

Assessment of Hearing Loss: Determining Type and Severity Through Audiometric Evaluation

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Abstract

Audiometry is the process of assessing hearing acuity. When conducted exclusively using pure tones, it is referred to as pure tone audiometry. In the Audiology unit of the Department of Otolaryngology-Head & Neck Surgery at Combined Military Hospital (CMH) in Dhaka, a cross-sectional prospective study was undertaken over the course of a year, spanning from March 2016 to February 2017. This study focused on patients admitted to the hospital who presented complaints of hearing impairment. A total of two hundred cases with hearing complications were included in this study, selected based on interviews, medical history, examination findings, and investigative reports.

The majority of patients were found to be female and ranged in age from 21 to 30. Based on the distribution of occupations, the majority of patients (45%) come from the families of Other Ranks (ORs). One hundred eighty-two individuals indicated that their hearing was impaired, making it the most often reported problem. Twenty patients had hearing loss alone in their left ear, and 28 individuals only in their right. As a result, 152 experienced an issue with both ears losing hearing. Conductive hearing loss is the most common form, making up 51.12% of the cases in the right ear and 61.62% in the left. The chronic suppurative otitis media (CSOM) affected 78 people. On the other hand, Otitis media with effusion (OME) accounts for 54 cases.

According to this study, conductive type hearing loss was the most common type, mild degree hearing loss was the most common degree, and otitis media with effusion (OME) and Chronic suppurative otitis media (CSOM) were the most prevalent causes of hearing loss. We were considering that these ailments are avoidable. Thus, hearing damage can be avoided with the right interventions.

Keywords: Audiometry, Pure tone, Deafness, Conductive, Chronic suppurative otitis media, Hearing loss

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I. Introduction

Hearing loss is a prevalent sensory impairment that can significantly impact an individual's communication abilities and overall quality of life. Accurate diagnosis of the type and severity of hearing loss is essential for appropriate intervention and management. Hearing loss is a multifaceted condition influenced by various factors, including genetics, environmental exposure, and age-related changes¹. To address hearing loss effectively, it is imperative to conduct a thorough assessment to ascertain its type and severity. Audiometric evaluation is a pivotal diagnostic procedure employed by healthcare professionals for this purpose. There are three primary types of hearing loss: conductive, sensorineural, and mixed².

Conductive hearing loss occurs when there is a problem in the outer or middle ear, preventing sound waves from reaching the inner ear properly. Causes may include earwax buildup, middle ear infections, or structural abnormalities. Sensorineural hearing loss results from damage to the inner ear or the auditory nerve. It is typically permanent and can be caused by factors such as aging, noise exposure, or certain medical

conditions. Then, mixed hearing loss is a combination of both conductive and sensorineural components. It occurs when there are issues in both the middle or outer ear and the inner ear³.

Pure tone audiometry is a fundamental hearing test that assesses the sensitivity of the auditory system to pure tone bursts of varying frequencies. This form of audiometry is widely practiced and relies on the simplicity of pure tones, which are characterized by a single frequency and sound pressure level. This simplicity ensures high test reliability. The primary objective of pure tone audiometry is to establish hearing threshold levels for pure tones, which represent the minimum intensity at which a person can detect a sound⁴⁻⁵. The threshold of hearing is defined as the level at which a person correctly identifies a sound in 50 percent of repeated trials. Standardized frequencies ranging from 125 to 8000 Hz are used in the test, and a standardized type of earphone is employed for monaural presentation. Sound intensity can be adjusted in 5 dB increments, ranging from -10 dB to 120 dB. Calibration is set so that 0 dB corresponds to the average threshold of normal, healthy ears at each frequency. The optimum step size for the test is typically 5 dB, as larger steps may reduce measurement accuracy, while smaller steps do not significantly enhance it⁶⁻⁸.

Pure tone audiometry has emerged as the standard method for quantitatively characterizing the degree of hearing loss. It also provides valuable insights into the localization of the underlying lesion causing the hearing impairment. The degree of hearing impairment at a given frequency is depicted graphically on an audiogram, which shows the amount by which intensity needs to be increased above the normal level. Additionally, the threshold of bone conduction serves as an indicator of cochlear function, and the difference between air and bone conduction thresholds (A-B gap) is used to assess the degree of conductive deafness⁹⁻¹¹.

