

# Prevalence of Otological Disorders in Diabetic Cases with Hearing Loss

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## Abstract

**Objective:** Diabetes mellitus is a systemic metabolic disease, characterized by fluctuating levels of glucose which affects multiple organs. Hearing loss is one of the most common otological disorders in adults with diabetes. This study aims to evaluate the prevalence of otological diseases and hearing loss patterns in adults suffering from diabetes.

**Methods:** A total of 174 diabetic cases with hearing loss visiting MAA ENT Hospitals, Hyderabad, India along with 420 age and sex matched subjects with hearing loss constituted the study subjects. The age group of the cases above 40 years and the diagnosis was confirmed by otological examinations. Hearing loss was evaluated using pure tone audiometry and average for the frequencies at 0.5, 1, 2, 4 and 8 kHz was recorded. Statistical analysis was performed using PASW STATISTICS 18.0 for determining the association of various demographic and otological parameters with hearing loss of diabetes subjects compared with non-diabetics.

**Results:** In the present study, chronic suppurative otitis media (47.1%) and presbycusis (27%) were the common otological disorders prevalent in diabetic patients with hearing loss at elderly age (>60 years). 44.3% of the study subjects showed prevalence of conductive hearing loss followed by sensorineural (38.5%) and mixed hearing loss (17.2%). It was also observed that there was a significant association of sensorineural hearing loss (OR=4.85; 95% CI=2.37-9.96; p<0.001) with advancing age (>60 years).

**Conclusion:** Therefore, the present study has revealed hearing loss in otological disorders is as an important consequence of diabetes.

**Keywords:** Diabetes; Chronic suppurative otitis media; Presbycusis; Sensorineural hearing loss; Tinnitus

## Introduction

Diabetes mellitus (DM) is a non-communicable chronic metabolic disease with abnormal blood glucose levels caused by relative or absolute insulin deficiency [1]. The clinical manifestation of diabetes mellitus involves development of broad spectrum of irreversible serious medical complications that affects nearly each organ system of the body leading to serious negative impact on the health and quality of patient's life [2-4]. The prevalence of diabetes all over the globe is increasing at an alarming rate and it is more pronounced in India [5]. India is considered to be the "Diabetes capital of the world" as the total number of diabetic patients is around 40.9 million and by 2025 the number is expected to be 69.92 millions [6].

Diabetes is an important etiological factor for the onset of hearing loss in the elderly population [7,8]. Hearing impairment is a common sensory disability to comprehend sound in the auditory pathway of one or both ears, caused by either genetic or environmental factors (i.e., organic and non-organic) which can be of conductive (outer and/or middle ear), sensorineural (inner ear), mixed (outer/ middle/ inner ear) and central (brain stem lesions) types. Prevalence of hearing loss in diabetic patients is higher when compared with non-diabetic population [9,10]. Increased risk of long-term complications especially damage to the vessels of stria vascularis and nerves of auditory system leads to neuronal degeneration and diminishes the ability of hearing in elderly people [7,8]. Studies on prevalence of otological disorders associated with hearing loss in relation to diabetes have not received attention in South Indian population. The present study aimed to determine the onset and magnitude of otological disorders associated with hearing loss in diabetic cases of South India.

## Subjects and Methods

### Subjects

A total of 174 diabetic cases the age group above 40 years affected with hearing loss and 420 age and sex matched non-diabetic cases with hearing loss visiting MAA ENT Hospitals, Hyderabad, Telangana State, India from 2011 to 2014 constituted the study subjects. Individuals with trauma, auricular anomaly, head and neck deformity and history of ear surgery were excluded from the study. Confirmatory diagnosis of diabetes was done by the general physician and auditory examinations were carried out by the ENT specialist to classify the otological disorders. Hearing loss was evaluated using pure tone audiometry and average for the frequencies at 0.5, 1, 2, 4 and 8 kHz was recorded.

