage resulting from diabetic microangiopathy. DM-related hearing loss is a major public health issue in both low- and middle-income countries and the developed economies. With the projected increase in the world's diabetes burden due to increased longevity and changes in lifestyle, its prevalence is bound to increase. It impacts adversely on the patients' quality of life and their capacity for independent living.<sup>6, 7</sup> Hence; the present study was conducted for comparing the hearing threshold levels

among adult diabetes mellitus patients in a known region.

**MATERIALS & METHODS**

The present study was conducted for comparing the hearing threshold levels among adult diabetes mellitus patients in Department of ENT and Head Neck Surgery, LN Medical College and JK Hospital, Bhopal, Madhya Pradesh, India. A total of 100 subjects with presence of type 2 diabetes mellitus were enrolled. Complete demographic and clinical details of all the patients were obtained. Another set of 100 age- and gender-matched healthy subjects were enrolled as control group. All the subjects were evaluated for pure tone average (PTA), speech discrimination score (SDS), and speech reception threshold (SRT) tests.<sup>8</sup> The criteria for diagnosing diabetes in people were having a fasting blood sugar of more than 125 mg/dL and the glucose tolerance test (GTT)  $\geq 200$  or  $6.5 \leq \text{HbA1c}$ .<sup>9</sup> The patient's blood pressure was checked. Blood samples were obtained, and renal profile was evaluated. In addition, a physical examination of both ears was performed

using an otoscope. Patients underwent audiometric testing using the PTA, SDS, and SRT tests. All the results were recorded in Microsoft excel sheet followed by statistical analysis using SPSS software.

**RESULTS**

Mean age of the control group and diabetic group 43.5 years and 41.9 years respectively. Majority proportion of subjects of both the study groups were males. mean hearing thresholds among subjects of diabetic group and control group was 26.5 dB and 13.8 dB respectively. Significant results were obtained while comparing the hearing threshold among subjects of diabetic group and control group. Normal PTA findings were seen in 51 percent of the patients of the diabetic group and in 98 percent of the patients of the control group. On comparing the PTA findings among diabetic group and control group, significant results were obtained. While comparing the hearing thresholds at different frequencies among diabetic group and control group, significant results were obtained.

**Table 1: Hearing threshold**

Hearing thresholds in dB	Diabetic group	Control group
Mean	26.5	13.8
SD	5.9	2.7
p-value	0.0010 (Significant)	

**Table 2: Pure tone audiogram findings**

Pure tone audiogram findings	Diabetic group	Control group	p-value
Normal PTA findings	51	98	0.001 (Significant)
Sensorineural hearing loss	42	2	
Conductive hearing loss	7	0	
Total	100	100	

**Table 3: Comparison of hearing threshold (mean of right and left ear)**

Frequency hearing level (dB)	Diabetic group	Control group	p-value
250	22.9	14.6	0.00 (significant)
500	22.1	14.8	0.00 (significant)
1000	23.1	13.9	0.01 (significant)
2000	25.9	13.4	0.00 (significant)
4000	28.3	16.1	0.03 (significant)
8000	28.9	15.3	0.01 (significant)

**DISCUSSION**

Diabetes mellitus (DM) is probably one of the oldest diseases known to man. It was first reported in Egyptian manuscript about 3000 years ago. In 1936, the distinction between type 1 and type 2 DM was clearly made. Type 2 DM was first described as a component of metabolic syndrome in 1988. Type 2 DM (formerly known as non-insulin dependent DM) is the most common form of DM characterized by hyperglycemia, insulin resistance, and relative insulin deficiency. Type 2 DM results from interaction between genetic, environmental and behavioral risk factors.<sup>10-13</sup>

Once the diagnosis of type 2 diabetes has been established, in the absence of contributing factors, is there any hope of a remission? From a glycaemic standpoint it is certainly possible, but it remains to be ascertained whether such aggressive intervention significantly alters the underlying pathophysiology of the disease or merely arrests it. The effectiveness of aggressive lifestyle modification in preventing progression to diabetes in a high-risk group was clearly established by the Diabetes Prevention Program (DPP), where a 7% weight loss as result of a combination of caloric restriction and exercise led to a 58% reduction in the incidence of diabetes after 3

years.<sup>14</sup>T2DM is a multisystemic disease, and its prevalence has increased in recent years, especially in young adult populations, who are associated with a sedentary lifestyle. This has created a critical public health problem because of the increase in chronic complications due to a longer development time of the illness. Hearing loss as a chronic complication of this disease is an underexplored subject that requires necessary attention, because it can seriously affect the patients' quality of life and potentially lead to other complications, such as depression.<sup>15</sup>Hence; the present study was conducted for comparing the hearing threshold levels among adult diabetes mellitus patients in a known region.

Mean age of the control group and diabetic group 43.5 years and 41.9 years respectively. Majority proportion of subjects of both the study groups were males. mean hearing thresholds among subjects of diabetic group and control group was 26.5 dB and 13.8 dB respectively. Significant results were obtained while comparing the hearing threshold among subjects of diabetic group and control group. Al-Rubeaan K et al, in a previous study, investigated hearing loss as a comorbidity associated with type 2 diabetes mellitus and evaluate the factors associated with hearing loss. Of the 157 patients, 77 had hearing loss in both ears (49.0%), 13 in the right ear only (8.3%), 14 in the left ear only (8.9%), and 53 (33.8%) had normal hearing. In the 181 ears with sensorineural hearing loss, 90 had mild loss (49.7%), 69 moderate loss (38.2%), 16 severe loss (8.8%) and 6 had profound loss (3.3%). Disabling hearing loss was observed in 46 (29%) patients. A higher frequency of hearing loss was present in patients with glycosylated hemoglobin levels  $\geq 8\%$ . In the multivariate logistic regression analysis, the most important factors associated with hearing loss were longer diabetes duration, poor glycemic control and the presence of hypertension. Hearing loss is an underestimated comorbid condition in type 2 diabetes that warrants frequent hearing assessments and management.<sup>16</sup>