Understanding the type and degree of hearing loss through pure tone audiometry is crucial for developing treatment plans, prescribing hearing aids, assessing handicap for neurological purposes, and predicting speech reception threshold. It plays a pivotal role in addressing the social and functional challenges faced by individuals with hearing impairments, emphasizing the importance of routinely conducting these tests in patients reporting hearing issues¹²⁻¹⁴.

II. Materials And Methods

This prospective cross-sectional study was conducted at the Audiology unit within the Department of Otolaryngology Head and Neck Surgery at Combined Military Hospital, Dhaka, from March, 2016, to February, 2017. The study focused on individuals with complaints of hearing loss who sought treatment at this hospital. A total of two hundred cases of hearing-impaired individuals were selected, and data was gathered through interviews using a structured questionnaire, along with examination and investigation reports. The study specifically included cases that were clinically and diagnostically confirmed to have hearing impairment, while excluding individuals with audiometrically confirmed normal hearing and children below the age of four.

Operational definitions

Pure tone: A single-frequency sound is called a pure tone, e.g., a sound of 500, 1000, or 2000 Hz.

Frequency: It refers to the number of cycles per second. The frequency unit is Hertz (Hz), which bears the name Heinrich Rudolf Hertz, a German scientist. 1000 Hz is the frequency of a sound in cycles per second. Speech frequencies fall between 500 and 2000 Hz because this is the range in which most human voices are produced.

Decibel (dB): Named in gratitude for Alexander Graham Bell, it is one-tenth of a bell. It represents the ratio of two distinct intensities and is expressed in logarithmic units. The most negligible perceptual difference in sound that the human ear can detect at speech-related frequencies is one dB. The standard hearing threshold in clinical work is 0 dB.

Threshold of hearing: The sound level at which, under particular circumstances, a person provides 50% of accurate detection responses on multiple trials is known as the threshold of hearing¹.

Degree of hearing loss measurement: Mild: 25-40 dB; Moderate: 41-55 dB; Moderately Severe: 55-70 dB; Severe: 71-90 dB and Profound :> 91 dB.

III. Results

This study investigated 200 cases to determine the type and degree of hearing loss. The outcomes of the patient's demographic and diagnostics values are shown in tabulated and graphical representation.

| Age (year) | No of patients | % |
|------------|----------------|----|
| 0-10 | 12 | 6 |
| 11-20 | 24 | 12 |
| 21-30 | 60 | 30 |
| 31-40 | 32 | 16 |
| 41-50 | 24 | 12 |
| 51-60 | 28 | 14 |

| | | |
|---|-----------------------|------------|
| >61 | 20 | 10 |
| Total | 200 | 100 |
| Age group | No of patients | % |
| Male | 78 | 39 |
| Female | 122 | 61 |
| Total | 200 | 100 |
| Occupation | No of patients | % |
| Other ranks (ORs) family | 90 | 45 |
| Civilian's family | 46 | 23 |
| Other ranks (Ors) | 34 | 17 |
| Civilians | 14 | 7 |
| Civilians not entitled & Relative entitled (CNE & RE) | 8 | 4 |
| Officers and family | 8 | 4 |
| Total | 200 | 100 |

Table 1: Demographic (age, sex and occupation) distribution among the study group