### Statistical analysis

The data obtained was coded for statistical evaluations. Appropriate statistical analysis was performed using the Statistical Package for Social Sciences PASW STATISTICS 18.0 software (SPSS Inc., Chicago, IL, USA). Continuous data is represented as means and standard deviations whereas categorical data as proportions and percentages for

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illustrations. The chi-square test and binary logistic regression analysis was used to compare the proportions and association of categorical variables.

## Results

Among the 174 diabetic subjects, 65.5% were males and 34.5% were females with increased male preponderance of 1.9. There was no difference in mean age of onset of hearing loss for the diabetic (56.2 ± 11.31) and non-diabetic (54.4 ± 10.74) groups. The distribution of gender, age and otological parameters among diabetic and non-diabetic subjects is depicted in (Tables 1 and 2). Chronic suppurative

Parameters	Diabetic (n=174)	Non-diabetic(n=420)	p-value	OR(95% CI)††
<b>Gender</b>				
Female	60(34.5)	182(43.3)	0.031	1.00(Reference)
Male	114(65.5)	238(56.7)		1.46(1.05-2.06)*
<b>Age(years)†</b>	58.3 ± 11.36	55.5 ± 11.47		NC
<b>Age of onset(years)†</b>	56.2 ± 11.31	54.4 ± 10.62		NC
40-60	108(62.1)	307(73.0)	0.004	1.00(Reference)
>60	66(37.9)	113(27.0)		1.70(1.21-2.39)**
<b>Laterality</b>				
Unilateral	62(35.6)	191(45.5)	0.017	1.00(Reference)
Bilateral	112(64.4)	229(54.5)		1.62(1.16-2.27)**
<b>Mean PTA(dBHL)</b>	50.5 ± 17.34	49.4 ± 17.54	0.776	NC
<40dB	71(40.8)	167(39.7)		1.00(Reference)
>40dB	103(59.2)	253(60.3)		1.11(0.80-1.54)
<b>Types of hearing loss</b>				
Conductive hearing loss	77(44.3)	193(45.9)	0.903	1.00(Reference)
Sensorineural hearing loss	67(38.5)	159(37.8)		1.06(0.74-1.51)
Mixed hearing loss	30(17.2)	68(16.2)		1.11(0.70-1.76)
<b>Otological disorders</b>				
Otosclerosis	1(0.6)	8(1.9)	0.107	1.00(Reference)
Acute suppurative otitis media	17(9.8)	34(8.1)		3.00(0.95-9.48)
Chronic suppurative otitis media	82(47.1)	176(41.8)		2.89(0.98-7.99)
Otitis media with effusion	17(9.8)	58(13.9)		1.74(0.56-5.45)
Meniere's disease	4(2.3)	24(5.7)		0.75(0.07-7.21)
Presbycusis	47(27.0)	113(26.9)		2.49(0.86-7.26)
Sudden sensorineural hearing loss	6(3.4)	7(1.7)		5.14(1.27-20.82)
<b>Associated symptoms</b>				
Tinnitus	56(32.2)	161(36.0)	0.287	0.85(0.60-1.19)
Vertigo	24(13.8)	69(15.3)	0.897	0.89(0.56-1.41)

- a. † -Independent sample t test(mean ± standard deviation);  
 b. Values in paranthesis are percent frequency; NC-Not calculated.  
 c. †† - Chi-square test  
 d. p-value <0.05\*, <0.001\*\*

