

Original Article**Prevalence of dyslipidemia among Iranian patients with idiopathic tinnitus**

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Abstract

BACKGROUND: Tinnitus is a sense of sound perception in absence of an external source which can affect life quality. Different conditions may lead to tinnitus including metabolic disorders such as dyslipidemia. The aim of this study was to investigate the prevalence of dyslipidemia among Iranian patients with idiopathic tinnitus.

METHODS: This was a cross-sectional study in which prevalence of dyslipidemia in fasting state and its subclasses were assessed in 1043 tinnitus patients aged 12-90 years who referred to Rasool Akram Hospital, Tehran, Iran, 2006-2009. Data was summarized by SPSS software version 17 and one sample t-test and Chi-Square test were applied to analyze the results. P less than 0.05 were considered significant.

RESULTS: The most prevalent type of dyslipidemia was hypercholesterolemia with the frequency of 14.4% followed by low HDL-C with the frequency of 12.8%. Mean of total cholesterol, HDL-C, LDL-C and triglyceride levels in all patients were not greater than general population.

CONCLUSIONS: Based on the results of the present study, there might be no need to check the serum lipid profile in tinnitus patients. We recommend further studies to assess both fasting and postprandial serum lipid profile in patients with idiopathic tinnitus. Simultaneous investigation of their dietary intake is also suggested.

KEYWORDS: Tinnitus, Dyslipidemia, Hypercholesterolemia, Iran.

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It has been well established that tinnitus is a perception of sound in proximity to the head in the absence of an external source.¹ According to the American Tinnitus Association, an estimated 50 million people in the United States have chronic tinnitus, persisting greater than six months.^{2, 3} Tinnitus is often caused by damage to the tiny hairs on auditory hairy cells which may be a result of some metabolic disorders, including dyslipidemia,

hyperinsulinemia and diabetes.^{4, 5} The relationship between tinnitus and dyslipidemia was first observed by Spencer, who identified 1400 patients with both abnormal serum lipids and inner ear symptoms. He stated that many patients seen by otolaryngologists because of tinnitus, come from that same large population group who are prone to obesity, maturity-onset diabetes, atherosclerosis, and coronary artery disease; and these patients share the

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common problem of dyslipidemia.⁶ Recently, dyslipidemia is being reported as an etiology of tinnitus, particularly in association with sensory-neural hearing loss and associated dizziness.^{7, 8} Some research showed that a hyperlipidemic diet could damage hairy cells, impairing normal functioning of inner ear and some revealed that high serum cholesterol can cause tinnitus by damaging the normal function of inner ear.⁹ However, existing data about prevalence of dyslipidemia in idiopathic tinnitus is scarce.

In a study conducted by Cooper, prevalence of dyslipidemia in tinnitus patients was not different with normal population.¹⁰ Anbari et al. found no relationship between sensory-neural hearing loss and tinnitus with dyslipidemia in children aged 5-18 years.¹¹ However, Qian et al.,¹² Przewozny et al.,¹³ and Arnold et al.¹⁴ revealed the epidemiologic association between tinnitus and hyperlipidemia in separate studies. Kazmierczak and Doroszewska in a case-control study indicated that markers of glucose metabolism were different between tinnitus patients and control group, yet markers of lipoprotein metabolism were not significantly different between groups.¹⁵ In a study performed by Basut et al., a low fat and low glycemic index diet reduced the severity of tinnitus.¹⁶ Sutbas et al. reported that incidence of dyslipidemia in tinnitus patients were higher than general population and tinnitus severity decreased when serum lipid profile was normalized.¹⁷ Pulec et al. found a prevalence of 5.1% for hypercholesterolemia in tinnitus patients in California. The tinnitus and other inner ear symptoms improved after hypolipidemic diet.¹⁸

It is important to find out whether there is a relationship between dyslipidemia and tinnitus, as both are common medical conditions. In case of any relationship, it would be logic to monitor serum lipid profile in tinnitus patients, which in turn would also reduce the risk of cardiovascular diseases among them. Otherwise, it would not cost to check serum lipid profile in all tinnitus patients. As there is no literature available regarding lipid profile in

Iranian tinnitus patients, the aim of this study was to investigate the prevalence of dyslipidemia among Iranian patients with idiopathic tinnitus.

