

Frequency of Hidden High Frequency Hearing Loss in Patients with Idiopathic Tinnitus

Tallat Najeeb^{1,*}, Arshia Bilal², Saleem Ahmed³, Nisa Siddiqui⁴

¹Otorhinolaryngology, FMC Air University, Islamabad, Pakistan

²Community Medicine, FMC Air University, Islamabad, Pakistan

³Anaesthesiology, FMC Air University, Islamabad, Pakistan

⁴Radiology, Capital Hospital, Islamabad, Pakistan

Email address:

tallatnajeeb@yahoo.com (Tallat Najeeb), nisaa.sidd@gmail.com (Nisa Siddiqui)

*Corresponding author

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Abstract: Tinnitus is a hallucination of sound, usually described as ringing and buzzing in the ears. Many factors are known to cause tinnitus but sensorineural hearing loss (SNHL) was found to be the most common. The objective of this study is to determine the actual frequency of idiopathic tinnitus and frequency of hidden SNHL in patients presenting with idiopathic tinnitus without hearing loss. This cross sectional study was performed at PAF Hospital Islamabad between December 2018 to Dec 2022. All the patients that presented with tinnitus without any subjective complaint of hearing loss were included in the study. All the possible causes of tinnitus were ruled out before labelling it idiopathic tinnitus. PTA was performed in all patients. The number of patients was calculated who had tinnitus without hearing loss on PTA. These were the patients with idiopathic tinnitus (G_{Hi}). Then these patients were tested for hearing loss on PTA in frequencies higher than 8000 Hz to find out hidden hearing loss. In these patients, the number of patients having hearing loss in frequencies higher than 8000 Hz (G_H) was calculated. These patients (G_H) were removed from the list of idiopathic tinnitus and were the patients with hidden SNHL. In this way the actual frequency of idiopathic tinnitus (G_i) was calculated. The results were tested biostatistically using SPSS 20. Chi-square, simple t test and Fisher's exact test were applied. The significance of results was calculated. Out of 100 patients, 65 were female and 35 were male. The mean age was 28.9 ± 11.7 years. On audiometry only 10% patients had hearing loss in frequencies usually tested during audiometry (500Hz- 4000Hz), G_s . All of these were males (100%). Routine audiometry was normal in the remaining 90% of patients (G_{Hi}). When these patients were tested in frequencies higher than 8000 Hz, out of these 90% patients, 55% of the patients had high frequency hearing loss (>8000 Hz), (G_H); this is the hidden hearing loss. P values were < 0.001 and 0.75 on Fisher's exact and Chi-square tests, the results were found to be significant. It is often seen that patients with idiopathic tinnitus develop SNHL later in life. Therefore, tinnitus can be considered as an early symptom of hearing loss. The actual frequency of idiopathic tinnitus ($G_i=45\%$) is far less than documented, in most of the cases there is hidden SNHL.

Keywords: Idiopathic Tinnitus, Hearing Loss, Sensorineural

1. Introduction

Tinnitus is a hallucination of sound, usually described as ringing and buzzing in the ears. It is a subjective feeling experienced by the patients only. Many factors are known to cause tinnitus but sensorineural hearing loss was found to be the most common. As smartphones have become essential to

our daily lives, hearing loss and tinnitus is rapidly increasing in the patients [1, 2]. Numerous researches have been conducted to find out the relationship between tinnitus and hearing loss. SNHL can be due to inner hair cell degeneration [2, 3]. Ototoxic drugs, noise, inner ear tumors, hypertension, diabetes, stroke, trauma, renal diseases, cervical spondylosis and age related hearing loss were often diagnosed as a cause

of tinnitus but whenever we failed to diagnose any cause of tinnitus, it was labelled as idiopathic tinnitus [2, 4].

It is often seen that the patients initially thought to have idiopathic tinnitus develop sensorineural hearing loss later in their lives. So, tinnitus can be considered as an initial symptom of hearing loss. Some patients with tinnitus live normal daily lives, but a lot of them feel discomfort and develop side effects like insomnia, headache, dyspepsia, depression and anxiety. According to studies SNHL is due to inner hair cell degeneration [1, 5, 6]. Moreover, hidden hearing loss was reported when these patients were tested in frequencies >8000 Hz, and many follow-up researches were conducted to find the cause and process of hidden hearing loss. Hidden SNHL occurs when there is degeneration of the inner hair cell or the synapse terminal is exposed to loud noise [1, 7, 8]. It takes some time to recover the original state of hearing however it cannot be recovered if the degeneration is severe. So, hidden sensorineural hearing loss can be found in patients presenting with idiopathic tinnitus [1, 3, 9, 10].