**Table 1:** Distribution of gender, age and otological parameters in diabetic and non-diabetic study subjects.

Parameters	Total	40-60 years	>60 years	p-value	OR (95% CI)
<b>Gender†</b>					
Female	66(37.9)	49(74.2)	17(25.8)	0.6	1.00(Reference)
Male	108(62.1)	65(60.2)	43(39.8)		1.45(1.03-2.04)
<b>Laterality†</b>					
Unilateral	62(35.6)	43(44.3)	19(24.7)	0.007	1.00(Reference)
Bilateral	112(64.4)	54(55.7)	58(75.3)		2.43(1.26-4.67)**
<b>Degree of hearing loss(Decibels-dB)†</b>					
<40 dB	26(14.9)	10(13.0)	16(61.5)	0.519	1.00(Reference)
>40dB	148(85.1)	67(87.0)	81(83.5)		1.32(0.56-3.11)
<b>Types of hearing loss††</b>					
Conductive hearing loss	77(44.3)	59(54.6)	18(27.3)	<0.001	1.00(Reference)
Sensorineural hearing loss	67(38.5)	27(25.0)	40(60.6)		4.85(2.37-9.96)***
Mixed hearing loss	30(17.2)	22(20.4)	8(21.1)		1.12(0.45-3.13)

- a. Values in paranthesis are percent frequency  
 b. †-Chi-square test, ††-binary logistic regression analysis  
 c. p-value <0.05\*, <0.001\*\*

**Table 2:** Association of gender and otological parameters with age of onset in diabetic subjects affected with hearing loss.

otitis media (CSOM) (47.1%) and presbycusis (27%) were the most prevalent otological disorders (Table 1). The occurrence of tinnitus in diabetes was seen in 32.2% of the cases.

It was observed that with advancing age in diabetic subjects there was a significant increase in the prevalence of presbycusis (63.8%), otosclerosis (50%) and sudden sensorineural hearing loss (SSNHL) (33.3%) compared to non-diabetics (Figure 1). In the present study, diabetes was found to cause significant hearing loss bilaterally (OR 1.62; 95% CI 1.16-2.27) and severity increased in above 60 years (OR 1.70; 95% CI 1.21-2.39) (Table 2). Bilateral form of hearing loss was reported to be highly prevalent in diabetic subjects with sudden sensorineural hearing loss (SSNHL) (66.7%), otitis media with effusion (OME) (58.8%) and acute suppurative otitis media (ASOM) (41.2%) while otosclerosis (76%), Meniere's disease (68%) and CSOM (50%) showed unilateral progression (Figure 2). The prevalence of hearing loss in males of diabetic subjects was significantly more when compared to non-diabetic subjects (OR 1.46; 95% CI 1.05-2.06).

With regard to pattern of hearing loss, conductive type was observed in 44.3% followed by sensorineural in 38.5% and mixed type in 17.2% of diabetes cases. It was also observed that there was a significant increase in sensorineural hearing loss (57.1%) in above 60 years of diabetic subjects (OR 4.85, 95% CI 2.37-9.96) (Table 2). Diabetic subjects with ASOM (76.5%) showed conductive hearing loss while sensorineural form of hearing loss was noticed to be high in Meniere's disease (82%), OME (29.4%) and otosclerosis (25%). Mixed form of hearing loss was seen in CSOM (32.9%) and otosclerosis (25%) of diabetic subjects (Figure 3). Diabetic subjects with presbycusis (89%), OME (52.9%) and CSOM (52.4%) were observed to have hearing loss at higher frequency (>40 dBHL) while Meniere's disease (100%) ASOM (70.8%) and otosclerosis (25%) had at lower frequency (<40 dBHL) when compared with non-diabetic subjects (Figure 4).

## Discussion

Diabetes Mellitus is one of the systemic, complex and metabolic disorders with under-recognized complication that has a serious impact on social and economic life style of the people. The prevalence of