In the present study, normal PTA findings was seen in 51 percent of the patients of the diabetic group and in 98 percent of the patients of the control group. On comparing the PTA findings among diabetic group and control group, significant results were obtained. While comparing the hearing thresholds at different frequencies among diabetic group and control group, significant results were obtained. The prevalence of hearing loss in patients with type 2 diabetes was evaluated in a previous study conducted by Shafiepour M et al. A total of 94 patients with type 2 diabetes, aged from 40 to 80 years, were selected randomly in the present descriptive cross-sectional study for pure tone audiometry (PTA), speech discrimination score (SDS), and speech reception threshold (SRT) tests. Accordingly, patients with a hearing threshold larger than or equal to 25 dB were considered hearing-impaired according to the PTA test. In addition, the patients' speech discrimination

score was measured using a list of monosyllabic words with an intensity of 40 dB or more than the SDS test. Most diabetic patients had hearing loss in both right and left ears based on the PTA and SRT tests. However, they did not have hearing loss in both ears according to the SDS test. There was no correlation between the PTA, SRT, and SDS tests and blood creatinine levels in both ears. Nevertheless, the right ear had a positive correlation with systolic blood pressure only in the PTA test.<sup>17</sup>The hearing threshold levels were compared among adult diabetes mellitus patients with non-diabetes mellitus subjects in another similar study conducted by Idugboe OJ et al. The mean ages for the test and control groups were 48.4 years and 46.5 years respectively. Male to female ratio was 1:1. The Pure tone average as well as the hearing threshold levels for air and bone conduction was significantly higher for all frequencies tested except 0.25 KHz in the diabetic group compared to the non-diabetic control group. Hearing threshold levels for adult diabetic patients are significantly higher than that of non-diabetic individual of a similar age.<sup>18</sup>

## CONCLUSION

Patients with diabetes have a significant prevalence of hearing loss, primarily sensorineural hearing loss.

## REFERENCES

1. Zheng Y, Ley SH, Hu FB. Global aetiology and epidemiology of type 2 diabetes mellitus and its complications. *Nat Rev Endocrinol.* 2018 Feb;14(2):88-98.
2. Malek R, Hannat S, Nechadi A, Mekideche FZ, Kaabeche M. Diabetes and Ramadan: A multicenter study in Algerian population. *Diabetes Res Clin Pract.* 2019 Apr;150:322-330.
3. Wong N.D., Zhao Y., Patel R., Patao C., Malik S., Bertoni A.G. et al. Cardiovascular Risk Factor Targets and Cardiovascular Disease Event Risk in Diabetes: A Pooling Project of the Atherosclerosis Risk in Communities Study, Multi-Ethnic Study of Atherosclerosis, and Jackson Heart Study. *Diabetes Care.* 2016;39:668-676.
4. Hu F.B., Manson J.E., Stampfer M.J., Colditz G., Liu S., Solomon C.G., Willett W.C. Diet, lifestyle, and the risk of type 2 diabetes mellitus in women. *N. Engl. J. Med.* 2001;345:790-797.
5. Schellenberg E.S., Dryden D.M., Vandermeer B., Ha C., Korownyk C. Lifestyle interventions for patients with and at risk for type 2 diabetes: A systematic review and meta-analysis. *Ann. Intern. Med.* 2013;159:543-551.
6. Makishima K, Tanaka AK. Pathological changes of the inner ear and central auditory pathway in diabetes. *Ann OtolRhinolLaryngol.* 1971;80(2):218-228.
7. Jorgensen MB, Buch NH. Studies on inner ear and cranial nerves in diabetes. *Acta Otolaryngol.* 1961;107:179-182.
8. Hong O, Buss J, Thomas E. Type 2 diabetes and hearing loss. *Dis Mon.* 2013;59(4):139-46
9. Association AD. 2 Classification and diagnosis of diabetes: standards of medical care in diabetes-2018. *Diabetes care.* 2018;41(Supplement 1):S13-S27.

10. Ahmed AM. History of diabetes mellitus. Saudi Med J 2002. Apr;23(4):373-378
11. Diabetes mellitus history- from ancient to modern times. Available at <http://science.jrank.org/pages/2044/Diabetes-Mellitus.html> (accessed on 22nd July, 2011)
12. Patlak M. New weapons to combat an ancient disease: treating diabetes. FASEB J 2002. Dec;16(14):1853
13. Maitra A, Abbas AK. Endocrine system. In: Kumar V, Fausto N, Abbas AK (eds). Robbins and Cotran Pathologic basis of disease (7th ed) 2005. Philadelphia, Saunders; 1156-1226.
14. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, Nathan DM. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med. 2002;346:393–403.
15. Calvin D, Watley SR. Diabetes and hearing loss among underserved populations Nurs Clin North Am. 2015;50:449–56
16. Al-Rubeaan K, AlMomani M, AlGethami AK, et al. Hearing loss among patients with type 2 diabetes mellitus: a cross-sectional study. Ann Saudi Med. 2021;41(3):171-178.
17. Shafiepour M, Bamdad Z, Radman M. Prevalence of hearing loss among patients with type 2 diabetes. J Med Life. 2022;15(6):772-777.
18. Idugboe OJ, Kolawole BA, Totyen EL. Hearing Threshold Level among Adult Diabetics in South-Western Nigeria. J OtolaryngolRhinol 2018; 4:051.