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**ORIGINAL RESEARCH**

# A Study on Association Between Dyslipidaemia And Sensorineural Hearing Loss

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## ABSTRACT

**Background:** Deafness is one of the most neglected chronic conditions and it is the most prevalent sensory disability worldwide. Though the etiology and pathogenesis of sensorineural hearing loss is yet unclear many metabolic disorders have their influence as associated risk factors. The relationship between dyslipidaemia and hearing is on scientific inquiry since many years and is controversial. **Aim:** To study the association between dyslipidaemia and sensorineural hearing loss. **Materials and Methods:** Hospital based prospective case-control study was done on sixty-two cases and sixty-two controls aged 20-60 years. Base line audiometric evaluation by history, demographic characteristics, otoscopic examination, pure tone audiometry and lipid profile testing was done. **Results:** In this study, case and control group were comparable in age and sex distribution. Sensorineural hearing loss was mild in 43.5%, moderate in 45.2%, moderately severe in 6.5% and severe in 4.8% of the cases. Mean levels of low-density lipoprotein (LDL), total cholesterol (TC), triglycerides (TG) and incidence of dyslipidaemia (24.2%) were significantly higher among cases compared to controls (*P* value <0.05). Elevated LDL showed significant association with severity of SNHL. **Conclusion:** In this study, it was found that there was significant association between serum lipid level and sensorineural hearing loss. Further, elevated LDL was also found to be significantly associated with the severity of SNHL. It can be concluded that dyslipidaemia increases the risk of occurrence of sensorineural hearing loss. Hence regular monitoring of serum lipid profile can be valuable to prevent SNHL.

**Keywords:** sensorineural hearing loss, dyslipidaemia, pure tone audiometry, high density lipoprotein, low density lipoprotein, total cholesterol, triglycerides



## INTRODUCTION

Hearing impairment is considered as the most prevalent sensory impairment worldwide. Nationwide disability survey has estimated hearing loss to be second most common cause of disability.[1] Sensorineural hearing loss (SNHL) is a symptom not a disease, but it is disability and causes psychological trauma. SNHL is a type of hearing loss or deafness, root cause of which lies in inner ear, vestibulocochlear nerve or central processing areas of the brain. However, hearing may be worsened by some medical conditions such as hypothyroidism, diabetes and dyslipidaemia. [2] Wilson et al. defined idiopathic sudden SNHL as sensorineural hearing loss greater than 30dB over at least three contiguous frequencies occurring over a period of 3 days. [3] The incidences and prevalence of the condition has been significantly increased in recent years. The cause of the disease has not been elucidated yet but cochlear ischaemia has been hypothesized among patient in whom infective or acoustic neurinoma have been excluded. [4] Insufficient perfusion of the cochlea due to an increased blood viscosity, micro thrombosis or altered vasomotion are assumed pathogenesis in SNHL. Hypercholesterolemia and hyperfibrinogenaemia are frequently observed in patients with SNHL. [5] Many studies have been conducted to see the possible correlation between hearing loss and high serum cholesterol levels and found that hearing appears to be influenced by high blood lipids. [6] Vascular events, immunological processes and viral infections have to be considered as pathomechanisms for most cases of

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SNHL. Various mechanism by which dyslipidaemia might cause SNHL have been postulated which includes atherosclerosis, lipidosis, metabolic disorders, hyper viscosity, hypoxia, microvascular disorders, hereditary and age induced factors. [7] Our study was designed to evaluate the association between dyslipidaemia of patients presenting with SNHL compared to normal controls. If a constant and significant association is found between dyslipidaemia and SNHL, it is possible that hearing loss will be ceased or even reversed with lifestyle modification, dietary habits and dyslipidaemia treatment and thus preventing its crucial consequences.

