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ORIGINAL ARTICLE

Audiometric Findings in Patients with age Related Hearing Loss

FARHAN AHMED[1], AYESHA JAWAD[2], MUMTAZ AHMAD UMAR[3], SAIRA IFTIKHAR[4], AIMEN AKHTAR[5], M ZAFAR RABBANI[7]
[1]*Assistant Professor, HITEC-IMS, Taxila.*
[2]*Assistant Professor, Shifa College of Medicine, Islamabad.*
[3]*Assistant Professor, Islamabad Medical and Dental College, Islamabad.*
[4]*Assistant Professor, Shifa College of Medicine, Islamabad.*
[5,6]*Registrar, Shifa College of Medicine, Islamabad.*
[7]*HOD, Shifa College of Medicine, Islamabad.*
Correspondence to Dr. Farhan Ahmed, Email: farhanahmed@hitec-ims.edu.pk Cell: +92-310-5771981

ABSTRACT

Aim: To determine the audiometric findings, prevalence of age related hearing loss and association of hearing loss with gender in patients of 60 years and above.
Setting and duration of study: This study was conducted in the Department of ENT at Shifa Foundation Community Health Centre (SFCHC), Shifa International hospital, Islamabad, over a period of 5 years from September 2014 to September 2019.
Methods: A total of 149 patients were included in the study. All the patients were subjected to audiometry after taking informed written consent. Information regarding the past medical history of all participants regarding ear and hearing disorders and risk factors was taken and recorded. All this information along with demographic information was recorded.
Results: The mean age of the participants was 70.72 ± 7.09 years. Most 46 (30.9%) of the patients were between 60 to 65 years old. The proportion of male participants 76 (51%) was slightly higher. In our study sample, 142 (95.3%) of the participants had high-frequency hearing loss, and 129 (86.6%) participants had low-frequency hearing loss. Mostly 62 (41.6%) participants had sloping curve. Most 125 (83.9%) participants were diagnosed with both types of hearing loss. Among male patients flat curve showed a significant (P-value < 0.05) relationship with age and in female patients, flat curve and neither flat curve nor sloping curve showed significant (P-value < 0.05) association with different age brackets.
Conclusion: High-frequency hearing loss was the most common type of hearing loss among older patients. Majority of the patients were diagnosed with both types of hearing loss. High-frequency hearing loss was found to be significantly associated with different age brackets.
Keywords: Hearing loss, Audiometric findings, High Frequency Hearing Loss,

INTRODUCTION

The hearing loss that occurs with advancing age is known as Presbycusis and it is a well-known cause of sensorineural hearing loss. This type of hearing loss affects usually both ears and occurs gradually over time[1]. One of the most important aetiological factors in the production of age-related hearing loss was the loss of outer and inner hair cells while degeneration of cochlea and stria vascularis was observed in other types[2].

Presbycusis can be classified as sensory, neural, strial, cochlear conductive, and mixed based on different patterns seen on the audiogram[3]. The sensory type is characterized by the degeneration of hair cells. Higher frequencies are affected but speech discrimination is good. The neural type in which there is pathology in the cochlear nerve cells and central auditory pathways. Higher frequencies will be affected but speech discrimination will be poor. Atrophy of the stria vascularis leads to a flat curve on the audiogram and is referred to as 'strial type. Speech discrimination is good. The cochlear type is due to the stiffening of the basilar membrane and the audiogram is sloping type. The mixed type is a combination of the symptoms of other types[4,5].

Hearing loss affects one's quality of life and is associated with social isolation and cognitive decline in the elderly. Hearing loss impacts around 50% of 85-year-olds, and the situation is expected to worsen as the population ages. In presbycusis, the traditional audiometric pattern displays a monotonic decline in hearing sensitivity as the pitch of the test-frequency tones increases[6]. The inner hair cells are responsible to convert sound into electrical signals and these signals are transmitted to brain through auditory nerve fibres. Whole this process begins in inner ear where presbycusis starts. An electric potential is maintained by inner ear, which is specialized for this purpose and transportation of ion, like a battery. When the transduction channels are opened with sound, the inner ear drives current into hair cells. Likewise outer hair cells are responsible to convert sound into electrical impulses. They convert electrical signals into mechanical motion by reversing the process. The inner ear sensitivity is based on cochlear amplifier, which is activated by this mechanical motion[7,8]. Hearing loss in elderly people is progressive in nature. Hearing thresholds and speech intelligibility in noise generally deteriorate from the fifth decade onwards. In older adults there are many factors which can influence the occurrence and severity of the hearing loss. These factors include gender, age, socioeconomic status, medical factors like cognition, cholesterol level, cardiovascular disease, diabetes mellitus, obesity and lifestyle related factors including exposure to the noise, and smoking status etc[9,10].