Methods

This was a cross-sectional study conducted in ENT-Head and Neck Research Center, Rasool Akram Hospital, Tehran, Iran, 2006-2009. This was a well known referral center for tinnitus in Tehran. All the known cases of tinnitus according to a protocol for assessing tinnitus patients including laboratory tests, otolaryngologist, internist and psychiatrist consults, who had medical record in the tinnitus clinic, were assessed. Inclusion criteria for the study were ages between 12-90 years and idiopathic tinnitus lasting at least for 6 months. These people was excluded if they had pulsatile or objective tinnitus, any kind of hearing loss or otologic diseases, history of taking ototoxic medications, long time exposure to high pitch sounds, head trauma, psychological disorders, diabetes mellitus, thyroid dysfunction and hypertension. A total number of 1043 tinnitus patients were eligible for the study.

Fasting serum lipid profile of the participants was also checked. Dyslipidemia was categorized as hypercholesterolemia, elevated LDL-C, low HDL-C or hypertriglyceridemia. Cholesterol values less than 200 mg/dl considered normal, 200-239 mg/dl considered as borderline-high and ≥ 240 mg/dl considered as high. HDL-C levels less than 40 mg/dl considered as low and ≥ 40 mg/dl considered as desirable. LDL-C values less than 130 mg/dl considered to be desirable, 130-159 mg/dl borderline-high and ≥ 160 mg/dl considered as high. Triglyceride levels less than 200 mg/dl considered normal, 200-400 mg/dl borderline-high, 400-1000 mg/dl high and finally >1000 mg/dl considered as very high according to American Heart Association criteria.^{19, 20}

The study was approved by the Ethics Committee of ENT-Head and Neck Research Center. Informed written consent was obtained from all the patients, and the patients were assured that their private information would be

kept confidential.

Data was summarized by SPSS software version 17 as means \pm SD of total cholesterol, LDL-C, HDL-C and triglyceride. Prevalence of each subclass of dyslipidemia according to American Heart Association criteria was also expressed both as frequency and percentage.^{19, 20} Mean values of total cholesterol, LDL-C, HDL-C and triglyceride were compared with the results of general population reported by Tehran Lipid and Glucose Study.²¹⁻²⁴ One sample t-test was applied to compare the results with that of general population. Prevalence of dyslipidemia in tinnitus patients was compared between men and women and also according to age groups and Chi-Square test was applied to compare among different levels of above mentioned variables. P less than 0.05 were considered significant.

The present research is approved in ENT-Head and Neck Research Center of Hazrat Rasoul Akram Hospital, Tehran University of Medical Sciences by the Research Project Number of 4300.

Results

We assessed 1043 tinnitus patients; 73.7% of patients were men and 26.3% were women. Mean age was 49.24 ± 12 which was 48.62 ± 13 among men and 50.96 ± 14 among women.

Mean of serum cholesterol in tinnitus patients was 188.73 ± 47 mg/dl which was 187.08 ± 46 mg/dl in men and 193.41 ± 51 mg/dl in women. Mean of serum HDL-C in all patients, men and women were 44.73 ± 8 , 44.41 ± 8 and 45.64 ± 9 mg/dl respectively. Mean of serum LDL-C in all patients, men and women were also 122.16 ± 22 , 122.63 ± 24 and 120.82 ± 23

mg/dl respectively. Mean of serum triglyceride in all patients, men and women were found to be 154.18 ± 99 , 155.89 ± 106 and 146.94 ± 81 mg/dl respectively. None of serum lipid profile components were significantly different between men and women.

We also investigated the prevalence of components of dyslipidemia according to American Heart Association criteria.^{19, 20} The results are presented in Tables 1 to 4 for total cholesterol, HDL-C, LDL-C and triglyceride respectively. The data is expressed both as frequencies and percentages. As expressed by the tables, prevalence of hypercholesterolemia, low HDL-C, high LDL-C and hypertriglyceridemia were not different between men and women. Levels of significance (Chi-square values) were 0.23(2.93), 0.37(0.78), 0.62(0.93) and 0.53(2.19) respectively.

Table 5 indicates the prevalence of components of dyslipidemia in tinnitus patients according to age groups. As expressed by the table, the most prevalent type of dyslipidemia among them was hypercholesterolemia with frequency of 14.4% followed by low HDL-C level with the frequency of 12.8%. Prevalence of low HDL-C and high LDL-C was not significantly different among age groups. However, prevalence of hypercholesterolemia was significantly higher in patients who aged 50 and older compared to those who aged 49 and younger. Prevalence of hypertriglyceridemia was also significantly higher in patients who aged 50-59 than patients in other age groups.