If this hidden sensorineural hearing loss in these patients is detected early, they can be protected from further hearing loss due to loud noise.

The aim of this study is to assess the actual frequency of idiopathic tinnitus and the frequency of hidden sensorineural hearing loss in patients presenting with idiopathic tinnitus without hearing loss.

2. Material and Methods

Cross sectional study was performed at PAF hospital Islamabad. All the patients that presented with tinnitus without the subjective complaint of hearing loss to PAF hospital Islamabad between December 2018-December 2022, were included in this study. After taking proper history, carrying out complete ENT and systemic examination, all the possible causes of tinnitus were ruled out and these patients were labeled as having idiopathic tinnitus. All the patients

found to have any organic cause of tinnitus after investigations were excluded from the study. Age, sex, hearing threshold, tinnitus laterality, tinnitus duration, tinnitus measurements and subjective disturbance caused by tinnitus were the parameters that were considered for this study. PTA was performed in all the patients. The number of patients who had tinnitus with hearing loss in speech frequencies (G_s) and without hearing loss in speech frequencies (G_{Hi}) on PTA were calculated. These were the patients with idiopathic tinnitus and hidden SNHL (G_{Hi}). Then these patients were tested for hearing loss on PTA in frequencies higher than 8000 Hz to find out hidden hearing loss. In these patients, we calculated the number of patients having hearing loss in frequencies higher than 8000 Hz (G_H). These patients (G_H) with hidden SNHL were removed from the list of idiopathic tinnitus. In this way we were able to calculate the actual frequency of idiopathic tinnitus (G_i). The results were tested biostatistically using SPSS 20.

Chi -square, simple t test and Fisher's exact test were applied. The significance of results was calculated.

3. Results

The total number of patients was 100 out of which 65 were female and 35 were male. The mean age of the participants was 28.9 ± 11.7 years and most of them (65%) were female (Table 1). On audiometry only 10% (G_s) patients had hearing loss in the frequencies usually tested during audiometry (500 Hz- 4000 Hz). All of these were males (100%) (Table 1). Routine audiometry was normal in the rest of the 90% (G_{Hi}) patients (Figure 1). When these patients were tested in frequencies higher than 8000 Hz, out of these 90% patients, 55% (Figure 2) of the patients had high frequency hearing loss (>8000 Hz), (G_H); These were the patients with hidden hearing loss. P values were < 0.001 and 0.75 on Fisher's exact and Chi-square tests, the results were found to be significant (Table 2).

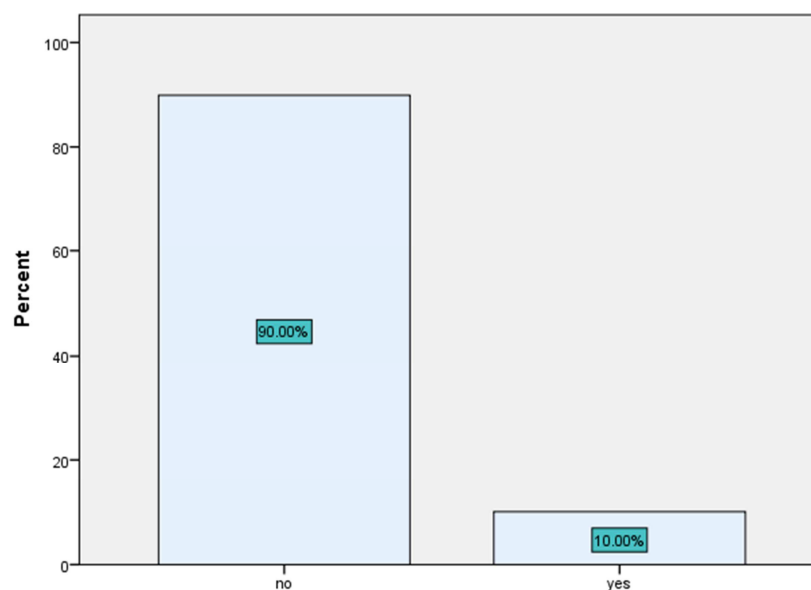


Figure 1. Proportion of participants with HL at speech level.

