

# Study of Association of Diabetes Mellitus and Hyperlipidaemia with Hearing Loss

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## ABSTRACT

**Introduction:** to find the association of diabetes mellitus and hyperlipidaemia with hearing loss and combined effect of diabetes and dyslipidaemia on hearing.

**Material and methods:** A cross sectional observational study was undertaken which comprised of a total of 100 subjects who were divided in 4 groups, which comprised of 25 control subjects in one group and 75 subjects in the other 3 groups with presence of diabetes mellitus type 2, hyperlipidemia and diabetic subject with hyperlipidaemia. Routine blood investigations like lipid profile and blood glucose were done and all subjects were evaluated by conducting pure tone audiometry.

**Results:** The prevalence of hearing loss in group IV was 68.0%, in group III 60.0%, in group II, it was 44.0% and in group I, it was 8.0%. There was increased association of hearing loss in subjects having high triglycerides, high total cholesterol and high LDL levels. Higher frequency of hearing loss was seen on audiogram analysis.

**Conclusions:** It was concluded that prevalence of sensorineural deafness was increased in the subjects with diabetes mellitus and in subjects having hyperlipidaemia while diabetic subjects with hyperlipidaemia had the highest risk of developing sensorineural deafness. The hearing loss was gradual, progressive, bilateral and sensorineural which affected mainly higher frequencies.

**Keywords:** Diabetes Mellitus, Hyperlipidaemia, Sensorineural Hearing Loss, Audiometry, Association

## INTRODUCTION

From decades, various researches have been conducted to find out the relationship of diabetes mellitus and hyperlipidaemia with sensorineural hearing loss (SNHL). However, relationship between hyperlipoproteinaemia and hearing loss is seen in many studies but this is still controversial. Reason for auditory dysfunction in these cases may be hyperviscosity of blood serum, vascular occlusion etc.<sup>1,2</sup>

Various histo-pathological studies have shown that diabetes in combination with dyslipidaemia causes damage to inner ear's nerves and vessels. This is the reason behind auditory dysfunction in diabetic dyslipidaemia subjects.<sup>3</sup>

Hearing loss may be conductive, sensorineural or mixed. In diabetic subjects having hyperlipidaemia have reported gradual, progressive and bilateral sensorineural loss which affected especially the high frequencies<sup>4</sup> and others reported hearing loss in the low and medium frequencies.<sup>5</sup> Therefore aim of present study was to find the association of diabetes

mellitus and hyperlipidaemia with hearing loss and combined effect of diabetes and dyslipidaemia on hearing.

## MATERIAL AND METHODS

Present study was a cross sectional study conducted in the department of E.N.T. at Rama Medical College Hospital & Research Center, Kanpur after getting informed consent and clearance from ethical committee. The study group consisted of 25 normal subjects (group I), 25 subjects with hyperlipidaemia (group II), 25 diabetic subjects with normal lipid profile (group III) and 25 diabetic subjects with hyperlipidemia. Subjects already taking treatment for hyperlipidaemia, having family history of deafness, a history of ototoxic drug intake, chronic smoking, history of systemic disease like hypertension, renal failure etc were excluded from the study. Routine investigations like blood glucose and lipid profile (total cholesterol, HDL-C, LDL-C, VLDL-C and triglycerides) were conducted. Subjects were termed diabetic as per the guidelines issued by National Institute for Clinical Excellence<sup>6</sup> and levels of lipid profile is termed as dyslipidemia as per the National Cholesterol Education Program Adult Treatment Panel-III guidelines.<sup>7</sup>

Clinical examination of ear, nose and throat was done. To rule out obstructive wax, ear canals were examined through an otoscope. The tuning fork tests (the Rinne test, the Weber test, the Absolute bone conduction (ABC) and pure tone audiometry (PTA) were done for bilateral ears. Pure tone audiogram is widely used to find out the degree of hearing loss. The audiological examination was performed by using a Pure Tone Audiometer by Hughson Westlake Method. All the participants underwent pure tone audiometry using Audiometer by Hughson Westlake Method for audiometric evaluation. The air conduction thresholds were measured for the tones of 250, 500, 1000, 2000, 4000, 6000, and 8000 Hz and bone conduction thresholds were measured for 250, 500,

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1000, 2000 and 4000 Hz. Air and bone conduction thresholds were tested in both ears and readings were recorded and plotted on an audiogram.

