



## ASSESSMENT OF HEARING THRESHOLD LEVELS IN CLINICALLY NORMAL INDIVIDUALS AND ESTIMATE THE RISK OF AGE FACTOR AMONG THEM.

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### ABSTRACT

**Background:** In the current study we estimated the hearing threshold in different age groups and compared the hearing threshold in older adults with younger adults.

**Aims & objectives:** 1. To identify the mean hearing threshold in different age groups & create baseline data of the hearing 2. To study the affect of age and gender on hearing threshold in adults.

**Materials and methods:** Cross-sectional study, simple random sampling method, sample size of 100 belonging to age group of 15-69 yrs, with normal tympanic membrane and no H/o of noise exposure. These subjects were motivated to undergo pure tone audiometry to analyze their hearing threshold levels. Data thus collected has been analyzed using tables and graphs, mean hearing threshold levels have been calculated.

**Results:** As the age increased the hearing threshold increased for all frequencies. Hearing thresholds of 4 KHz, 8 KHz showed a statistical significance between both genders for people older than 30 yrs, with the 4 KHz frequency showing the largest difference.

**Conclusion:** It is very common among general population for hearing to get worse as they get older. This usually affects their ability to understand and they can hear low frequencies better than high frequencies, hence people with age related hearing loss find it difficult to follow conversations in noisy environment.

**Recommendations:** After 40 years of age onwards, every individual must go for regular audiometric evaluation annually. In regular health check-up policies, pure tone audiometry must be included along with other routine investigations.

**KEYWORDS :** Hearing Threshold, Pure Tone Audiometry, Aging Effect

### INTRODUCTION:

In adults, hearing loss can often begin long before symptoms are noticed and the loss can progress slowly over time; if you suspect hearing loss get baselines hearing test and follow-up annually to look for changes.

#### Symptoms of hearing loss:

1. Listening to television or radio at high volume
2. Trouble understanding speech, especially in noisy areas
3. The perception that others are mumbling
4. Difficulty in hearing people on the phone
5. Often asking people to repeat themselves
6. Avoiding social situations
7. Exhaustion after attending social events
8. Tinnitus or ringing in the ears

Hearing loss can manifest in many different ways. Depending on the degree or severity of the hearing loss, symptoms can range from occasional difficulty understanding words to inability to communicate with others and social isolation. While there are a few different types of hearing loss and many different causes the symptoms are generally similar regardless of the type of cause. The most common type of hearing loss is sensorineural hearing loss and this type of hearing loss often results in decreased ability to hear high frequency sounds.

People with high frequency hearing loss often miss the following sounds:

- Female and young children's voice
- Certain consonant sounds like s, sh, f, v, th, f, making it difficult to understand some words.
- The car's turn signal
- Beeping sounds on timers and microwave oven
- Song birds

Sensorineural hearing loss develops later in life, it can be caused by a wide variety of triggers, include-

- Aging (presbiacusis)
- Blood vessel disease
- Auto-immune disease
- Infection such as meningitis, mumps, scarlet fever and measles
- Traumatic injuries
- Extremely loud noises exposure over a period of time
- Meniere's disease
- Acoustic neuroma
- Drug toxicity
- Cancerous growth in the inner ear

The major factor affecting the prevalence of hearing impairment is age, with smaller contribution coming from gender, occupational group and occupational noise exposure.<sup>1</sup> The major predictors of tinnitus are concerned with hearing impairment<sup>2</sup> and tinnitus & hearing disability are found to influence quality of life adversely.<sup>3,4</sup> Only a few reports have provided reference data for age and gender related hearing threshold level for Indians. In public health priority of hearing impairments and tinnitus in adults should be substantially higher than it presently appear, because hearing disorders constitute the most prevalent chronic impairment in the population. The situation has not changed substantially since Cochrane's assessment in 1971.<sup>5</sup> The major factor associated with this high prevalence is age with noise being the chief preventable factor, especially in young people. Because age is the major factor, the whole population prevalence of hearing impairments will increase over the next 20 years by upto 20% because of the demographics of the population.<sup>6</sup>

People with hearing disability and tinnitus have significantly worse quality of life which can be ameliorated by the appropriate use of rehabilitation such as the use of a hearing aid for most of the time.<sup>3,4</sup>

**MATERIALS AND METHODS:**

A cross-sectional study was conducted at Government General Hospital, Anantapur district, Andhra Pradesh from Jan 2018 to Feb 2018. A total of 100 participants with normal tympanic membrane and without any history of occupational noise exposure were included in the study. The study subjects have been selected randomly from the patients' attendants and visitors in the ENT inpatient ward, and have been motivated to participate in the current study and undergo audiometry in the department of ENT, GGH, Anantapur. A total of 100 subjects, were motivated to undergo audiometry, pure tone air conduction (AC) and unmasked bone conduction (BC) audiometry of both ears was performed. Pure tone averages (PTAs) and air-bone gap (ABG) were calculated.

