



A Study of Relationship Between Serum Lipids and Sensorineural Hearing Loss: A Cross – Sectional study

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Abstract

Introduction:

The modern life style poses new challenges on the normal physiological mechanisms of the human body. Drug abuse, tobacco smoking, and alcohol drinking, as well as lack of exercise may also increase the risk of developing certain diseases, especially older age. It has been found that hyperlipidemia is significantly associated with sensorineural hearing loss.

Aim:

To study the relationship between degree of sensorineural hearing loss and serum lipid level (total cholesterol, triglyceride, low density lipoproteins, high density lipoproteins).

Materials & Methods:

A cross-sectional study was conducted in 150 patients aged between 15 to 60 years diagnosed with sensorineural hearing loss at Otorhinolaryngology outpatient department at Sir Sunder Lal hospital, IMS, BHU. All the 150 patients were amongst age group of 15 to 60 years who were registered from August 2019 to July 2021.

Results

The serum levels of total cholesterol, triglyceride and low-density lipoprotein directly correlate with the severity of sensorineural hearing loss significantly ($p < 0.05$) whereas the serum levels of high-density lipoprotein had no direct co-relation with the severity of sensorineural hearing loss.

Conclusion

Hyperlipidemic state is a major risk factor for SNHL. Regular screening and monitoring of serum lipid might prevent morbid SNHL and improve patients' quality of life in long term.

Keywords: SNHL, Quality of life, Lipids, Hyperlipidemia, Total cholesterol, LDL, Triglyceride

Introduction

The modern life style poses new challenges on the normal physiological mechanisms of the human body. The adverse impact of a sedentary lifestyle,

excess body weight, and diets high in total and saturated fat superimposed on a genetic background confers susceptibility to increased circulating lipids¹. Diet and lifestyle are major factors thought to

influence susceptibility to many diseases. Drug abuse, tobacco smoking, and alcohol drinking, as well as lack of exercise may also increase the risk of developing certain diseases, especially later in life. Several studies have demonstrated a relation between hyperlipidemia and hearing disorders, but this point remains controversial.

Various mechanisms by which hyperlipidaemia might cause SNHL have been postulated and include atherosclerosis, lipidoses, metabolic, microvascular disease, hypoxia, embolic, hyperviscosity, hereditary ageing and hypertension. Estimation of serum lipids and their correlation with multiple variants and the levels of SNHL may provide an insight into this relationship².

There is an increased susceptibility to elevated levels of circulating serum lipids caused by modern sedentary life style, with greater indulgence of masses in diets rich in saturated fats along with obesity and obvious genetic predisposition. The above-mentioned entities i.e., sensorineural hearing loss and hyperlipidemia have been related and studied scientifically in past but their definite association is still a matter of debate³.

Materials & Methods

A cross-sectional study was conducted in 150 patients aged between 15 to 60 years diagnosed with sensorineural hearing loss at Otorhinolaryngology outpatient department at Sir Sunder Lal hospital, IMS, BHU from August 2019 to July 2021. Patients were screened for sensorineural hearing loss.

Only those cases were registered, who gave full consent for protocol.

Inclusion Criteria:

1. Patients presenting to the study centre with sensorineural hearing loss proven by pure tone audiometry between age of 15-60 years.
2. Healthy subjects without any major systemic disease or acute infection.
3. Individuals with bilateral intact tympanic membrane.

4. No prior ear, nose, throat surgery.

Exclusion Criteria:

1. Patients with any middle ear diseases.
2. All patients having Diabetes Mellitus, hypertension, vasculitis, hypo/hyperthyroidism.

All cases were subjected to detailed examination which included general physical examination, careful examination of ear, nose and throat. Otoscopic, otomicroscopic examination and pure tone audiometry was performed. Hearing assessment was done with MAICO MA42 audiometer.

The hearing threshold for pure tone audiometer was determined in a sound treated room at frequencies ranging from 125-8000 Hz for air conduction and 250- 4000 Hz for bone conduction. The patients were graded for hearing loss as per WHO (2008) grading.

Those patients diagnosed to be suffering from sensorineural hearing loss were investigated for fasting lipid levels. Serum lipid estimation was done inside our hospital laboratory. This included estimation of total cholesterol, triglycerides, HDL, LDL, VLDL. The estimation was done using fully automated analyzer RANDOX SUZUKA. The serum lipid assessment was done using NCEP Adult treatment panel III guidelines. Data were compiled, stored and analyzed using SPSS statistical software.