Out of the 55% patients with tinnitus and hidden hearing loss in high frequencies, 35 (63.6%) were females and 20 (36.3%) were males (Table 1). Mean age of the tinnitus patients who had hearing loss in speech frequencies was greater (35 years) as compared to those who had hidden hearing loss in frequencies greater than 8000 Hz (31 years). Independent sample t test showed p values <.001 and <.006. Out of the 100 patients who were diagnosed with idiopathic tinnitus clinically, 90% (G_{Hi}) did not have hearing loss in routinely tested frequencies. Then these patients were further evaluated for hearing loss at higher frequencies > 8000 Hz. Audiometry of only 45% patients was

normal (G_i) and the remaining 55% had SNHL (sensorineural hearing loss) in frequencies > 8000 Hz (G_{Hi}). Therefore, it was found that their tinnitus was not idiopathic but as a result of hearing loss and actual idiopathic tinnitus was 45% not 90%. Females predominated in both G_{Hi} and G_i . Subjective discomfort was more prominent among G_{Hi} along with feeling of anxiety and depression.

The patients who presented with tinnitus with hidden SNHL (G_{Hi}) gave history of continuous use of headphones for online teaching and work from home during COVID-19 period.

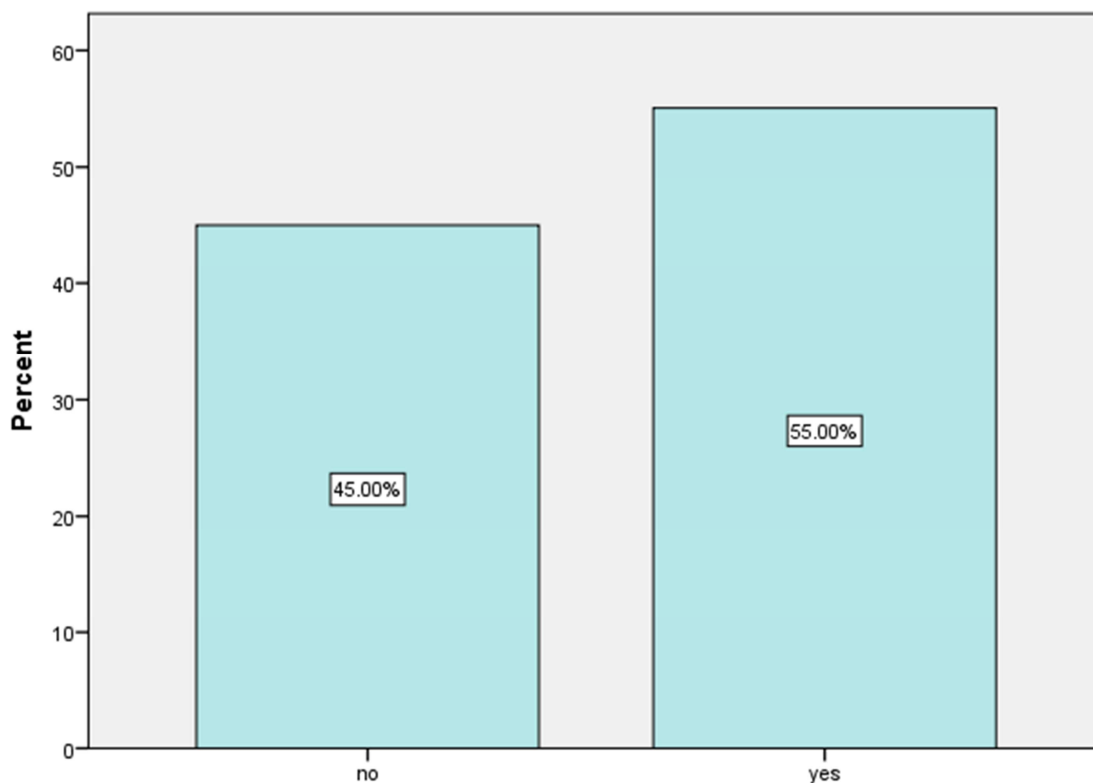


Figure 2. Proportion of participants with HL at higher frequency.

Table 1. Gender distribution of hearing loss.