Data was collected and analyzed by using the SPSS software. Descriptive tables were generated and the Chi square test and the ANOVA statistical techniques were used. A p value of less than 0.05 was considered to be statistically significant.

**RESULTS**

Table 1 compares hearing loss in various groups in present study. In group I, out of 25 individuals, only two individuals had deafness (8.0%) while in group II, 11 subjects (44%) had deafness. Group III showed that out of 25 diabetic subjects having normal lipid levels, 15 (60%) had hearing loss while in group IV, out of 25 subjects with both diabetes and hyperlipidaemia, 17 had hearing loss (68.0%). The

p value was 0.001, which was statistically significant (p<0.05).

Table 2 shows the hearing loss in cases of hyperlipidaemia. Out of 52 subjects with high cholesterol levels, 28 (53.9%) had hearing loss while in 48 subjects with normal cholesterol levels, 11 (22.9%) had deafness and the p value was statistically significant. Out of 46 patients with high triglyceride levels, 32 (69.6%) had hearing loss and the p value statistically significant. Out of 12 patients with low HDL levels, 7 (58.3%) had hearing loss and the p value was 0.48 which was statistically not significant. Out of 14 subjects with increased LDL levels, 9 (64.3%) had deafness and the p value was statistically significant.

Table 3 shows the audiogram analysis of the mean air conduction thresholds of all study groups at various frequencies. In groups III and IV, hearing loss started at 4000

Study Group	Hearing loss cases	Total Cholesterol (Mean ±SD)	Statistical values
Group I (normal subjects, n=25)	2 (8.0%)	206.4 ± 41.2	P value= 0.001 X <sup>2</sup> = 22.78
Group II (Subjects with hyperlipidemia, n=25)	11 (44%)	302.4 ± 37.6	
Group III (Diabetic subjects having normal lipid profile, n=25)	15 (60%)	209.4 ± 24.6	
Group IV (Diabetic subjects with hyperlipidemia, n=25)	17 (68%)	289.3 ± 26.8	

**Table-1:** Hearing loss in various study groups

Study Group	No. (%) of subjects		Statistical values
	Normal hearing	Hearing loss	
Subjects with normal cholesterol (n=48)	37 (77.0%)	11 (22.9%)	P value= 0.021 X <sup>2</sup> = 4.78
Subjects with high cholesterol (n= 52)	24 (46.1%)	28 (53.9%)	
Subjects with normal triglyceride (n=54)	42 (77.8%)	12 (22.3%)	P value= 0.001 X <sup>2</sup> = 22.26
Subjects with high triglyceride (n=46)	14 (30.4%)	32 (69.6%)	
Subjects with normal LDL-C (n=86)	59 (68.6%)	27(31.4%)	P value= 0.01 X <sup>2</sup> = 7.21
Subjects with high LDL-C (n=14)	5 (35.7%)	9 (64.3%)	
Subjects with normal HDL-C (n=88)	57 (64.8%)	31 (35.2%)	P value= 0.48 X <sup>2</sup> = 0.498
Subjects with low HDL-C (n=12)	5 (41.7%)	7 (58.3%)	

