



## Original Research Article

# Association between Dyslipidemia and Sensorineural hearing loss: A cross-sectional comparative study

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**Abstract:** **Background:** Sensorineural hearing loss (SNHL) is a common auditory disorder with multifactorial etiology. Recent evidence suggests that metabolic factors, particularly dyslipidemia, may contribute to cochlear dysfunction through vascular compromise and oxidative stress. However, the association between lipid abnormalities and hearing loss remains inconclusive. **Objective:** To evaluate the association between dyslipidemia and sensorineural hearing loss and to assess the relationship between lipid profile parameters and hearing thresholds. **Methods:** This hospital-based cross-sectional comparative study included 160 adults aged 18–75 years, comprising 80 patients with dyslipidemia and 80 age- and sex-matched controls. All participants underwent pure tone audiometry to assess hearing thresholds at frequencies ranging from 0.5 to 8 kHz. Hearing loss was classified using standard criteria. Fasting lipid parameters, including total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and triglycerides, were measured. Statistical analysis was performed using SPSS version 26.0, applying independent t-test, chi-square test, and Pearson correlation. **Results:** Sensorineural hearing loss was significantly more prevalent in the dyslipidemia group compared to controls (52.5% vs 27.5%,  $p = 0.002$ ). Higher hearing thresholds were observed across all frequencies, with greater differences at higher frequencies ( $p < 0.001$ ). Lipid parameters showed significant associations with hearing thresholds, particularly LDL ( $r = 0.48$ ,  $p < 0.001$ ), while HDL demonstrated a negative correlation. **Conclusion:** Dyslipidemia is significantly associated with SNHL and may contribute to high-frequency hearing impairment.

**Keywords:** Hearing Loss, Sensorineural; Dyslipidemias; Audiometry, Pure-Tone; Cholesterol; Lipoproteins, LDL; Triglycerides

## INTRODUCTION

Hearing loss is one of the most common sensory impairments worldwide and represents a significant public health concern due to its impact on communication, social interaction, and quality of life [1]. Among the different types, sensorineural hearing loss (SNHL) is the most prevalent form in adults and is often irreversible. It primarily results from damage to the cochlear hair cells or auditory neural pathways

[2]. While aging and noise exposure are well-established causes, increasing attention has been directed toward the role of systemic metabolic factors in the development of SNHL.

Dyslipidemia, characterized by abnormal levels of serum lipids, is a common metabolic disorder and a recognized risk factor for cardiovascular diseases [3]. It is associated with atherosclerosis and

microvascular compromise, which can affect various organ systems, including the inner ear [4]. Modern lifestyle patterns characterized by physical inactivity, unhealthy dietary habits, and increased body weight, especially diets high in total and saturated fats, combined with genetic predisposition, contribute to elevated lipid levels in the bloodstream. This rise in circulating lipids can impair cochlear blood flow, potentially affecting auditory function [5]. The cochlea is highly sensitive to alterations in blood supply due to its end-arterial circulation and high metabolic demand. Any disturbance in cochlear perfusion may lead to hypoxia, oxidative stress, and subsequent degeneration of sensory hair cells, ultimately resulting in hearing impairment [6].

Elevated levels of total cholesterol, low-density lipoprotein (LDL), and triglycerides, along with reduced high-density lipoprotein (HDL), have been implicated in cochlear damage through mechanisms involving vascular insufficiency and lipid deposition [4,5,6]. However, existing literature shows variability in findings, and the relationship between dyslipidemia and SNHL remains incompletely understood.

Given the rising prevalence of metabolic disorders and their potential systemic effects, it is important to explore their impact on auditory function. Identifying modifiable risk factors such as dyslipidemia may provide opportunities for early intervention and prevention of hearing loss.

The present study was undertaken to evaluate the association between dyslipidemia and sensorineural hearing loss. It also aimed to compare the prevalence and severity of hearing loss between individuals with dyslipidemia and those with normal lipid profiles, and to assess the correlation between lipid parameters and hearing thresholds.