Results

The findings were noted and analyzed. During this study following observations were made. 62% of patients were male and 38% were of female sex. In both the sexes maximum patients were having moderate degree of hearing loss; i.e., male (29%) and females (19%) [Figure 1].

The patients with mild hearing loss (57) constituted 38%, moderate hearing loss (73) were 48.67%, severe hearing loss (12) were 8% and profound constituted (8) 5.33% [Figure 2].

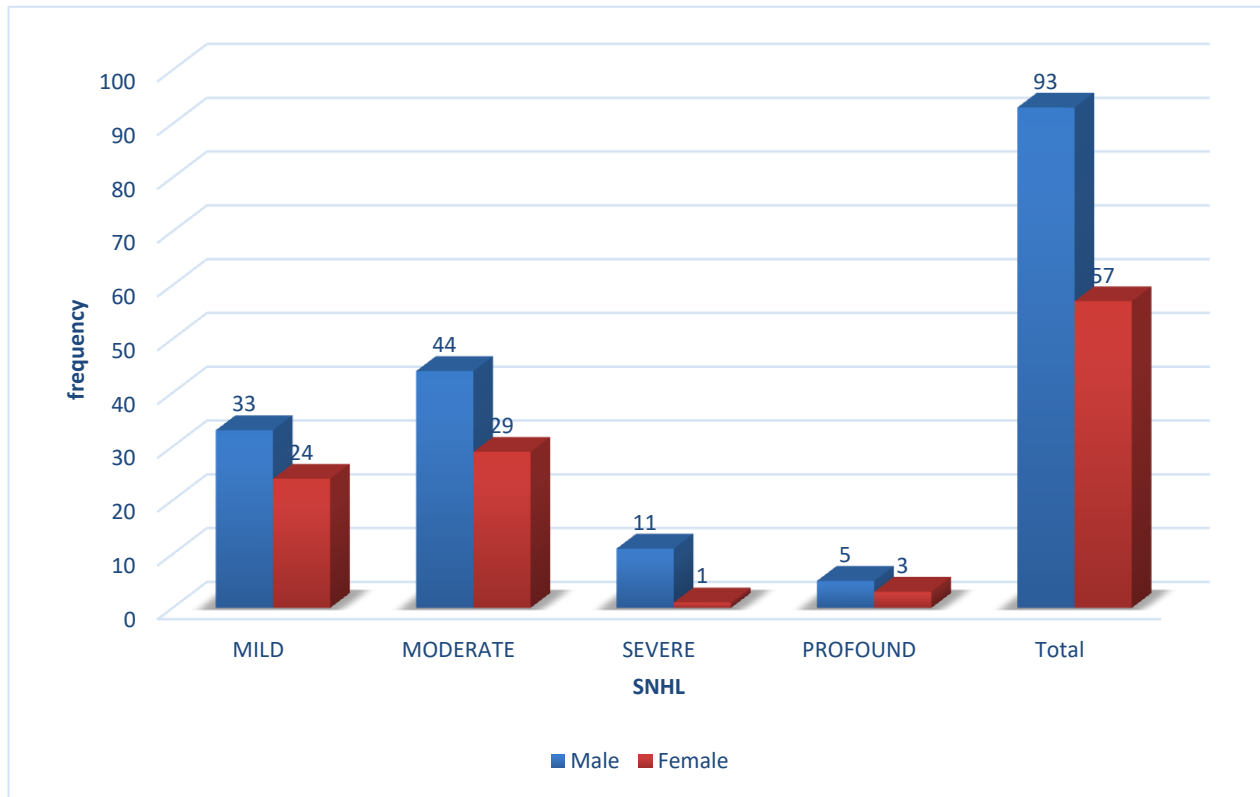


Figure 1: Distribution of subjects according to gender and level of SNHL

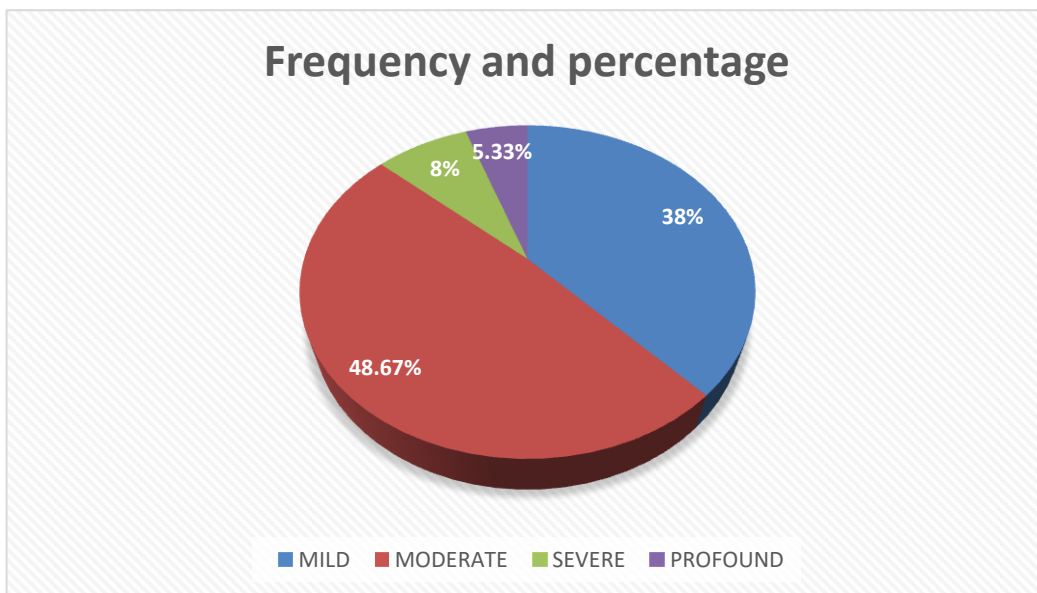