**Table-2:** Hearing profile of cases in hyperlipidemia

Frequencies (Htz)	Mean air conduction threshold (db) ±SD				ANOVA test
	Group I	Group II	Group III	Group IV	
250	15±0.0	15±0.0	15±0.0	15±0.0	F=0, P=0
500	15.1±0.6	15±0.0	15±0.0	15±0.0	F=1.04, P=0.372
1000	15.2±0.62	15.34±2.11	15.2±0.69	15±0.0	F=1.23, P=0.34
2000	18.92± 2.3	19.79± 5.05	20.92± 6.11	21.05± 6.41	F=1.39, P= 0.26
4000	21.02± 2.9	22.89± 9.86	23.05± 5.21	24.91± 5.14	F=7.32, P= 0.0003
6000	21.49± 6.89	23.82± 7.92	27.12± 7.51	29.02± 8.75	F= 6.57, P= 0.0004
8000	22.77± 3.82	26.52± 14.21	27.96± 9.62	31.72± 11.29	F=6.91, P= 0.0003

**Table-3:** Mean air conduction threshold at different frequencies by using audiogram

Frequencies (Htz)	Mean bone conduction threshold (db) ±SD				ANOVA test
	Group I	Group II	Group III	Group IV	
250	10±0.0	10±0.0	10±0.0	10±0.0	F=0, P=0
500	10.93±1.28	11.02±2.51	11.59± 2.35	11.62±0.43	F=1.39, P=0.28
1000	11.03±1.49	12.29±5.29	13.11± 5.23	14.01± 5.97	F=2.39, P=0.08
2000	11.82± 2.01	12.96± 7.98	13.98± 6.14	14.89± 4.37	F=2.41, P= 0.07
4000	12.11± 2.71	15.01± 10.98	16.41± 9.48	20.41± 9.1	F=5.81, P= 0.0009

**Table-4:** Mean bone conduction threshold at different frequencies by using audiogram

Hz but the mean air conduction threshold was maximum at 8000 Hz.

Table 3 shows the audiogram analysis of the mean bone conduction thresholds of all study groups at various frequencies. In groups III and IV, hearing loss started at 4000 Hz but the mean air conduction threshold was maximum at 8000 Hz.

## DISCUSSION

In present study, it was observed that the prevalence of hearing loss in group II (subjects with hyperlipidaemia) was 44%, in group III (subjects with diabetes) 60% and in group IV (subjects with both diabetes and dyslipidaemia), was 68%.

In present study, prevalence of hearing loss among subjects with high cholesterol level was 53.9% which is similar to the studies done by Swaminathan A et al.<sup>8</sup> and Michael A et al.<sup>1</sup> showing that hyperlipidaemia are a risk factor for hearing loss. Subjects with increased triglyceride levels showed hearing loss in 69.6% cases and had statistically significant relationship with hearing loss. Result of present study is similar to findings of Pan HG et al.<sup>9</sup> who found decrease in the amplitude and the latency of distortion product otoacoustic emissions (DPOAE) in the subjects with increased triglyceride levels..

The evaluation of the auditory function in subjects with low HDL showed deafness in 58.3% cases with no significant relationship (p value > 0.05). and hearing loss in subjects with high LDL levels was 64.3% with significant relationship (p value < 0.05). Study done by Parmar SM et al.<sup>10</sup> also observed similar results.

Prevalence of hearing loss in diabetic subjects with normal lipid profile was 60%. Study done by various authors (Weng SF et al.<sup>11</sup> and Friedman et al.<sup>12</sup>) also showed similar results. Rozanska-Kudelska et al.<sup>13</sup> observed 95% hearing loss in diabetic subjects by using audiometry. Various mechanisms like formation and accumulation of advanced glycation end products, activation of the protein kinase C pathway, increased oxidative stress, vascular inflammation and the Impairment of insulin action in the tissues are the reason behind hearing loss in the diabetic subjects.

It was observed that hyperlipidaemia and diabetes mellitus are independent risk factors for sensorineural hearing loss. But combinations of both (hyperlipidaemia and diabetes mellitus) have greatest effect on hearing. The reason behind this is vascular complications produced by diabetic dyslipidaemia. Diabetic subjects with hyperlipidaemia had hearing loss in 68% cases in present study which is in concordance with the findings of study done by Chapman T et al.<sup>3</sup>

The analysis of the mean air and bone conduction threshold of group II (subjects with diabetes) and group IV (subjects with diabetic dyslipidaemia ) was done by audiometry and it showed that hearing threshold increased at 2000 Hz and even more at 4000Hz, with the mean air conduction threshold being maximum at 8000 Hz in bilateral ears. Studies done by various authors<sup>14,15</sup> also reported similar results.