## MATERIAL AND METHODS

### Study Design and Setting

A hospital-based cross-sectional comparative study conducted in the Department of Otorhinolaryngology at a tertiary care center over a period of 8 months, from July 2025 to February 2026.

### Study Population

A total of 160 adult participants aged between 18 and 75 years were included in the study. Participants were divided into two groups: Dyslipidemia group: 80 patients diagnosed with dyslipidemia based on lipid profile parameters. Control group: 80 age- and sex-matched individuals with normal lipid profile. Participants were recruited from patients attending the ENT and General medicine outpatient department during the study period. The study was conducted after obtaining approval from the

Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrollment in the study.

### Inclusion Criteria

- Adults aged 18–75 years
- Patients willing to participate and provide informed consent
- Availability of recent fasting lipid profile
- Patients undergoing pure tone audiometry

### Exclusion Criteria

- History of chronic otitis media
- Previous ear surgery
- Exposure to occupational noise
- Use of ototoxic medications
- History of congenital hearing loss
- Presence of systemic illnesses such as Diabetes Mellitus or hypertension

### Data Collection Procedure

A detailed clinical history was obtained from all participants, including demographic details, auditory complaints, and relevant medical history. All participants underwent a comprehensive ear, nose, and throat examination.

### Audiological Assessment

Hearing assessment was performed using pure tone audiometry (PTA) in a sound-treated room. Air and bone conduction thresholds were measured at frequencies of 0.5, 1, 2, 4, and 8 kHz. The average hearing threshold was calculated, and hearing loss was categorized based on WHO standard criteria [7]. The type of hearing loss (sensorineural, conductive, or mixed) was determined based on audiometric findings.

### Biochemical Assessment

Fasting venous blood samples were collected from all participants for estimation of lipid profile parameters, including: Total cholesterol, Low-density lipoprotein (LDL), High-density lipoprotein (HDL), Triglycerides. Dyslipidemia was defined as the presence of one or more of the following abnormalities in fasting lipid profile: total cholesterol  $\geq 200$  mg/dL, low-density lipoprotein (LDL)  $\geq 130$  mg/dL, triglycerides  $\geq 150$  mg/dL, or high-density lipoprotein (HDL)  $< 40$  mg/dL, based on the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) guidelines [8].

### Outcome Measures

The primary outcome measure was the presence of sensorineural hearing loss (SNHL). Secondary outcomes included: Severity of hearing loss, Hearing thresholds at different frequencies, Correlation between lipid parameters and hearing thresholds.

### Statistical Analysis

All data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean  $\pm$  standard deviation (SD), while categorical variables were presented as frequencies and percentages. Comparison of continuous variables between the two groups was performed using the Independent t-test. Categorical variables were analyzed using the Chi-

square test or Fisher's exact test, as appropriate based on expected cell counts. For the comparison of hearing status between groups (4 $\times$ 2 contingency table), Fisher's exact test was applied due to small expected frequencies in some cells. Pearson correlation analysis was used to assess the relationship between lipid parameters and hearing thresholds. A p-value of less than 0.05 was considered statistically significant.

## RESULTS

A total of 160 participants were included in the study, comprising 80 patients with dyslipidemia and 80 age- and sex-matched controls. The mean age of participants in the dyslipidemia group was  $44.6 \pm 9.2$  years, while in the control group it was  $43.8 \pm 8.7$  years. There was no statistically significant difference in age or gender distribution between the two groups ( $p > 0.05$ ) (Table 1).

**Table 1: Demographic characteristics of study participants**

| Variable         | Dyslipidemia Group (n = 80) | Control Group (n = 80) | p-value |
|------------------|-----------------------------|------------------------|---------|
| Mean Age (years) | $44.6 \pm 9.2$              | $43.8 \pm 8.7$         | 0.62    |
| Age Range        | 22–75                       | 21–75                  | —       |
| Male, n (%)      | 46 (57.5%)                  | 44 (55%)               | 0.74    |
| Female, n (%)    | 34 (42.5%)                  | 36 (45%)               | —       |

Values are expressed as mean  $\pm$  standard deviation or number (percentage). No statistically significant difference was observed between the groups.