Figure 2: Distribution of subjects according to level of SNHL

In present study the mean level of total cholesterol was found to be 236.75 ± 55 mg/dl. Statistical analyses were carried out using ANOVA test [Figure 3]. The P value was 0.046 which being $<.05$ was statistically significant.

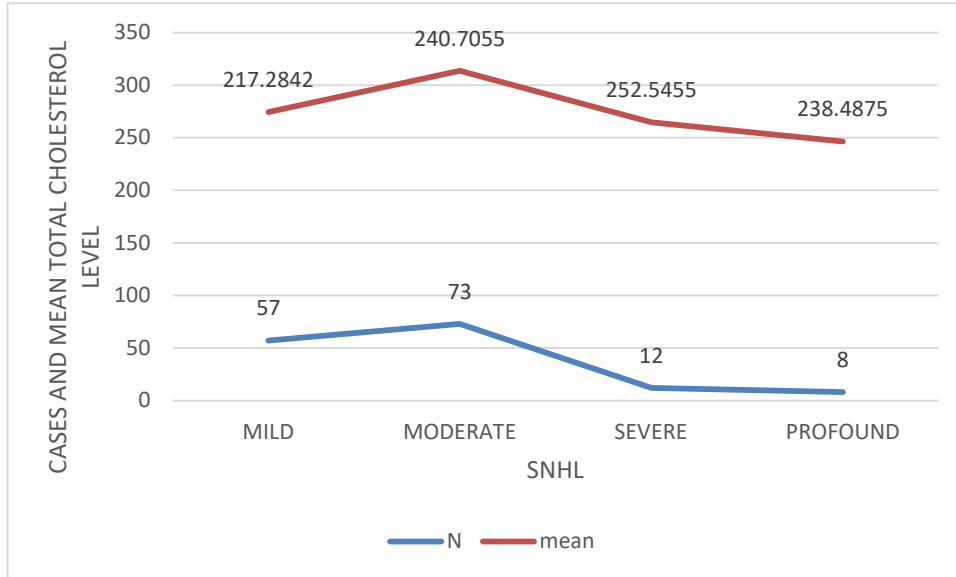


Figure 3: Mean Cholesterol levels according to level of SNHL [***p-value=0.046 (<0.05) is significant**]

In present study the mean level of total triglyceride was found to be 94.5 ± 57 mg/dl. Statistical analyses were carried out using anova test [Figure 4]. The P value was 0.18 which being $<.05$ was statistically significant.