After 60 years of age, the audiograms show a variety of patterns. Hearing loss is frequently misunderstood among the elderly as a natural part of ageing rather than a medical disease that can be treated. Hearing loss may affect the patients in may ways, when it is not properly treated. The untreated patient may experience depression, social isolation, cognitive impairment, and redueced workforce involvement. The quality of life of a diagnosed patient of hearing loss can be improved by enhancing audiometric testing to evaluate possibility of hearing loss.

This study was planned to assess different types of audiometric findings in patients 60 years and above. This will help us to understand the frequently occurring hearing losses and in selecting the appropriate treatment modality.

METHODOLOGY

This cross-sectional study was conducted after permission from IRB, in the department of ENT at Shifa Foundation Community Health Centre (SFCHC), Islamabad. All the patients of both genders and having age 60 years and above were selected by non-probability convenient sampling. The sample size was calculated with the help of WHO sample size calculator, taking 95% confidence interval, anticipated population proportion (rate of age-related hearing loss) P=43%[11] and with an absolute precision level of 8%. A total number of 149 patients visiting the outpatient department according to the selection criteria were included in the

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study. Patients who had any history of previous ear surgery and with non-age-related hearing loss were excluded from the study.

All the patients were subjected to audiometry after taking informed written consent. Information regarding the past medical history of all participants regarding ear and hearing disorders and risk factors was taken and recorded. All this information along with demographic information was recorded on a predesigned proforma.

All the collected data was entered and analyzed using SPSS version 25. Descriptive statistics in the form of mean and standard deviation for quantitative variables and frequency and percentages for qualitative variables were calculated. The chi-square test was applied to see the association of hearing loss with age, gender, and other associated symptoms. P-value ≤ 0.05 was taken as significant.

RESULTS

In this cross-sectional study, a total of 149 participants were included in the study. The mean age of the participants was 70.72 ± 7.09 years. Most 46 (30.9%) of the patients were between 60 to 65 years old followed by 37(24.8%) in the age group of > 75 years. The proportion of male participants 76(51%) was slightly higher than 73(49%) females in the study sample. In 8(5.4%) participants conductive hearing loss was diagnosed, in 115 (77.2%) participants sensorineural hearing loss was observed, and in 40(26.8%) participants, mixed hearing loss was detected as elaborated in Table 1.

In our study sample, 142 (95.3%) of the participants had high-frequency hearing loss, 129 (86.6%) participants had low-frequency hearing loss. On audiometry flat curve was noted in 28 (18.8%) participants and in 62(41.6%) participants sloping curve was noted. Most 125 (83.9%) participants were diagnosed with both types of hearing loss. In 59(39.6%) patients, none of the curves were found and 90(60.4%) of the participants had one type of curve as given in table 2.

The association of hearing loss and audiometry curve types showed that in male participants conductive hearing loss, sensorineural hearing loss, mixed hearing loss, and low-frequency hearing loss had no statistically significant (P-value > 0.05) association with different age brackets. Only high-frequency hearing loss was found to be significantly (P-value < 0.05) associated with different age brackets showing that the proportion of high-frequency hearing loss significantly increases with increasing age. According to the results among female patients the conductive hearing loss, sensorineural hearing loss, mixed hearing loss, high-frequency hearing loss, and low-frequency hearing loss showed no statistically significant (P-value > 0.05) association with different age brackets as elaborated in Table 3.

The results of the analysis showed that among male patients flat curve showed a significant (P-value < 0.05) relationship with age indicating the highest frequency (29.41%) in age bracket of 70 to 75 years followed by (20%) in the age group of 60 to 65 years. In male patients' sloping curve on audiometry, both types of hearing loss and neither flat nor sloping curve showed no significant (P-value > 0.05) association with different age brackets.

In female patients, the flat curve and neither flat curve nor sloping curve showed significant (P-value < 0.05) association with different age brackets. The analysis showed that the proportion of flat curve increases significantly with increasing age and in the age group of > 75 years, the flat curve was observed in all the female patients (100%). The rate of one type of curve was observed significantly higher with increasing age and in all (100%) female patients one type of curve was noted after age of 75 years as elaborated in Table 4.