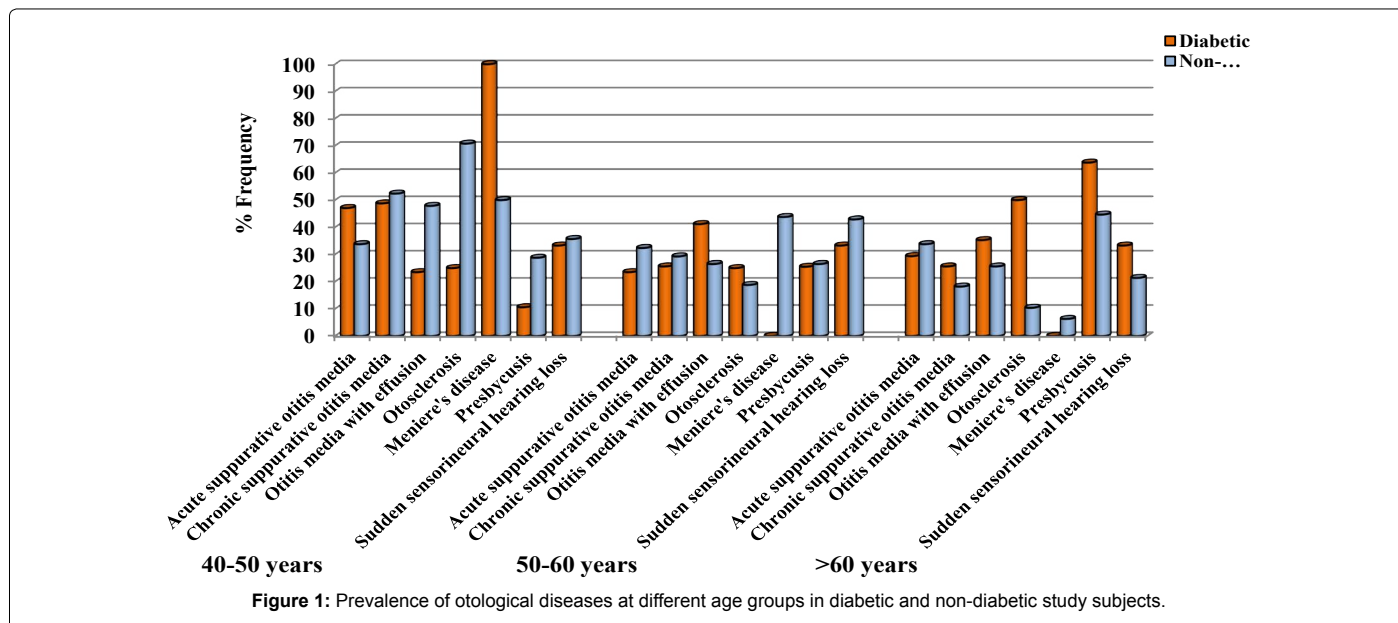


Figure 1: Prevalence of otological diseases at different age groups in diabetic and non-diabetic study subjects.