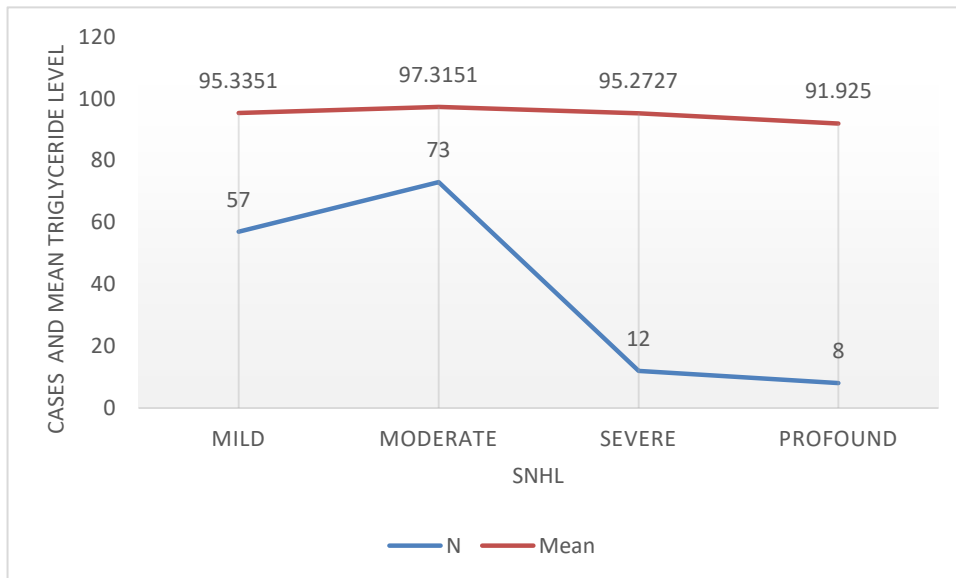


Figure 4: Mean triglyceride levels according to level of SNHL [***p-value=0.018(<0.05) is significant**]

In present study the mean level of high-density cholesterol was found to be 47.75 ± 11.81 mg/dl. Statistical analyses were carried out using anova test [Figure 5]. The P value was 0.090 which being >0.05 was not statistically significant.

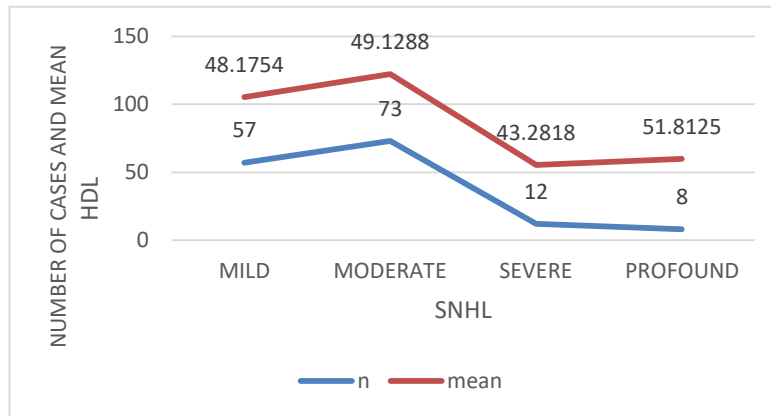


Figure 5: Mean HDL levels according to level of SNHL [*p-value=0.090 (>0.05) is insignificant]

In present study the mean level for low density lipoprotein was found to be 136.56 ± 43 mg/dl. The mean values of LDL levels among different hearing groups were statistically analyzed using anova test [Figure 6]. The p value came out to be 0.007 which is <0.05 and is statistically significant.

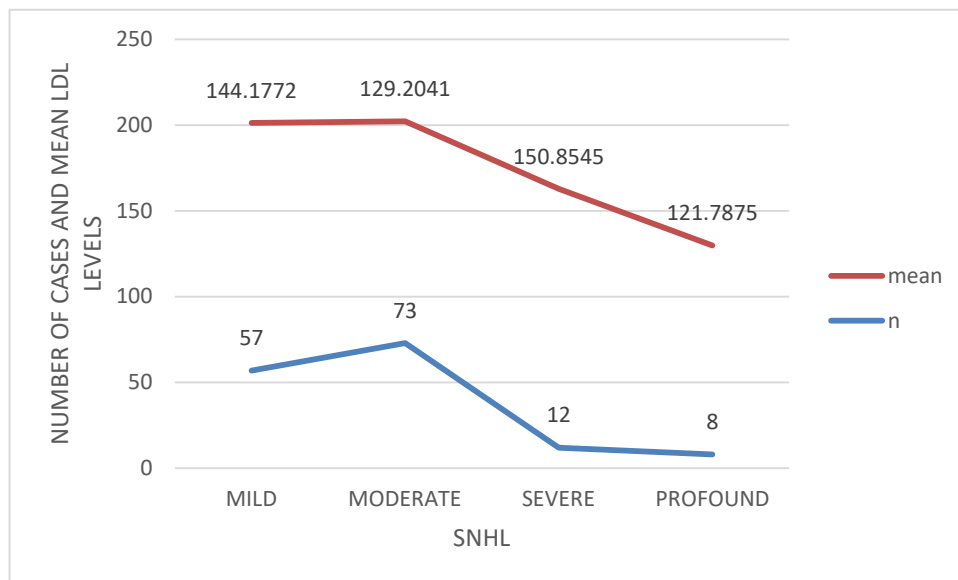


Figure 6: Mean LDL levels according to SNHL [*p-value=0.007 (<0.05) is significant]