The overall prevalence of hearing impairment was higher in the dyslipidemia group compared to controls. Sensorineural hearing loss (SNHL) was identified in 52.5% of patients in the dyslipidemia group, whereas only 27.5% of individuals in the control group exhibited SNHL. There was a statistically significant difference in hearing status distribution between the dyslipidemia and control groups (Fisher's exact test,  $p = 0.002$ ), with a higher prevalence of sensorineural hearing loss in the dyslipidemia group. Normal hearing was observed more frequently in the control group (65%) compared to the dyslipidemia group (37.5%). The proportions of conductive and mixed hearing loss were relatively low and comparable between the two groups (Table 2).

**Table 2: Distribution of hearing status**

| Hearing Status             | Dyslipidemia Group n (%) | Control Group n (%) | p-value |
|----------------------------|--------------------------|---------------------|---------|
| Normal Hearing             | 30 (37.5%)               | 52 (65%)            | 0.002*  |
| Sensorineural Hearing Loss | 42 (52.5%)               | 22 (27.5%)          | —       |
| Conductive Hearing Loss    | 5 (6.25%)                | 4 (5%)              | —       |
| Mixed Hearing Loss         | 3 (3.75%)                | 2 (2.5%)            | —       |

SNHL: Sensorineural hearing loss. Fisher's exact test (extended) applied for comparison. A significantly higher prevalence of SNHL was observed in the dyslipidemia group ( $p < 0.05$ ).

Among participants diagnosed with SNHL, the dyslipidemia group demonstrated a greater proportion of individuals with moderate to severe degrees of hearing loss. While mild hearing loss remained the most common presentation in both groups, moderately severe and severe hearing loss were more frequently observed in patients with dyslipidemia. This difference in severity distribution between the two groups reached statistical significance ( $p = 0.041$ ) (Table 3).

**Table 3: Severity of sensorineural hearing loss**

| Degree of SNHL    | Dyslipidemia Group n (%) | Control Group n (%) | p-value |
|-------------------|--------------------------|---------------------|---------|
| Mild              | 18 (42.8%)               | 12 (54.5%)          |         |
| Moderate          | 14 (33.3%)               | 7 (31.8%)           |         |
| Moderately Severe | 7 (16.7%)                | 2 (9.1%)            |         |
| Severe            | 3 (7.2%)                 | 1 (4.6%)            | 0.041   |

SNHL: Sensorineural hearing loss. Severity classified according to WHO criteria. Statistical comparison performed using chi-square test.

Analysis of pure tone audiometry (PTA) thresholds revealed consistently higher hearing thresholds across all tested frequencies in the dyslipidemia group compared to controls. The difference was statistically significant at all frequencies, with greater differences noted at higher frequencies (4 kHz and 8 kHz). For instance, the mean hearing threshold at 8 kHz was  $42.3 \pm 10.7$  dB in the dyslipidemia group compared to  $30.5 \pm 8.4$  dB in controls ( $p < 0.001$ ). This pattern suggests a predominant high-frequency hearing loss in patients with dyslipidemia (Table 4).

**Table 4: Mean pure tone audiometry thresholds**

| Frequency (kHz) | Dyslipidemia Group (Mean $\pm$ SD) | Control Group (Mean $\pm$ SD) | p-value          |
|-----------------|------------------------------------|-------------------------------|------------------|
| 0.5             | $24.8 \pm 6.1$                     | $20.3 \pm 5.4$                | 0.01             |
| 1               | $26.5 \pm 7.0$                     | $21.6 \pm 6.2$                | 0.008            |
| 2               | $29.2 \pm 8.3$                     | $23.4 \pm 6.8$                | 0.004            |
| 4               | $36.8 \pm 9.5$                     | $27.1 \pm 7.6$                | <b>&lt;0.001</b> |
| 8               | $42.3 \pm 10.7$                    | $30.5 \pm 8.4$                | <b>&lt;0.001</b> |

PTA: Pure tone audiometry; kHz: kilohertz. Values expressed as mean  $\pm$  standard deviation. Statistical analysis performed using independent t-test.