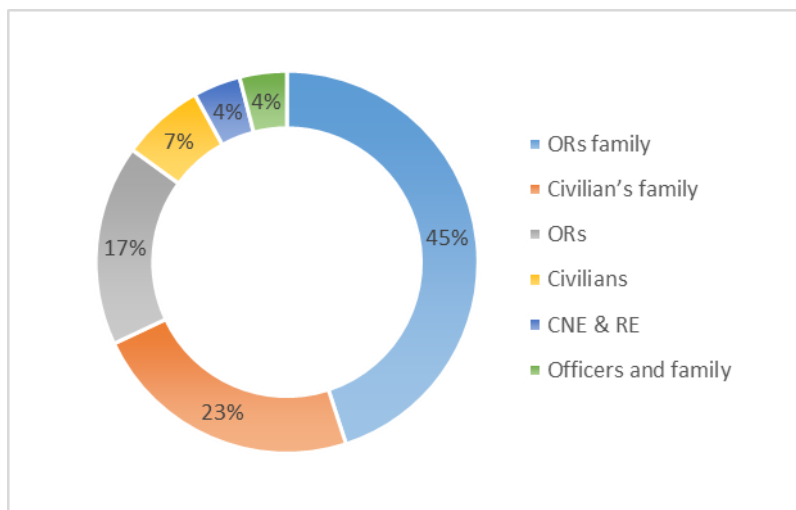


Figure 1: Pie chart- occupation patterns of the patients in percentage

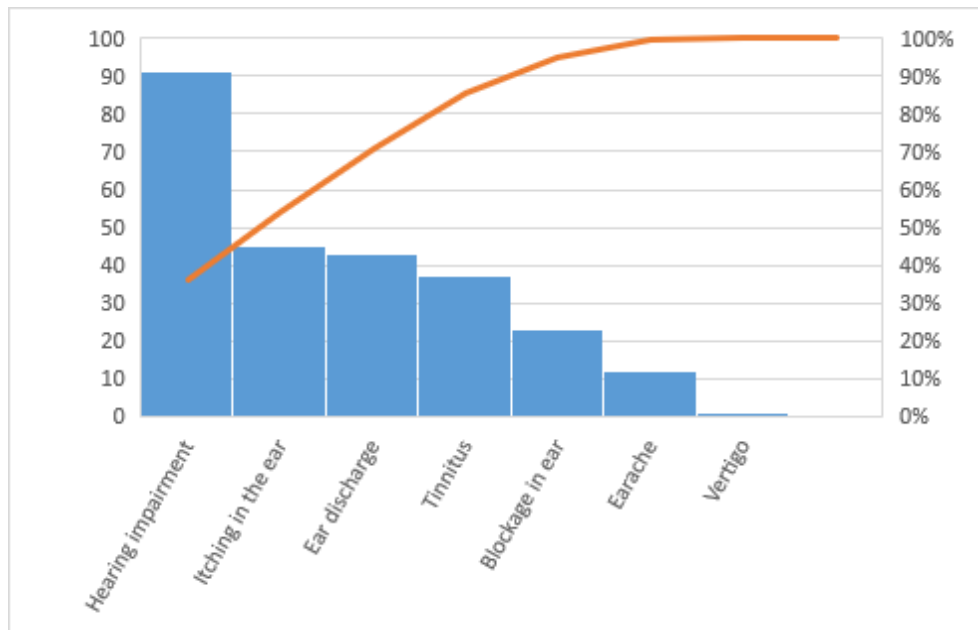
Maximum patients found at the age range of 21-30 years and mostly were female. The occupation distribution shows that the largest proportion of patients, making up 45%, are from the families of Other Ranks (ORs).

The most commonly reported issue was hearing impairment; 182 patients were found who were experiencing this concern.

Table 2: Distribution of presenting complaints (n=200)

| Complaints | No of patients |
|--------------------|----------------|
| Hearing impairment | 182 |
| Itching in the ear | 90 |
| Ear discharge | 86 |
| Tinnitus | 74 |
| Blockage in ear | 46 |
| Earache | 24 |
| Vertigo | 02 |

Figure 2: Graphical representation of complaints



| Degree of hearing loss | Right ear (n=180) | | Left ear (n= 172) | |
|------------------------|-------------------|-------|-------------------|-------|
| | No of patients | % | No of patients | % |
| Mild | 90 | 50 | 104 | 60.46 |
| Moderate | 54 | 30 | 40 | 23.25 |
| Severe | 20 | 11.11 | 16 | 9.30 |
| Profound | 16 | 8.88 | 14 | 8.13 |

Table 3: Degree of hearing loss among the patients

From Table-3, it is evident that 28 patients had only right ear hearing loss and 20 patients had only left ear hearing loss. Therefore, 152 had both ear hearing loss complication.

| Types of hearing loss | Right ear (%) | Left ear (%) |
|-----------------------|---------------|--------------|
| Conductive | 51.12 | 61.62 |
| Sensorineural | 30.00 | 15.13 |
| Mixed | 18.88 | 23.25 |

Table 4: Types of Hearing loss in percentage (n=200)