Discussion

The cochlea, whose blood supply comes from an end artery⁴, is considered to be highly sensitive to

vascular pathologic changes. It is well known that hypercholesterolemia causes arteriosclerotic changes in vessel walls, leading to partial vascular obstruction

and end-organ hypoxia⁵. It has been proposed that these arteriosclerotic changes in cochlear vessels may lead to hearing loss⁶.

Oxidative LDL is believed to play an important role in the events associated with the initiation of atherosclerosis⁷. Any condition that affects blood viscosity or the physical characteristics of red blood cells is likely to change the efficiency of oxygen and nutrient delivery to the stria vascularis tissue⁸. Inner ear tissues with high metabolic requirements may show altered metabolic activity in the presence of hypercholesterolemia due to reduced oxygen availability⁹. Intercellular edema in the stria vascularis layer and intracellular edema in the outer hair cells observed could be the reason for auditory dysfunction¹⁰. Edema in the stria vascularis was very likely caused by changes in the vessel wall and deteriorating blood flow, similar to arteriosclerosis seen in the coronary arteries¹¹.

The other mechanism explains hearing loss by glycogen accumulation in the stria vascularis and the outer hair cells arising from changes in cochlear blood supply and strial transportation. This mechanism also depends on blood viscosity alterations in hypercholesterolemia¹². J S Thakur et al¹³ conducted prospective cross section study to evaluate the effect of different lipid fraction on auditory brainstem evoked responses in hyperlipidaemia. A statistically significant association between low-density lipoproteins and many wave forms in the hyperlipidaemic group was found.

Handique Gautam et al¹⁴ did a case control study included a total of 108 subjects (54-control, 54-clinically diagnosed cases of SNHL), aged 18 years and above. They concluded that Serum lipid profile can be used as an indicator of severity of SNHL as hyperlipidaemia seems to be significantly correlated with occurrence of SNHL.

Dr Anil.H.T et al¹⁵ conducted a study with 100 adults aged 30-60 years, with SNHL were included in a prospective comparative study and various degree of hearing loss was compared with serum lipids level. The study showed significant relationship between serum lipid and various degrees of sensorineural hearing loss. Increase in total cholesterol, triglycerides and LDL, were associated with worsening of hearing levels. Elevated levels of HDL

were found to be associated with better hearing levels.

In present study conducted on 150 patients, the number of males is 93 (62%) and the number of females is 57 (38%). The ratio of male: female for SNHL comes out to be 1.64:1. The numbers of males and female's patients studied by Lee FS et al¹⁶ were 128 and 89 respectively as a part of study of relationship between blood chemistry levels and hearing levels. The ratio came out to be 1.44:1.

The numbers of male and female patients studied by Suzuki K et al¹⁷ were 607 and 317 respectively in the study to evaluate the influence of serum lipids on auditory function and the male: female ratio was 1.91:1. Y. K Maru and N. Jain¹⁸ in their study found the number of male patients 29 (58%) and the 21 (42%). The male: female in their study was 1.38:1. Above mentioned studies are in favor of male predisposition of the disease.

In our study maximum degree of hearing loss i.e., moderate degree was found in 41-50 years age group. Karen J. Cruickshanks et al¹⁹ in their study of population -based epidemiology of hearing loss to measure the prevalence of hearing loss in adults aged 48-92 years. Wysokinski A²⁰ in 4,541 people found the odds of hearing loss increased with age (odd ratio = 1.88 for 5 years, 95% confidence interval (CI) 1.80 -2.97).

The mean level of total cholesterol was found to be 236.75 mg/dl. The level in males was found to be 248.54 mg / dl and in females it was 235.23 mg/dl in this study. The mean Total Cholesterol values among various groups of SNHL in males were insignificant. ($p = 0.077$) and for females was significant ($p = 0.027$).