Table 1: Distribution of Demographic Characteristics and Hearing Loss

Characteristics	Frequency	Percent
Age of the patients		
Mean ± SD	70.72 ± 7.09	
Age Brackets		
< 65	46	30.9
65-70	31	20.8
70-75	35	23.5
> 75	37	24.8
Gender of the patient		
Male	76	51.0
Female	73	49.0
Conductive hearing loss		
No	141	94.6
Yes	8	5.4
Sensorineural hearing loss		
No	34	22.8
Yes	115	77.2
Mixed hearing loss		
No	109	73.2
Yes	40	26.8
Total	149	100.0

Table 2: Distribution of Hearing Loss and Curve type

Hearing Loss	Frequency	Percent
High-frequency Hearing loss		
No	7	4.7
Yes	142	95.3
Low-Frequency hearing loss		
No	20	13.4
Yes	129	86.6
Flat curve		
No	121	81.2
Yes	28	18.8
Sloping curve		
No	87	58.4
Yes	62	41.6
Both types of Hearing loss		
One type of hearing loss	24	16.1
Both Hearing Losses	125	83.9
Neither Flat curve nor Sloping curve		
One type of curve	90	60.4
None of the curves	59	39.6
Total	149	100.0

Table 3: Association of Hearing Loss and Curve type with different age brackets based on gender

Sex	Hearing Loss	Age Brackets				Total	P-value
		< 65	65-70	70-75	> 75		
Male	**Conductive hearing loss**						
	No	19	11	17	24	71	0.524
	Yes	1	1	0	3	5	
	Sensorineural hearing loss						
	No	4	1	5	7	17	0.55
	Yes	16	11	12	20	59	
	Mixed hearing loss						
	No	16	10	12	20	58	0.835
	Yes	4	2	5	7	18	
	High-frequency Hearing loss						
	No	3	0	0	0	3	0.033
	Yes	17	12	17	27	73	
	Low-Frequency hearing loss						
	No	5	1	1	4	11	0.366
	Yes	15	11	16	23	65	
	Total	20	12	17	27	76	
Female	**Conductive hearing loss**						
	No	24	18	18	10	70	0.55
	Yes	2	1	0	0	3	
	Sensorineural hearing loss						
	No	6	5	4	2	17	0.982
	Yes	20	14	14	8	56	
	Mixed hearing loss						
	No	19	12	12	8	51	0.775
	Yes	7	7	6	2	22	
	High-frequency Hearing loss						
	No	0	2	1	1	4	0.418
	Yes	26	17	17	9	69	
	Low-Frequency hearing loss						
	No	2	1	5	1	9	0.144
	Yes	24	18	13	9	64	
	Total	26	19	18	10	73	

Table 4: Association of audiometric Curve types with different age brackets based on gender

Sex	Curve type	Age Brackets				Total	P-value
		< 65	65-70	70-75	> 75		
Male	**Flat curve**						
	No	16	9	12	27	64	0.037
	Yes	4	3	5	0	12	
	Sloping curve						
	No	13	7	11	10	41	0.174
	Yes	7	5	6	17	35	
	Both types of Hearing loss						
	One type of hearing loss	7	1	1	4	13	0.079
	Both Hearing Losses	13	11	16	23	63	
	Neither Flat curve nor Sloping curve						
	One type of curve	11	8	11	17	47	0.899
	None of the curves	9	4	6	10	29	
	Total	20	12	17	27	76	
Female	**Flat curve**						
	No	23	18	11	5	57	0.006
	Yes	3	1	7	5	16	
	Sloping curve						
	No	20	12	9	5	46	0.241
	Yes	6	7	9	5	27	
	Both types of Hearing loss						
	One type of hearing loss	2	3	5	1	11	0.310
	Both Hearing Losses	24	16	13	9	62	
	Neither Flat curve nor Sloping curve						
	One type of curve	9	8	16	10	43	0.000
	None of the curves	17	11	2	0	30	
	Total	26	19	18	10	73	

DISCUSSION

Presbycusis often began in the fifth decade of life, advanced slowly over time, and peaked in the eighth decade, accompanied by unpleasant symptoms of tinnitus and vertigo, with the majority of patients presenting within three years of recognising hearing los[12]. Presbycusis is the slow decrease of hearing ability that most people experience as they get older. ARHL is the third most frequent chronic condition among adults over 65, after hypertension and arthritis. Presbycusis is a progressive bilateral symmetrical age-related hearing loss, according to the definition. Although the cause is unknown, past research has linked it to several types of physiological degeneration, environmental variables (such as noise exposure and ototoxic chemicals), and hereditary vulnerability. ARHL should be regarded a serious public health issue since it has a variety of negative consequences on older individuals' quality of life, cognitive, emotional, and social functionin[13,14].