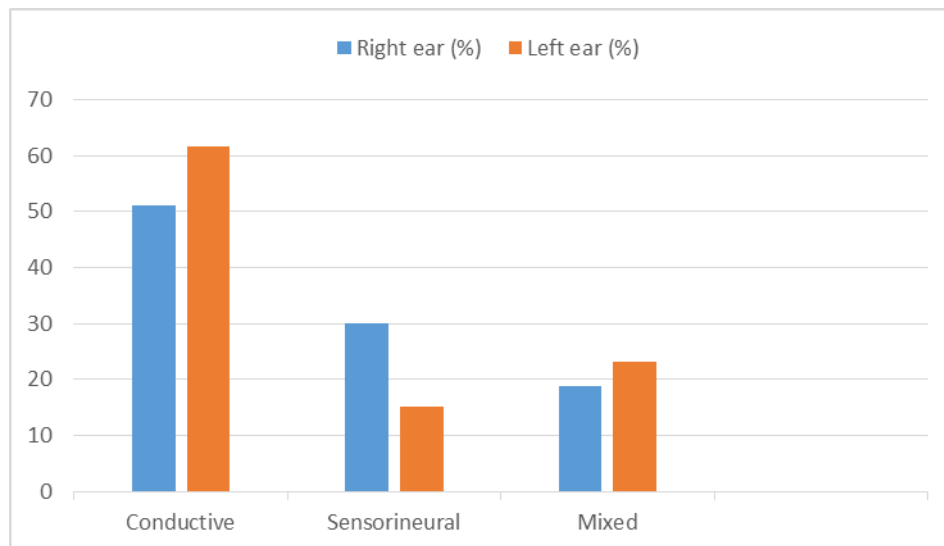


Figure 3: Graphical representation of types of hearing loss in both ears

Among the cases, the most prevalent type of hearing loss is conductive, accounting for 51.12% in the right ear and 61.62% in the left ear.

| Causes of hearing loss | No of patients |
|--|----------------|
| Chronic suppurative otitis media (CSOM) | 78 |
| Otitis media with effusion (OME) | 54 |
| (Sensorineural hearing loss) ISNHL (Check the full form) | 18 |
| Senile | 18 |
| Otosclerosis | 8 |
| Mixed Hear Loss (MHL) | 10 |
| External auditory canal (EAC) Atresia | 4 |
| Rupture Tympanic Membrane (RTM) | 2 |
| Meniere's disease MD (check the full form?) | 2 |
| Idiopathic sudden severe sensorineural hearing loss (ISSNHL) | 6 |

Table 5: Causes of hearing loss (n=200)

The above table provides a breakdown of the causes of hearing loss among a total of 200 patients. Chronic suppurative otitis media (CSOM) is the most prevalent cause, affecting 78 individuals, followed by otitis media with effusion (OME) which accounts for 54 cases.

IV. Discussion

Accurate diagnosis and evaluation are necessary in order to treat the population of hearing-impaired people. Pure tone audiometry (PTA) is crucial for this reason. The PTA is the primary hearing test that is used to determine a person's hearing threshold levels, which allows for the identification of the kind, degree, and configuration of a hearing loss¹⁵. Among the total population, 37.5 million people (15%) in America who are 18 years of age and older reported having some hearing loss¹⁶. According to a typical hearing examination, one in eight Americans (13%, or 30 million) who are 12 years of age or older have hearing loss in both ears¹⁷.

According to a British study, the prevalence of hearing impairment is 3.5% in the 18–40 age group, 17.4% in the 41–60 age group, and 45.3% in the 61–80 age group¹⁸. In our study, 30% patients were in the age of 21-30 years old. Following closely behind are individuals in the 31-40 and 51-60 age groups, each comprising 16% and 14% of the total respectively. Patients aged 0-10 and 11-20 make up 6% and 12% of the total respectively, while those between 41-50 years old account for another 12%. Lastly, individuals over the age of 61 constitute 10% of the total patient population. When it comes to gender, the data reveals that 39% of the patients are male, while 61% are female. This indicates a slight majority of female patients within the sample group.

A British study found that conductive hearing impairment affected manual workers 1.3 times more frequently than non-manual workers¹⁸. Our study shows that the largest proportion of patients, making up 45%, are from the families of Other Ranks (ORs). Following this, families of civilians account for 23% of the total, while actual Other Ranks themselves make up 17%. Civilians not entitled and relatives entitled (CNE & RE) represent 4% of the total, as do officers and their families. Lastly, civilians as a distinct group account for 7% of the total patient population.