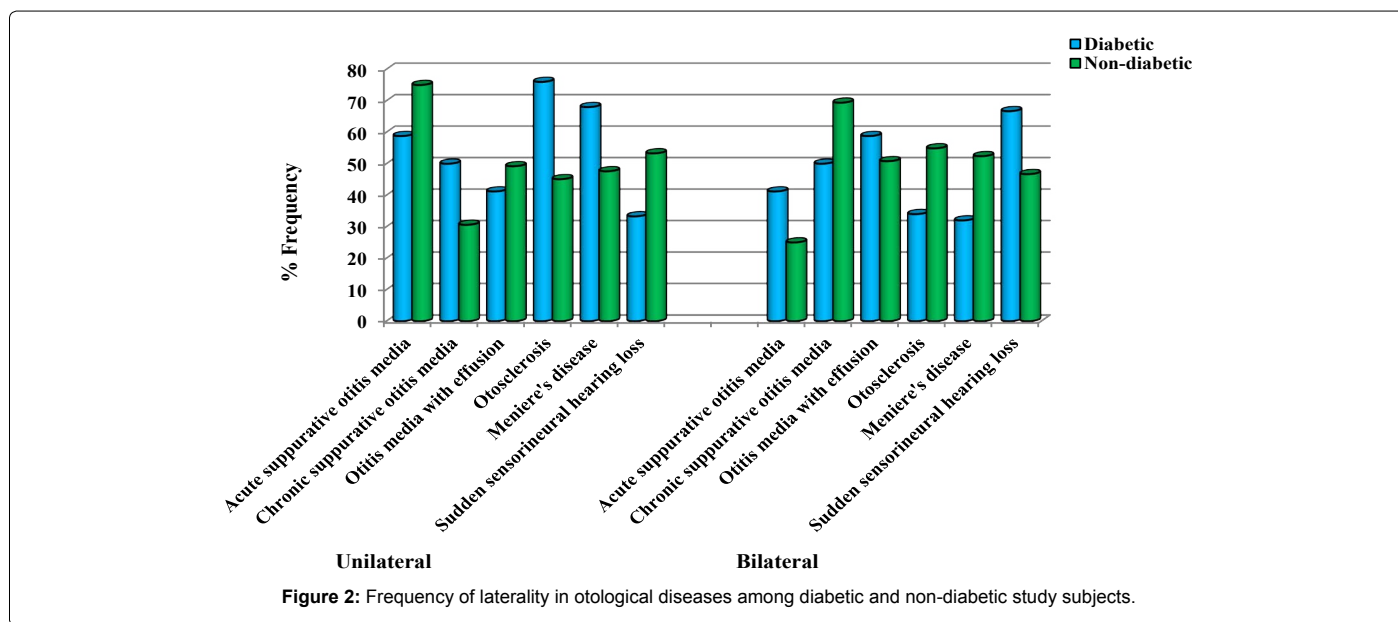


Figure 2: Frequency of laterality in otological diseases among diabetic and non-diabetic study subjects.

diabetes is widespread globally and affects all age groups. Diabetes is an important risk factor for the onset of hearing loss and the progression of which involves neuronal degeneration, microangiopathy, degeneration of glucose metabolism, hypertrophy of intima of blood vessels narrowing in the inner ear and inevitable consequence of ageing [11-13]. Complex relation exists between the otological disorders and metabolic diseases which may act as important risk factors for the hearing impairment [14,15]. Studies have reported that otitis media has been influenced by diabetes leading to the onset of hearing loss [16-18]. The occurrence of hearing loss at higher thresholds in CSOM and OME in the present study has been attributed to diabetic micro and macroangiopathies that would induce middle ear infections.

Conductive form of hearing loss was more prevalent in ASOM while sensorineural form prevalent in OME, otosclerosis and Meniere's disease. Mixed form of hearing loss was seen in CSOM and otosclerosis.

Further, the prevalence of hearing loss in diabetic subjects significantly increased with advancing age. Presbycusis (63.8%), otosclerosis (50%) and SSNHL (33.3%) were the otological disorders which showed high prevalence of hearing loss in the elderly diabetic subjects (>60 years) when compared to non-diabetics.

Conflicting findings have been reported on the degree of hearing loss in young and elderly diabetics at different thresholds. Some studies have shown high frequency thresholds being affected whereas other studies have reported to affect at all the frequencies or only at lower frequencies [2,19,20]. However, in the present study the prevalence of hearing loss was found to be more prevalent at higher frequency (>40 dBHL) in diabetics when compared to non-diabetics. CSOM, OME and presbycusis showed hearing loss at higher frequencies (>40 dBHL) while Meniere's disease with lower frequency (<40 dBHL). The possible reason for the prevalence of hearing loss at higher frequency