Lee FS et al¹⁶ in their study of 217 patients found mean total cholesterol values to be 211.83 ± 20 mg/dl. Jones NS et al²¹ in their study on 85 patients found mean Total Cholesterol values to be 225.77mg/dl. Marco matteo Ciccone et al²² in their study on 29 patients of idiopathic sensorineural hearing loss found total cholesterol levels to be 188 mg/dl and it was significantly associated with hearing loss. ($p < 0.05$). Among the male population of the study group, Suzuki K et al¹⁷ found mean Total Cholesterol to be 202.9 ± 32.5 and 210.9 ± 39.1 in the female population.

The mean level of total triglyceride was found to be 94.5 mg/dl. The level in males was found to be 92 mg / dl and in females it was 91.25 mg/dl. There was statistically significant association between mean triglyceride level and degree of sensorineural hearing loss in both males and females. ($p = 0.017$ in males and $p=0.037$ in females).

Lee FS et al¹⁶ studied various blood chemistry measures and serum lipids in 217 patients with hearing levels ranging from normal to moderate/severe. They found mean triglyceride values to be 52.8 ± 12.88 mg/dl. Jones NS et al²¹ in their prospective study on 85 patients found mean triglyceride levels to be 43 mg/dl. Marco Matteo Ciccone et al²² study on 29 patients of idiopathic sudden SNHL found triglyceride level to be 109 mg/dl with no significance.

In present study the mean level for low density lipoprotein was found to be 136.56 mg/dl. In males the level was found to be 131.5 mg /dl and in females 147.25 mg/dl. A high statistically significant association between level of low-density lipoprotein and degree of sensorineural hearing loss in females ($p=0.001$) and in males it was statistically insignificant ($p=0.088$).

Marco Matteo Ciccone et al²² study on 29 patients of idiopathic sudden SNHL found LDL level to be 118 mg/dl and it was significantly higher than control group. Lee FS et al¹⁶ found in their study the mean LDL levels to be 185.33 ± 20.32 , whereas in the present study the mean LDL value was found to be 124.41 ± 4.30 mg/dl. The levels of serum LDL were statistically significant in the different degrees of SNHL and had a positive correlation with the hearing levels in both males and female populations of the study group. GOK Uzeyir et al²³ in their study found LDL level to be 163mg/dl and it was significantly associated with hearing loss ($P < 0.0001$).

Annie N. Simpson et al²⁴ in their determined the role of cardiovascular disease markers, lipids and C-reactive protein in age related to hearing loss over time. The mean LDL in 824 patients was found to be 118.2 mg/dl and it did not show any significant association with hearing loss.

In our study the mean level of high-density cholesterol was found to be 47.75mg/dl. In males the level was found to be 46.35 mg/dl and in females

49.5 mg/dl. no significant association was seen between high density lipoprotein and degree of sensorineural hearing loss both in males and females.

Lee FS et al¹⁶ in their study found the mean HDL values to be 16.00 ± 6.43 mg/dl. In the present study the mean HDL values were found to be 40.48 ± 3.81 mg/dl. Marco Matteo Ciccone et al²² in their study on 29 patients of idiopathic sudden SNHL found HDL level to be 48 mg /dl and it showed no significance than the control group. GOK Uzeyir et al²³ in their study found HDL level to be 37 mg/dl and it was negatively significant ($p < 0.00001$).

Annie N. Simpson et al²⁴ in their study determined the role of cardiovascular disease markers, lipids and C-reactive protein in age related hearing loss over time. The mean HDL in 831 patients was found to be 52.5 mg/dl and it did not show any significant association with hearing loss. Suzuki K et al¹⁷ found mean HDL to be 54.6 ± 14 and 66.5 ± 15 in the male and female patients respectively. RS Mudhol et al²⁵ in 2019 conducted an observational study. In their study HDL and triglycerides negatively correlated with hearing levels in both males and females.

Conclusion

The serum levels of total cholesterol, triglyceride and low-density lipoprotein directly correlate with the severity of sensorineural hearing loss significantly ($p < 0.05$) whereas the serum levels of high-density lipoprotein had no direct co-relation with the severity of sensorineural hearing loss. Hyperlipidemic state is a major risk factor for SNHL. Regular screening and monitoring of serum lipid might prevent morbid SNHL and improve patients' quality of life in long term.

Abbreviation

PTA-Pure tone audiometry

SNHL- Sensory neural hearing loss

LDL-Low density lipoprotein

HDL -High density lipoprotein

NCEP -National cholesterol education program

GPO-PAP-Glycerin phosphate oxidase peroxidase

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