As expected, patients in the dyslipidemia group demonstrated significantly altered lipid parameters compared to controls. The mean total cholesterol, LDL cholesterol, and triglyceride levels were markedly elevated, while HDL cholesterol levels were significantly reduced. All these differences were found to be highly statistically significant ( $p < 0.001$ ), confirming appropriate group classification and biochemical distinction (Table 5).

**Table 5: Comparison of lipid profile parameters**

| Parameter                 | Dyslipidemia Group (Mean $\pm$ SD) | Control Group (Mean $\pm$ SD) | p-value          |
|---------------------------|------------------------------------|-------------------------------|------------------|
| Total Cholesterol (mg/dL) | $232.6 \pm 28.4$                   | $168.9 \pm 22.7$              | <b>&lt;0.001</b> |
| LDL Cholesterol (mg/dL)   | $154.2 \pm 21.6$                   | $98.3 \pm 18.5$               | <b>&lt;0.001</b> |
| HDL Cholesterol (mg/dL)   | $38.7 \pm 6.5$                     | $49.6 \pm 7.1$                | <b>&lt;0.001</b> |
| Triglycerides (mg/dL)     | $198.5 \pm 35.2$                   | $132.4 \pm 27.9$              | <b>&lt;0.001</b> |

LDL: Low-density lipoprotein; HDL: High-density lipoprotein. Values expressed as mean  $\pm$  standard deviation. Statistical comparison performed using independent t-test.

Correlation analysis demonstrated a moderate positive relationship between lipid parameters and hearing thresholds. Among these, LDL cholesterol showed the strongest positive correlation ( $r = +0.48$ ,  $p < 0.001$ ), indicating that higher LDL levels were associated with worse hearing thresholds. Total cholesterol and triglycerides also exhibited significant positive correlations. In contrast, HDL cholesterol demonstrated a negative correlation ( $r = -0.32$ ,  $p = 0.006$ ), suggesting a possible protective role against hearing loss (Table 6).

**Table 6: Correlation between lipid levels and hearing thresholds**

| Lipid Parameter   | Correlation Coefficient (r) | p-value          |
|-------------------|-----------------------------|------------------|
| Total Cholesterol | +0.41                       | 0.001            |
| LDL Cholesterol   | +0.48                       | <b>&lt;0.001</b> |
| HDL Cholesterol   | -0.32                       | 0.006            |
| Triglycerides     | +0.37                       | 0.002            |

Pearson correlation test was used. Positive values indicate direct correlation, while negative values indicate inverse correlation.

Further analysis revealed a significant association between dyslipidemia and the presence of SNHL. More than half (52.5%) of patients with dyslipidemia had SNHL, compared to only 27.5% in the control group. This association was statistically significant ( $p = 0.001$ ), indicating that individuals with dyslipidemia are at a higher risk of developing sensorineural hearing loss (Table 7).

**Table 7: Association between dyslipidemia and SNHL**

| Variable           | SNHL Present n (%) | SNHL Absent n (%) | p-value      |
|--------------------|--------------------|-------------------|--------------|
| Dyslipidemia Group | 42 (52.5%)         | 38 (47.5%)        |              |
| Control Group      | 22 (27.5%)         | 58 (72.5%)        | <b>0.001</b> |

SNHL: Sensorineural hearing loss. Association assessed using chi-square test. A statistically significant association was observed ( $p < 0.05$ ).