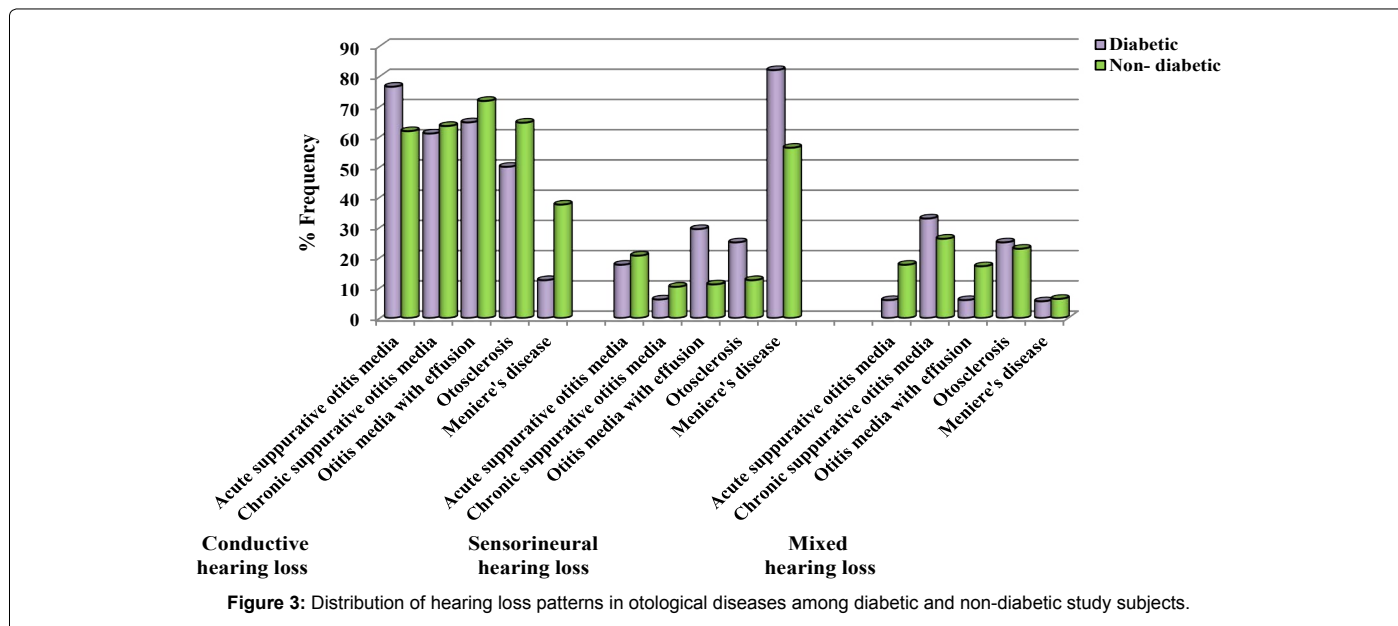


Figure 3: Distribution of hearing loss patterns in otological diseases among diabetic and non-diabetic study subjects.