## MATERIALS AND METHODS

A hospital based prospective case-control study was conducted among sixty-two patients with sensorineural hearing loss and sixty-two controls attending outpatient department of Otorhinolaryngology of a tertiary care medical college for a duration of two years from October 2022 to October 2024. Patients between age group of twenty to sixty years and with sensorineural hearing loss greater than 26dB for speech frequencies were included in the study. Patients with deaf mutism, history of recent upper respiratory tract infection, noise induced hearing loss, patients using ototoxic drugs, patients with ear discharge, hearing loss due to other causes like otitis media, Meniere's disease, otosclerosis, presbycusis, acoustic neuroma, temporal bone fracture, patients with medical diseases such as diabetes mellitus, ischemic cerebrovascular or haematological disease, hypothyroidism, patients with chronic alcoholism and patients on drugs affecting lipid level like statins, fibrates, oral contraceptive pill were excluded from the study. **Sample size estimation:** The sample size has been estimated in consultation with a biostatistician, with anticipated mean difference of lipid profile level between cases and control as 6.5 and anticipated SD as 8.6, the minimum sample size per group is sixty-two with 90% power and 1% level of significance. **Methodology:** Detailed history was taken and complete ear, nose and throat (ENT) examination was conducted including otoscopic examination. Patients underwent Rinne's and Weber's tuning fork test with 512 Hz tuning fork to confirm sensorineural hearing loss. Pure tone audiometry was performed by qualified audiologist in sound proof room using standard advanced digital audiometer AD2100 calibrated regularly to All India Institute of Speech and Hearing (AIISH) standards, for both case and control group hearing thresholds for pure tone audiometer was determined at frequencies from 250Hz to 8000Hz for air and 250Hz to 4000Hz for bone. Diagnosis of sensorineural hearing loss was based on no air bone gap and was labelled abnormal if hearing threshold was 26dB or more at one or more test frequencies. Audiometry was performed by a single audiologist who was kept blind to lipid status of the participants. In this study the degree of sensorineural hearing loss is based on the World Health Organization (WHO) classification and classified as with reference to ISO: R 389-1970. Serum lipid profile was done after confirmation of eight hours of fasting. The optimal ranges of lipid parameters were defined according to guidelines of the American association of clinical endocrinologist (AACE). [8] **Statistical analysis:** Data collected was compiled and was analysed using SPSS software v.23.0. Continuous variables were expressed as mean ± standard deviation (SD), categorical data as frequencies and percentages. Chi-square ($\chi^2$) test was used to test association between two categorical variables. Comparison of means was done by unpaired t test and ANOVA test. *P* value < 0.05 was considered statistically significant.

## RESULTS

**Table 1: Comparison of demographic profile between cases and controls (N-frequency)**

| Variable | | Cases | | Controls | | p value |
|---|---|---|---|---|---|---|
| | | N | % | N | % | |
| Age (Years) | ≤20 | 3 | 4.8% | 2 | 3.2% | 0.99 |
| | 21-30 | 9 | 14.5% | 9 | 14.5% | |
| | 31-40 | 5 | 8.1% | 6 | 9.7% | |
| | 41-50 | 19 | 30.6% | 19 | 30.6% | |
| | 51-60 | 26 | 41.9% | 26 | 41.9% | |
| | *Total* | *62* | *100.0%* | *62* | *100.0%* | |
| Gender | Male | 30 | 48.4% | 31 | 50.0% | 0.857 |
| | Female | 32 | 51.6% | 31 | 50.0% | |
| | *Total* | *62* | *100.0%* | *62* | *100.0%* | |

The age of the patients varied from twenty to sixty years among both cases and controls. Majority of the cases twenty-six (41.9%) belonged to the age group of fifty-one to sixty years among both the groups. The mean age was 44.6 ± 11.3 years among cases and 44.7 ± 11.0 years among controls. Gender distribution was almost equal among both the groups. There was no significant difference in age and gender distribution between case and controls groups. (Table 1)