## DISCUSSION

The present study demonstrated a significant association between dyslipidemia and sensorineural hearing loss (SNHL), with a higher prevalence and greater severity of hearing impairment observed among individuals with abnormal lipid profiles. These findings support the hypothesis that metabolic factors, particularly lipid abnormalities, may play a role in cochlear dysfunction.

In this study, SNHL was significantly more common in the dyslipidemia group compared to controls. Similar observations have been reported by several investigators, suggesting that altered lipid metabolism may contribute to auditory impairment [9,10]. The cochlea is highly dependent on an adequate vascular supply, and dyslipidemia may lead to atherosclerotic changes, reduced cochlear perfusion, and subsequent hypoxic damage to hair cells. Experimental and clinical evidence supports the role of microvascular compromise in the pathogenesis of SNHL in metabolic disorders [4,6].

The present study also demonstrated that hearing thresholds were significantly elevated in the dyslipidemia group, particularly at higher frequencies (4 and 8 kHz). This pattern of high-frequency involvement is consistent with early cochlear damage, especially affecting the basal turn of the cochlea. Previous studies have similarly reported predominant high-frequency hearing loss in patients with dyslipidemia, highlighting the susceptibility of outer hair cells to metabolic and vascular insults [11].

With regard to severity, a greater proportion of moderate to severe hearing loss was observed among dyslipidemic individuals. This suggests that dyslipidemia may not only influence the occurrence but also the progression of hearing impairment. Chronic exposure to elevated lipid levels may result in progressive cochlear damage through mechanisms such as oxidative stress, inflammation, and lipid deposition within the vascular endothelium [12,13].

The correlation analysis in the present study revealed a significant positive relationship between lipid parameters and hearing thresholds, with low-density lipoprotein (LDL) showing the strongest association [14]. This finding is consistent with the known atherogenic potential of LDL, which may contribute to endothelial dysfunction and reduced blood flow in the cochlear microcirculation. In contrast, high-density lipoprotein (HDL) demonstrated a negative

correlation, suggesting a possible protective effect [15]. Clinical studies have demonstrated an association between altered lipid profiles and sensorineural hearing loss, while experimental evidence suggests that lipids influence cochlear function through oxidative stress and inflammatory pathways. [16,17].

The findings of this study are in agreement with previous reports that have identified dyslipidemia as a potential risk factor for hearing loss. However, Jones NS et al. [18], in their study evaluating the association between hyperlipidemia and sensorineural hearing loss, reported no consistent or significant correlation between elevated lipid levels and hearing impairment.

The clinical implications of these findings are significant. Early identification and management of dyslipidemia may help reduce the risk or progression of hearing loss. Routine screening of lipid profiles in patients presenting with unexplained SNHL may aid in identifying an underlying modifiable risk factor. Additionally, lifestyle modifications and lipid-lowering therapy may have a potential role in preserving auditory function, although further longitudinal studies are required to establish causality.

The present study has certain limitations. Being a cross-sectional study, it does not establish a causal relationship between dyslipidemia and SNHL. The sample size, although adequate, was limited to a single center, which may affect generalizability. Furthermore, other potential confounding factors such as genetic predisposition and environmental influences were not extensively evaluated.

## CONCLUSION

The present study demonstrates a significant association between dyslipidemia and sensorineural hearing loss, with affected individuals showing higher prevalence, greater severity, and predominantly high-frequency involvement. Elevated lipid parameters, particularly low-density lipoprotein, were positively correlated with worsening hearing thresholds, while high-density lipoprotein appeared to have a protective role. These findings highlight dyslipidemia as a potential modifiable risk factor for hearing impairment. Early detection and appropriate management of lipid abnormalities may contribute to the prevention or attenuation of sensorineural hearing loss. Further longitudinal studies are

warranted to establish causality and evaluate the impact of lipid-lowering interventions on auditory outcomes.

### Conflict of Interest

The authors declare no conflicts of interest related to this study.

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