## CONCLUSION

From the results of present study, it can be concluded that hearing loss is more prevalent in diabetic subjects having dyslipidaemia in comparison of diabetes and hyperlipidaemia alone. In group I subjects, hearing loss was lowest in comparison of other groups. In present study, there was a positive significant correlation between hyperlipidaemia and diabetes on hearing loss. The audiograms of the diabetic subjects with dyslipidaemia had no significant air bone gap. There was progressive, bilateral, sensorineural type of hearing loss which predominantly affected the higher frequencies.

Major limitation of present study was small sample size. There is need of further studies to measure the otoacoustic emissions and brain stem auditory evoked response to understand the pathology behind hearing loss.

## REFERENCE

1. Michael A. Sikora, Morizono T, Ward WD, Paparella MM, Leslie K. Dietinduced hyperlipidaemia and auditory dysfunction. *Acta Otolaryngol.* 1986; 102:372-81.
2. Pillsbury HC. Hypertension, hyperlipoproteinaemia and chronic noise exposure: is there synergism in the cochlear pathology? *Laryngoscope* 1986; 96: 1112-38.
3. Chapman T, Mcqueen, Baxter A, Smith T L, Raynor E, Yoon SM, et al. Non-insulin – dependent diabetic microangiopathy in the inner ear. *The Journal of Laryngology and Otology.* 1999; 113: 13-18.
4. Cullen JR, Cinnamon MJ. Hearing loss in diabetics. *J Laryngol Otol.*1993; 107:179-82.
5. Frisina ST, Mapes F, Kim S, Frisina DR, Frisina RD. Characterization of hearing loss in aged type II diabetics. *Hear Res.* 2006; 211: 103-13.
6. NICE. National Institute for Health and Care excellence. Type 2 diabetes: The management of type 2 diabetes Clinical guideline [CG87].
7. NCEP. ATP III Guidelines, NIH Publication No. 01-3305 May 2001.
8. Swaminathan A, Sambandam R, Bhaskaran M. Evaluation of the auditory effect of Hyperlipidaemia and Diabetes Mellitus by using Audiometry. *Journal of Clinical and Diagnostic Research.*2011;5:1528-32.
9. Pan HG, Cui YH, Gao QX, Wang CF, Ge X. The study of the distortion product emission in people with hypertriglycerides. *Lin Chuang Er Bi Yan Hou Ke Za Zhi.* 2000; 14:299-300.
10. Parmar SM, Khare P, Chaudhary M. Evaluation of effects of Diabetes Mellitus Type 2 and Hyperlipidemia on Hearing. *Indian Journal of Otology.* 2017;23:155-61.
11. Weng SF, Chen YS, Hsu CJ, Tseng FY. Clinical features of sudden sensorineural hearing loss in diabetic patients. *Laryngoscope.* 2005;115:1676-80.
12. Friedman SA, Schulman RH, Weiss S. Hearing and diabetic neuropathy. *Arch Intern Med.* 1975; 135:573-76.
13. Rozanska-Kudelska M, Chodynicky S, Kinalska I, Kowalska I. Hearing loss in patients with diabetes mellitus type II. *Otolaryngol Pol.* 2002;56:607-10.
14. Vaughan N, James K, McDermott D, Griest S, Fausti S.

A 5-year prospective study of diabetes and hearing loss in a veteran population. *Otol Neurotol.* 2006; 27:37-43.

15. Cunningham D.R, Goetzinger C.P. Extra high frequency hearing loss and hyperlipidaemia. *Audiology* 1974; 13:470-84.

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