We analyzed various complaints related to ear health. The most commonly reported issue was hearing impairment, with 182 patients experiencing this concern. Following closely behind was itching in the ear, which affected 90 individuals, while 86 patients reported experiencing ear discharge. Tinnitus, characterized by a ringing or buzzing sensation in the ears, was reported by 74 patients. Blockage in the ear was noted by 46 individuals, and 24 patients reported experiencing earache. On the other hand, vertigo, a sensation of dizziness or spinning, was the least commonly reported complaint, affecting only 2 patients out of the total sample. These findings provide valuable insights into the prevalence of different ear-related complaints among the study population.

We found the degree of hearing loss among the study patients, with a total of 180 individuals for the right ear and 172 for the left ear. In the right ear, 50% of patients exhibited a mild degree of hearing loss, while 30% had a moderate level, 11.11% showed severe hearing loss, and 8.88% experienced profound hearing impairment. On the other hand, in the left ear, the distribution of hearing loss was slightly different, with 60.46% of patients displaying a mild degree, 23.25% exhibiting a moderate level, 9.30% experiencing severe hearing loss, and 8.13% facing profound impairment.

Among the cases, the most prevalent type of hearing loss is conductive, accounting for 51.12% in the right ear and 61.62% in the left ear. Following this, sensorineural hearing loss is the second most common, making up 30.00% in the right ear and 15.13% in the left ear. Lastly, mixed hearing loss is observed in 18.88% of cases in the right ear and 23.25% in the left ear. The UK national Study of Hearing, a prospective clinical trial with random selection, provided information on the prevalence of middle ear illness in adults in the British

community. A diagnosis was made by otoscopic means using a sample of 2708 adult British people. Chronic otitis media (COM) was found in 12, 2.6, and 1.5 percent of cases, respectively where the total cases was 16.1%¹⁸. In another study, 686 kids (7.4%) in Yemen were assessed for CSOM and related hearing loss by interviews and examinations¹⁹. Otitis media with effusion (OME) age-specific prevalence rates were examined by Zielhuis et al. in 23 studies up to the age of 10. The first and biggest peak of the bimodal prevalence occurs at two years of age, is around 20% and most children attending primary school at age five, there is a second peak of roughly 16%²⁰. Our study shows that Chronic suppurative otitis media (CSOM) is the most prevalent cause, affecting 78 individuals, followed by otitis media with effusion (OME) which accounts for 54 cases.

A Taiwanese retrospective cross-sectional investigation estimated the incidence to be about eight cases per 100,000 people annually²¹. From our study, 3 cases of ISSSNHL (idiopathic sudden severe sensorineural hearing loss) were found and all were unilateral. Sensorineural hearing loss (ISNHL) and senile-related hearing loss are both observed in 18 patients each. Otosclerosis, a condition characterized by abnormal bone growth in the middle ear, is identified in 8 cases. Mixed hearing loss (MHL), which combines elements of both conductive and sensorineural hearing loss, is present in 10 patients. External auditory canal (EAC) atresia, a congenital condition where the external ear canal does not develop properly, is observed in 4 individuals. Ruptured Tympanic Membrane (RTM) and Meniere's disease (MD) each account for 2 cases. Finally, idiopathic sudden severe sensorineural hearing loss (ISSSNHL), a sudden loss of hearing without an apparent cause, is noted in 6 patients.

V. Conclusion

In this study, 200 cases of pure tone audiometry were examined in hearing-impaired patients. It is important to note that this sample may only partially represent the broader population. While the data presented here may differ from larger cohorts, the meticulous collection of cases over one year from a tertiary-level hospital lends credibility to the findings. In Bangladesh, ear diseases are prevalent, but their diagnosis often experiences delays, leading to some degree of hearing loss. This study highlights that the most common type of hearing loss observed is conductive, with the mildest degree (21-40 dB) being the most frequently encountered. The primary causes of hearing loss identified were chronic suppurative otitis media (CSOM) and otitis media with effusion (OME). Given the prevalence of ear diseases in the country, the predominance of milder hearing loss, and the preventable nature of many underlying causes, concerted efforts should be made to implement preventive measures against hearing impairment.

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