There are many risk factors which have shown significant association with hearing loss in many studies. These risk factors include noise exposure, use of ototoxic medication which can cause hearing loss in any age. There are some factors which increases the chances of hearing loss like environmental noise exposure in factor worker, armed forces or dramatic increase in use of personal music devices. The other factors which were found to be associated with hearing loss are smoking, passive smoking, obesity and low BMI and comorbid diseases like dibetease melitus, CHD and hypertenstion[15,16].

In this present study the mean age of the participants was 70.72± 7.09 years. Most 30.9% of the patients were between 60 to 65 years and male participants 51% in the study sample. In 5.4% participants conductive hearing loss was diagnosed, in 77.2%

participants sensorineural hearing loss was observed, and in 26.8% participants, mixed hearing loss was detected. These results are in accordance with previous studies indicating sensory pattern the most common presentation like in the study of Sarfraz M, et al who found that Sensory presbycusis is the most common (64.2%), followed by neural, conductive, metabolic, and sensory-neural presbycusis, which account for 16.25 %, 9.54%, 2.68%, and 7.16%, respectively[14].

Despite their higher disease burdens and healthcare needs, individuals with HL frequently encounter a variety of healthcare barriers, especially patient provider communication breakdowns and poorer physician understanding of HL' impact on health. Elevated disease burden and difficulty with patient provider communication put people with HL at a particularly high risk for disease complications and higher healthcare costs. Timely access to care is a particularly salient factor for these individuals[17].

The results of this study showed that among male patients flat curve showed a significant (P-value <0.05) relationship with age indicating the highest frequency (29.41%) in age bracket of 70 to 75 years followed by (20%) in the age group of 60 to 65 years. In female patients, the flat curve and neither flat curve nor sloping curve showed significant (P-value < 0.05) association with different age brackets. The conductive hearing loss, sensorineural hearing loss, mixed hearing loss, and low-frequency hearing loss showed no statistically significant (P-value > 0.05) association with different age brackets. These results are in very much agreement with prious studies in which it was found that the beginning of hearing loss was linked to sex. Hearing thresholds in the lower frequencies were shown to be related with females, while hearing thresholds in the speech and higher frequencies were found to be connected with males[18]. High-frequency hearing is better in women, while low-frequency hearing is better in men. This could be explained by the belief that men are more susceptible to noise-induced hearing loss[19].

A person's psychological, functional and social well-being may be influenced significantly due to hearing loss. This issue is badly influenced due to our lack of understanding about the illness process and our incapability to minimize or stop the disease process from prognression. Up till now the clinicians are only able to characterize the intensity of impairment, prediction of future hearing loss possibility and recommendations of amplification by means of hearing aids using family history, the description of beginning and progression and the results of audiometric testing[20]. The treatment protocol of this disease must contain the examination of quality of life status and its assessment as a mendatory part of the treatment care. This is because many studies have proved that presbycusis have a strong negative impact on quality of life and psychological well-being, which may cause anxiety, depression, social isolation and even cognitive deterioration among older patients suffering from hearing loss[21].

CONCLUSION

In conclusion, high-frequency hearing loss was found to be the most frequent kind of hearing loss among the elderly. Both forms of hearing loss were detected in the majority of the individuals. High-frequency hearing loss was shown to be substantially linked with various age groups, indicating that the number of people with high-frequency hearing loss rises as they get older. There was no statistically significant relationship between conductive hearing loss, sensorineural hearing loss, mixed hearing loss, high-frequency hearing loss, and low-frequency hearing loss and age ranges. The proportion of flat curve increases significantly with increasing age and in the age group of > 75 years, the flat curve and one type of hearing loss was observed in all the female patients.

Conflict of interest: Nil

Authors Contribution: MAU; provided concept/research design and did data collection, **NA, MNB and NQ** did statistical analysis and manuscript writing, **MAU & MM** did edit of manuscript and project management, **AJ** did critical revision of the manuscript for important intellectual content, **MAU & MM** takes the responsibility and is accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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