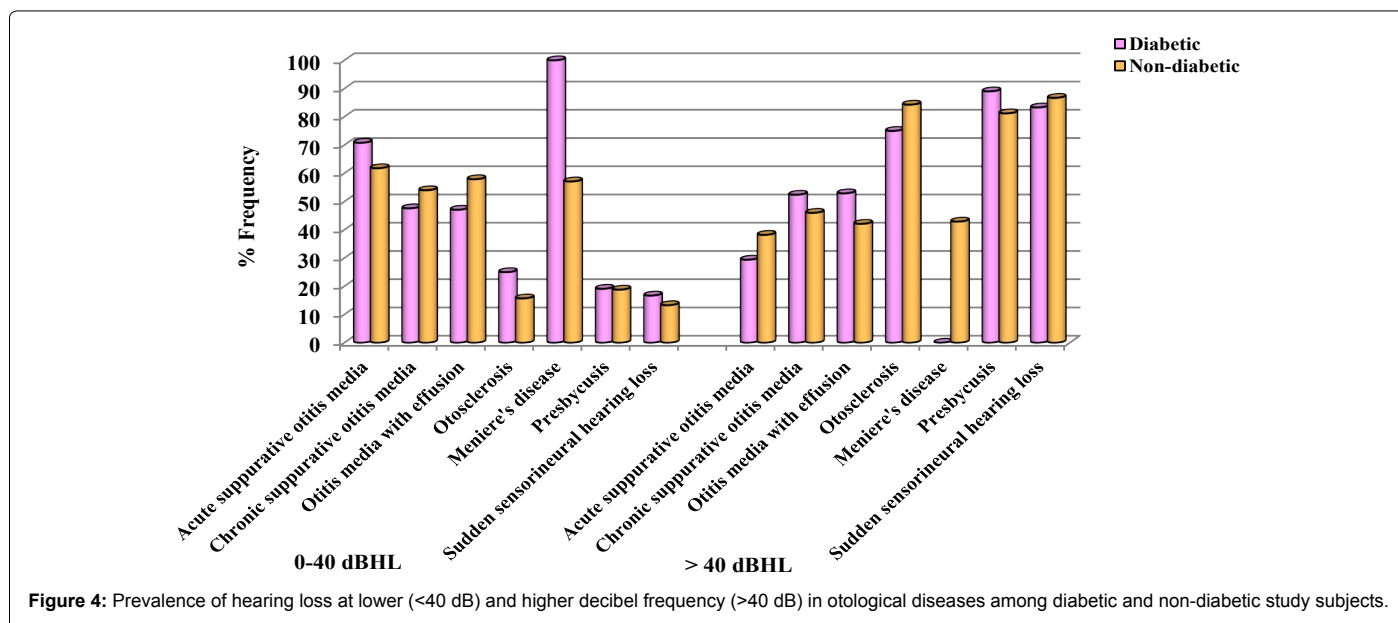


Figure 4: Prevalence of hearing loss at lower (<40 dB) and higher decibel frequency (>40 dB) in otological diseases among diabetic and non-diabetic study subjects.

in the present study could be due to the abnormal blood glucose levels reducing the blood flow to cochlea causing cell degeneration which is in accordance with the study of Kakarlapudi et al. [2].

Sex, age and race were the principle factors associated with hearing loss and diabetes [21,22]. The results of the present study indicated that males had significantly higher prevalence of hearing loss compared to non-diabetic which is in agreement with the previous studies [23,24]. However, some studies reported no association while others showed female preponderance [25,26]. Most of the progressive form of hearing loss occurring bilaterally is caused by diabetes [13,22]. In the present study, there was a significant association of bilateral form of hearing loss in diabetic subjects compared to non-diabetic and has increased with advancing age (>60 years). SSNHL, OME and ASOM showed bilateral progression of hearing loss representing the severity of the otological pathology induced by diabetes.

## Conclusion

The present study has revealed hearing loss as an important consequence of diabetes indicating metabolic assessment may be useful for diagnosing patients presenting hearing loss. The study also helped to establish the prevalence of otological disorders in diabetic subjects caused by the dysfunction of middle and inner ear. Diabetes was significantly associated with various otological disorders and hearing loss patterns in the age group above 60 years. Therefore, effective control of diabetes is essential to reduce the incidence of deafness in the elderly to lead a quality life.