Hearing loss	Gender		p-value
	Male n (%)	Female n (%)	
Speech Frequency hearing loss (10%)			
No	25 (27.7%)	65 (72.2%)	<0.001*
Yes (G_s)	10 (100%)	0	
High frequency hearing loss			
No (45%) G_i	15 (33.3%)	30 (66.6%)	0.75**
Yes (55%) (G_{Hi})	20 (36.3%)	35 (63.6%)	

*Fisher exact test

**Chi-square test

Table 2. Association of age with hearing loss.

Age^		No of patients	Mean	Standard Deviation	Standard error of mean	p-value*
Speech frequency hearing loss	No (G_{Hi})	90	28.1667	12.20264	1.29	<0.001
	Yes (G_s)	10	35.5000	.52705	0.17	
High frequency hearing loss	No (G_i)	45	26.2222	8.94145	1.33	0.006
	Yes (G_{Hi})	55	31.0909	13.35730	1.80	

*Independent sample t-test

4. Discussion

In most of the cases, even with adequate medical examination, the origin of tinnitus is not found, so it is labelled as idiopathic tinnitus but it is well documented in literature that tinnitus is usually related to hearing loss [1, 11, 12].

Tinnitus can also be due to other inner ear dysfunctions, sudden SNHL, acoustic trauma [1, 13, 14], pharmaceutical medicines or part of otological and neurological diseases such as Ménière's disease, acoustic neuroma and severe head injury [1, 2, 15, 16]. Other factors include conditions such as vascular disease [1, 16] diabetes, hypertension, autoimmune disorders, and degenerative neural disorders [1, 2, 16, 17]. Therefore, all organic causes must be ruled out before declaring idiopathic tinnitus [1-3, 18]. In the presenting study we ruled out all these causes by proper history, examination and required investigations. In this study we observed that tinnitus with hearing loss in speech frequencies (Gs) was more common in males (100%) as compared to females. Our study is comparable to previously conducted studies in which, there was an increase number of males having tinnitus with hearing loss (61.42 %) as compared to females (38.58%) [3]. The age of the patients with idiopathic tinnitus (Gi) was less as compared to patients with hearing loss (the mean age was 35 years for patients with hearing loss and 26 years for patients without hearing loss). This is also comparable with previous studies (41–50 years for patients without hearing loss and >70 years for patients with hearing loss) [2].

In patients having tinnitus without any type of hearing loss (Gi), female population was high [3].

Although tinnitus is commonly associated with hearing loss, other aetiological factors form the potential causes of tinnitus with normal hearing constitute an important group, it may be a an initial sign of diseases that are only diagnosed after the onset of hearing loss due to cochlear damage. Our study is also comparable with past studies with respect to percentage of idiopathic tinnitus. In our study idiopathic tinnitus was found to be 90 % clinically (G_{Hi}), 55% of the patients had tinnitus due to hidden hearing loss (G_H) and 45% patients actually proved to have idiopathic tinnitus without any hearing loss (G_i). However, according a previous study, idiopathic tinnitus was found to be 63 % clinically, 27% of the patients had tinnitus due to hidden hearing loss and 36% patients had idiopathic tinnitus without any hearing loss. This increased incidence of hidden hearing loss in patients can be due to increase usage of ear phones along with smart phones. Pure idiopathic tinnitus was more common in females [2, 4].

5. Conclusion

There is a strong relationship between tinnitus and hearing loss. Sensorineural hearing loss is due to inner hair cell degeneration. Ototoxic drugs, noise, inner ear tumors, Hypertension, diabetes, stroke, trauma, renal diseases, cervical spondylosis and age are the common causes of tinnitus and

hearing loss. If a definite cause of tinnitus is not determined, it is labelled as idiopathic tinnitus. It has frequently been seen that the patients initially thought to have idiopathic tinnitus develop sensorineural hearing loss later in life. Thus, tinnitus can be considered as an early symptom of hearing loss. The actual frequency of idiopathic tinnitus is far less than documented, in most of the cases there is hidden SNHL, which is detected later in life when it involves the speech frequencies. Incidence of hidden SNHL is growing day by day due to the increased use of earphones with smart phones and blue tooth gadgets among the younger generation. If this hidden sensorineural hearing loss is diagnosed early, their ears can be protected from further hearing loss due to loud noise.

6. Recommendations

The frequency of tinnitus should be calculated in future in patients with or without hearing loss. This will be beneficial in prescribing a suitable tinnitus masker.

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