Mean values of lipid profile of tinnitus patients were compared with that of general population reported by Tehran Lipid and Glucose Study.²¹ The results are expressed in Table 6

Table 1. Distribution of hypercholesterolemia in tinnitus patients

	Desirable (<200 mg/dl)		Borderline- high (200-239 mg/dl)		High (\geq 240 mg/dl)	
	frequency	percentage	frequency	percentage	frequency	percentage
Men	500	64.7%	165	21.3%	104	14.0%
Women	163	57.7%	65	24.6%	46	17.7%
Total	663	63.6%	230	22.1%	150	14.4%

The value of chi-square test was 2.93 and the significant level was 0.23.

Table 2. Distribution of low HDL-C in tinnitus patients

	Desirable (≥ 40 mg/dl)		Low (< 40 mg/dl)	
	frequency	percentage	frequency	percentage
Men	666	85.2%	103	14.8%
Women	243	87.5%	31	12.5%
Total	909	87.2%	134	12.8%

The value of chi-square test was 0.78 and the significant level was 0.37.

Table 3. Distribution of high LDL-C in tinnitus patients

	Desirable (< 130 mg/dl)		Borderline- high (130-159 mg/dl)		High (≥ 160 mg/dl)	
	frequency	percentage	frequency	percentage	frequency	percentage
Men	767	99.7%	1	0.1%	1	0.1%
Women	273	99.6%	1	0.4%	-	-
Total	1040	99.7%	2	0.2%	1	0.1%

The value of Fisher exact test was 0.93 and the significant level was 0.62.

Table 4. Distribution of hypertriglyceridemia in tinnitus patients

	Desirable (< 200 mg/dl)		Borderline- high (200-400 mg/dl)		High (401-1000 mg/dl)		Very high (≥ 1000 mg/dl)	
	frequency	percentage	frequency	percentage	frequency	percentage	frequency	percentage
Men	607	79.3%	143	18.7%	18	2.2%	1	0.1%
Women	223	81.5%	48	17.3%	3	1.2%	-	-
Total	830	79.6%	191	18.3%	21	2.0%	1	0.1%

The value of Fisher exact test was 2.19 and the significant level was 0.53.

Table 5. Prevalence of dyslipidemia in tinnitus patients according to age groups

Age groups	Total number of patients	Hypercholesterolemia (≥ 240 mg/dl)		Low HDL-C (< 40 mg/dl)		High LDL-C (≥ 160 mg/dl)		Hypertriglyceridemia (> 400 mg/dl)	
		Frequency	percentage	frequency	percentage	frequency	percentage	frequency	percentage
≤ 29	95	5	4.9	13	15.9	1	1.2	-	-
30-39	123	14	11.4	16	14.0	-	-	3	2.6
40-49	411	46	10.9	63	16.4	-	-	7	1.7
50-59	228	42	18.4	29	13.5	-	-	8	3.3
60-69	122	26	21.2	13	12.1	-	-	2	1.5
≥ 70	64	16	24.4	6	10.1	-	-	1	1.3
Total	1043	149	14.4	140	12.8	1	0.1	21	2.1
Chi-square		45.03		2.42		14.55		31.34	
P-Value		$< 0.001^*$		0.79		0.15		$< 0.001^*$	

* Chi-square test was significant at the level of 0.05

Table 6. Mean serum lipid values of tinnitus patients comparing to general population

	Men			Women			Total		
	Tinnitus patients	General population	P value	Tinnitus patients	General population	P value	Tinnitus patients	General population	P value
Cholesterol (mg/dl)	187 ± 46	204 ± 43	<0.001	193 ± 51	212 ± 49	<0.001*	188 ± 47	209 ± 47	<0.001
HDL-C (mg/dl)	44 ± 8	38 ± 10	<0.001	45 ± 9	45 ± 11	0.309	44 ± 8	42 ± 11	<0.001
LDL-C (mg/dl)	122 ± 24	131 ± 36	<0.001	120 ± 23	135 ± 40	<0.001*	122 ± 22	133 ± 38	<0.001
Triglyceride (mg/dl)	155 ± 106	184 ± 132	<0.001	146 ± 81	163 ± 111	0.002*	154 ± 99	172 ± 120	<0.001

As the table indicates, mean of total cholesterol, HDL-C, LDL-C and triglyceride levels in all patients were not greater than general population. When separated by sex, the results were the same.

Discussion

Our results showed that most prevalent type of dyslipidemia was hypercholesterolemia with the frequency of 14.4% followed by low HDL-C with the frequency of 12.8%. Mean of total cholesterol, HDL-C, LDL-C and triglyceride levels in all patients were not greater than general population, in other words, we found no association between tinnitus and dyslipidemia.