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**Table 2: Comparison of severity of SNHL between cases and controls (N-frequency)**

| SNHL | Cases | | Controls | | p value |
|---|---|---|---|---|---|
| | N | % | N | % | |
| Normal | 0 | 0.0% | 62 | 100.0% | <0.001* |
| Mild | 27 | 43.5% | 0 | 0.0% | |
| Moderate | 28 | 45.2% | 0 | 0.0% | |
| Moderately Severe | 4 | 6.5% | 0 | 0.0% | |
| Severe | 3 | 4.8% | 0 | 0.0% | |
| *Total* | 62 | 100.0% | 62 | 100.0% | |

* Statistically significant

SNHL was moderate in 45.2%, mild in 43.5% and moderately severe in 6.5%, and severe in 4.8% of the cases. The severity of SNHL between cases and controls was statistically significant ($p<0.05$). (Table 2)

**Table 3: Comparison of mean pure tone audiometry between cases and controls (SD-standard deviation)**

| Ear | Cases | | Controls | | p value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| **Right Ear** | 34.5 | 12.1 | 24.6 | 9.3 | <0.001* |
| **Left Ear** | 33.9 | 13.6 | 26.6 | 5.4 | 0.048* |

*-statistically significant

Hearing loss was assessed at different speech frequencies and mean audiogram values were found to be 34.5 ± 12.1 in the right ear among cases and 24.6 ± 9.3 among controls. In left ear, the mean audiogram value among cases was 33.9 ± 13.6 and 26.6 ± 5.4 among controls. The mean audiogram value was significantly higher among cases compared to controls for both the ears ($p<0.05$). (Table 3)

**Table 4: Comparison of mean lipid profile between cases and controls (SD-standard deviation)**

| Lipid profile | Cases | | Controls | | p value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| LDL | 119.1 | 38.2 | 93.1 | 35.6 | <0.001* |
| HDL | 38.4 | 16.2 | 52.7 | 16.6 | <0.001* |
| Total Cholesterol | 184.0 | 52.3 | 178.7 | 37.8 | 0.520 |
| Triglycerides | 248.5 | 44.5 | 185.5 | 96.7 | 0.005* |

*-statistically significant.

Mean LDL, HDL, TC and TG was 119.1 ± 38.2, 38.4 ± 16.2, 184.0 ± 52.3 and 248.5 ± 44.5 (mg/dl) among cases and 93.1 ± 35.6, 52.7 ± 16.6, 178.7 ± 37.8 and 185.5 ± 96.7 among controls. The mean levels of LDL, HDL, TG was found to be significantly higher among cases compared to controls ($p < 0.05$) whereas HDL showed no significant difference between the groups. (Table 4)

**Table 5: Association between lipid profile and severity of SNHL**

| Lipid profile | | Severity of SNHL | | p value |
|---|---|---|---|---|
| | | Mild to moderate | Moderately severe to severe | |
| LDL | >130 | 11 | 2 | 0.046236* |
| | ≤130 | 48 | 1 | |
| HDL | <60 | 51 | 6 | 0.520996 |
| | ≥60 | 3 | 2 | |
| Total Cholesterol | >200 | 16 | 2 | 0.339478 |
| | ≤200 | 42 | 2 | |
| Triglycerides | >150 | 41 | 4 | 0.698123 |
| | ≤150 | 16 | 1 | |

LDL showed significant association with severity of SNHL ($p<0.05$) whereas HDL, TC and TG showed no association with severity of SNHL ($p>0.05$). (Table 5)

## REVIEW OF LITERATURE AND DISCUSSION

A study by Mohammed et al [9] found, age ranging from twenty-six to sixty-five years with SNHL peak age incidence in the fifth decade of life. Also, the average age was 44.7 years among cases and 41.7 years among controls. It showed there was a significant difference in the means of lipid profile between cases and the control group (*P* value <0.05) concluding that high lipid levels are significantly associated with the occurrence of sudden SNHL. Study by Gautom et al [10] found that majority belonged to the age group of more than fifty-five years with a mean age of the patients to be 48.31 ± 15.0 years. Male: Female distribution was 1:1 among both cases