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## References

1. Diniz TH, Guida HL (2009) Hearing loss in patients with diabetes mellitus. *Braz J Otorhinolaryngol* 75: 573-578.
2. Kakarlapudi V, Sawyer R, Staecker H (2003) The effect of diabetes on sensorineural hearing loss. *Otol Neurotol* 24: 382-386.
3. Janghorbani M, Amini M, Tavassoli A (2006) Coronary heart disease in type 2 diabetes mellitus in Isfahan, Iran: prevalence and risk factors. *Acta Cardiol* 61: 13-20.
4. Esteghamati A, Abbasi M, Nakhjavani M, Yousefizadeh A, Basa AP, et al. (2006) Prevalence of diabetes and other cardiovascular risk factors in an Iranian population with acute coronary syndrome. *Cardiovasc Diabetol* 5: 15.
5. Tabish SA (2007) Is Diabetes Becoming the Biggest Epidemic of the Twenty-first Century? *Int J Health Sci (Qassim)* 1: V-VIII.
6. Mohan V, Sandeep S, Deepa R, Shah B, Varghese C (2007) Epidemiology of type 2 diabetes: Indian scenario. *Indian J Med Res* 125: 217-230.
7. Fukushima H, Cureoglu S, Schachern PA, Paparella MM, Harada T, et al. (2006) Effects of type 2 diabetes mellitus on cochlear structure in humans. *Arch Otolaryngol Head Neck Surg* 132: 934-938.
8. Malucelli DA, Malucelli FJ, Fonseca VR, Zeigeboim B, Ribas A, et al. (2012) Hearing loss prevalence in patients with diabetes mellitus type 1. *Braz J Otorhinolaryngol* 78: 105-115.
9. Díaz de León-Morales LV, Jáuregui-Renaud K, Garay-Sevilla ME, Hernández-Prado J, Malacara-Hernández JM (2005) Auditory impairment in patients with type 2 diabetes mellitus. *Arch Med Res* 36: 507-510.
10. Mitchell P, Gopinath B, McMahon CM, Rochtchina E, Wang JJ, et al. (2009) Relationship of Type 2 diabetes to the prevalence, incidence and progression of age-related hearing loss. *Diabet Med* 26: 483-488.
11. Shikowitz MJ (1991) Sudden sensorineural hearing loss. *Med Clin North Am* 75: 1239-1250.
12. Tóth F, Várkonyi TT, Rovó L, Lengyel C, Légrády P, et al. (2003) Investigation of auditory brainstem function in diabetic patients. *Int Tinnitus J* 9: 84-86.
13. Frisina ST, Mapes F, Kim S, Frisina DR, Frisina RD (2006) Characterization of hearing loss in aged type II diabetics. *Hear Res* 211: 103-113.
14. Enrietto JA, Jacobson KM, Baloh RW (1999) Aging effects on auditory and vestibular responses: a longitudinal study. *Am J Otolaryngol* 20: 371-378.
15. Davanipour Z, Lu NM, Lichtenstein M, Markides KS (2000) Hearing problems in Mexican American elderly. *Am J Otol* 21: 168-172.
16. Ito K, Naito R, Murofushi T, Iguchi R (2007) Questionnaire and interview in screening for hearing impairment in adults. *Acta Otolaryngol Suppl* : 24-28.
17. Austin DF, Konrad-Martin D, Griest S, McMillan GP, McDermott D, et al. (2009) Diabetes-related changes in hearing. *Laryngoscope* 119: 1788-1796.
18. Park M, Lee JS, Lee JH, Oh SH, Park MK (2015) Prevalence and risk factors of chronic otitis media: the Korean National Health and Nutrition Examination Survey 2010-2012. *PLoS One* 10: e0125905.
19. Cullen JR, Cinnamon MJ (1993) Hearing loss in diabetics. *J Laryngol Otol* 107: 179-182.
20. Bainbridge KE, Hoffman HJ, Cowie CC (2008) Diabetes and hearing impairment in the United States: audiometric evidence from the National Health and Nutrition Examination Survey, 1999 to 2004. *Ann Intern Med* 149: 1-10.
21. Lin FR, Thorpe R, Gordon-Salant S, Ferrucci L (2011) Hearing loss prevalence and risk factors among older adults in the United States. *J Gerontol A Biol Sci Med Sci* 66: 582-590.
22. Horikawa C, Kodama S, Tanaka S, Fujihara K, Hirasawa R, et al. (2013) Diabetes and risk of hearing impairment in adults: a meta-analysis. *J Clin Endocrinol Metab* 98: 51-58.
23. Huang W (2004) Characteristics of hearing loss in type 2 diabetic patients. *Chin J Clin Rehab* 8: 1612-1613.
24. Bener A, Salahaldin AH, Darwish SM, Abdulla OA, Al Hamaq, et al. (2008) Association between hearing loss and type 2 diabetes mellitus in elderly people in a newly developed society. *Biomed Res* 19: 187-193.
25. Chamyal PC (1997) Vestibulo-cochlear functions in diabetes mellitus. *Indian J Otolaryngol Head Neck Surg* 49: 162-164.
26. Rajendran S, Anandhalakshmi, Mythili B, Vishwanatha R (2011) Evaluation of the Incidence of sensorineural hearing loss in patients with type 2 diabetes mellitus. *Int J Biol Med Res* 2: 982-987.