This is possibly due to several factors. At first it may be due to different age distribution in tinnitus patients comparing to general population which affects prevalence of dyslipidemia. Second, there is a general concept that tinnitus may be induced by dyslipidemia, which in turn may affect dietary intake of tinnitus patients. Third, we didn't assess the postprandial lipid profile of tinnitus patients. Some people may have normal fasting lipid profile while abnormal postprandial serum lipids. Now it is a well known concept that postprandial serum lipid profile also plays a role in one's metabolic state.^{25, 26}

Based on our internet-based literature review there are only few studies about dyslipidemia and tinnitus. Indeed, no study has been conducted to determine exact prevalence of

dyslipidemia in tinnitus. However, dyslipidemia has been studied as a one of several factors that may be related to tinnitus. The role of dyslipidemia in tinnitus has not been elucidated in previous studies, although the relationship between serum lipid abnormalities and inner ear dysfunction has been more studied and defined. It is believed that dyslipidemia causes localized pathologic process that occurs in the periphery of the cochlea which is characterized by changes in the small blood vessels of the inner ear.²⁷ Specific changes that have been noted are thickening of the stria vascularis and basement membrane of capillaries in the endolymphatic sac. In addition, thickening has also been observed in the vestibulocochlear neurovasculature. The above mentioned pathologies may interfere with inner ear function through reduction in blood supply.⁸ However, it seems that additional contributing factors are required for tinnitus to develop in the setting of dyslipidemia. In other words, dyslipidemia cause pathologic changes that form the basis for the onset of tinnitus in predisposed individuals.

Our results support those of Cooper's and Kazmierczak and Doroszewska's studies which showed no relationship between tinnitus and dyslipidemia.^{10, 15} However, our findings are in disagreement with those of Sutbas et al. who revealed that incidence of dyslipidemia in tinnitus patients are higher than general population.¹⁷ The study performed by

Sutbas et al. was conducted in tinnitus patients with noise-induced hearing loss, while our study was conducted on patients with idiopathic tinnitus. This may be a possible explanation for the different results. Another possible explanation is the age distribution of the patients, which in turn may confound the results of studies about true prevalence of dyslipidemia in tinnitus. Finally none of the studies assessed postprandial serum lipid profile which may play a role in inner ear dysfunction and tinnitus. This may explain the difference between results of above-mentioned studies.

Prevalence of hypercholesterolemia in our patients was 14.4% that was higher comparing to 5.1% which was found by Pulec et al. in California.¹⁸ A hypolipidemic diet improved serum lipid profile as well as tinnitus in their study. The researchers conclude that in the case of hypercholesterolemia, the problem within the inner ear is chronic obstruction of the capillaries of the strict vascularis, which might result in both a biochemical change in the endolymphatic space and ischemia, and may explain the improvement of tinnitus following a hypolipidemic diet.¹⁸ Prevalence of hypercholesterolemia in the present study was higher than theirs, which could be explained by different age distribution, different laboratory methods and different dietary intake, which make it difficult to compare the results with that of another country.

Conflict of Interests

Authors have no conflict of interests.

Authors' Contributions

MMSh coordinated the study, analyzed the data and prepared the manuscript. MF provides assistance in the design of the study, coordinated all the experiments and participated in manuscript preparation. MJ carried out the design, provided assistance for all experiments and participated in manuscript preparation. SKK, AHB and BA, coordinated all the experiments and participated in manuscript preparation. All authors have read and approved the content of the manuscript.

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Strength of the present study lies in the use of a large sample size of both sexes and different age groups. However, some limitations to our study merit mentioning. First, the dietary intake of total fat, cholesterol and cholesterol raising fatty acids were not evaluated. Second we did not assess the postprandial level of serum lipids.

Conclusion

Although the most prevalent type of fasting dyslipidemia was hypercholesterolemia with frequency of 14.4%, mean of total cholesterol, HDL-C, LDL-C and triglyceride levels in all patients were not greater than general population, in other words, we found no association between tinnitus and dyslipidemia. Based on the results of the present study, there is no need to check the serum lipid profile in tinnitus patients. We recommend further studies to assess both fasting and postprandial serum lipid profile in patients with idiopathic tinnitus. Simultaneous investigation of their dietary intake seems logical. Assessment of tinnitus response to improvement of postprandial dyslipidemia is also recommended.

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