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and control groups in both these studies. Levels of serum TC, TG, LDL and VLDL were elevated among cases with SNHL and HDL level was found to be elevated among controls and the results were found to be highly significant with *P* value < 0.001. [10] Studies by Lee FS et al [11] and Suzuki K et al [12] reported male predominance with male to female ratio of 1.44:1 and 1.91:1. They found mean TC to be 211.83 ± 20mg/dl, mean TG value to be 52.8 ± 12.88mg/dl, mean LDL level 185.33 ± 20.32 and mean HDL values to be 40.48 ± 3.81. Ballesteros et al [13] in their study reported 6% with mild level of hearing loss, 41% moderate, 39% severe and 14% with profound hearing loss. Hashim et al [14] found, among cases with SNHL, 54.7% had increased level of TC, 57.5% had decreased HDL and 60.3% showed elevated LDL. Jones N.S, et al [15] found mean TC to be 225.77mg/dl and mean TG to be 43mg/dl. A similar study by Weng, et al [16] reported that TC and LDL cholesterol concentration was responsible for the pathogenesis of sudden SNHL. Also, Oreskovic et al [17] observed that sudden SNHL had significantly high plasma concentration of TC and LDL. In a study by Pu et al [18] decreased HDL levels showed significant correlation with SNHL. Studies by Jones et al [15] and Ulrich et al [19] reported no significant association between hyperlipidaemia and hearing loss. In our study, LDL showed significant association with severity of SNHL (*P* value <0.05) whereas HDL, TC and TG showed no association with severity of SNHL (*P* value >0.05). A study by Gautom et al [10] revealed similar results in which lipid profile except for TG showed no significant association with severity of SNHL (*P* value <0.05). A study by Silky et al [20] in which serum levels of TC, TG and LDL showed significant association with the severity of SNHL (*P* value < 0.05) except for the levels of HDL. A study by Sharma et al [21] reported that TC, TG, LDL showed significant association with severity of SNHL (*P* value <0.05). In this study, age of the patients varied from twenty to sixty years among both cases and controls and twenty-six (41.9%) belonged to the age group of fifty-one to sixty years among both the groups. In this study, mean age was 44.6 ± 11.3 years among cases and 44.7 ± 11.0 years among controls.

In our study, there was no significant difference in age and sex distribution between case and control groups, with male to female ratio of 1:1. SNHL was mild in 43.5%, moderate in 45.2%, and moderately severe in 6.5%, and severe in 4.8% of the cases. The severity of SNHL between cases and controls was statistically significant (*P* value <0.05). Mean audiogram values were significantly higher among cases compared to controls for both the ears (*P* value <0.05). (34.5 ± 12.1 v/s 24.6 ± 9.3 in the right ear, 33.9 ± 13.6 v/s 26.6 ± 5.4 in left ear). Among cases thirteen (21%) had LDL > 130, fifty-seven (91.9%) had HDL < 60, eighteen (29%) had TC > 200, forty-five (72.6%) had TG > 150. Mean LDL level was 119.1 ± 38.2, mean HDL 38.4 ± 16.2, mean total cholesterol was 184.0 ± 52.3 and mean triglyceride was 248.5 ± 44.5 among cases. Mean levels of LDL, HDL, TG was found to be significantly higher among cases compared to controls (*P* value < 0.05) whereas HDL showed no significant difference between the groups.

## CONCLUSION

In our study, it was found that there was significant association between serum lipid level and SNHL. Further, elevated LDL was also found to be significantly associated with the severity of SNHL. It can be concluded that dyslipidaemia increases the risk of occurrence of sensorineural hearing loss. Hence regular monitoring of serum lipid profile can be valuable to prevent SNHL. Also, treating patients with lipid lowering drugs can be safely and strongly postulated to treat SNHL.

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