**Audiometric measure:**

The testing was performed using 'Labat Asia' clinical audiometer (Made in Germany). Pure tone audiometry was performed on both ears, one at a time, at frequencies of 0.250, 0.5, 1, 2, 4 & 8 KHz. Before the test, the volunteer was enquired to identify his or her better ear. On confirmation the test was started with his or her better ear. In case he or she could not notice any difference between the right and left ear, the test was started in the right ear at 1000 Hz (intensity, 30 dB hearing level) proceeding to higher octave frequencies. After testing at 8000 Hz, lower octave frequencies were evaluated started at 250, 5000 Hz. In case of no response at 30 dB, the intensity was increased in 10 dB steps until a response was recorded; then the descending bracketing method was initiated again. A pulsed tone of more than 200 milli seconds duration was given for each frequency being tested. Volunteers were instructed to press a hand held response switch upon hearing a tone, to hold the key down as long as they hear the tone, and to release it when they no longer hear the tone. A short rest period was given in between testing of right and left ears for air conduction (AC) & bone conduction (BC) audiometry.

**Bone conduction audiometry:**

BC was done for both the ears (one each at a time) at frequencies of 0.250, 0.05, 1,2,4, 8 KHz placing the vibrator on the mastoid bone. The threshold seeking paradigm used the same threshold seeking method used in the pure tone test configuration.

The threshold levels at all measured frequencies for AC & BC audiometry were plotted as an audiogram to graphically show the hearing threshold trends.

The hearing tests were carried out in a soundproof room in the department of otorhinolaryngology of Govt. Medical College, Anantapur. Clinical examination of ear, nose and throat was performed by an otolaryngologist. It was found that all subjects had a normal tympanic membrane, with no history of noise exposure. The subjects who had a history of noise exposure, tympanosclerosis on examination and PTA average more than 30 dB between the two ears were excluded from the study.

**Statistical analysis:**

The data thus collected was presented in the form of tables, bar graphs, pie charts and analyzed using means and proportions.

**RESULTS:**

It is clear from Figure 1 that there were more male participants than females in the present study. The reason may be that, generally females in India are reluctant to undergo audiometry which is conducted in closed sound proof room. But, it is observed from Figure 2 that younger age females are more compared to younger age males because younger age females are more concerned about their hearing loss due to social stigma attached to it and came forward for audiometry.

In old age, females are reluctant to know about their hearing status and audiometric examination as they were busy with their family responsibilities.

**Sex distribution of study subjects**

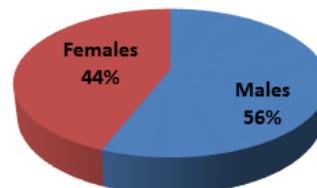


Fig 1: Pie chart showing sex distribution of study subjects

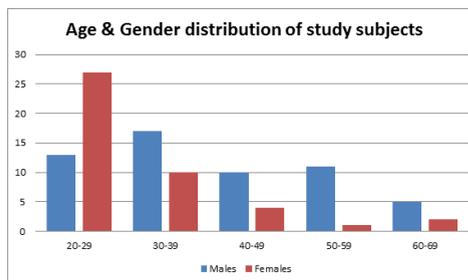


Fig 2: Bar graph showing age and gender distribution of study subjects

The results in Table 1, shows various presenting symptoms of hearing loss of the study participants in the present study. Majority of them presented with tinnitus occasionally followed by unable to understand speech in noisy environment.

Table 1: List of presenting symptoms of hearing loss in study subjects.

S.No	Symptoms of study subjects	No. of subjects (%)
1	Listening TV or Radio at high volume	3 (3%)
2	Trouble understanding speech in noisy environment	5 (5%)
3	The perception that others are mutating	0 (0%)
4	Difficulty hearing people on phone	2 (2%)
5	Often asking people to repeat themselves	3 (3%)
6	Avoid social situations	2 (2%)
7	Exhaustion after attending social events	2 (2%)
8	Tinnitus or ringing in ear occasionally	9 (9%)

The results in Table 2, show that there is no uniformity or a pattern in mean hearing thresholds in our cases between right and left ear in men and women.

The observations in Table 3 show that, from younger age to older age the mean hearing threshold levels were increased parallel to age; mean hearing threshold levels for women increased more than men.

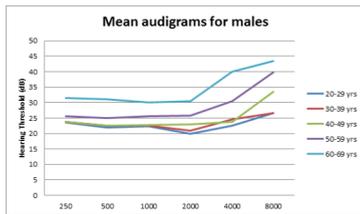
Table 2: Age group verses Mean Hearing Threshold levels in dB

Age group (yrs)	Mean Hearing Threshold Values			
	Males		Females	
	Right	Left	Right	Left
20-29	21.4	21.5	22.6	23.1
30-39	22.1	21.8	23.1	22.4
40-49	24.2	20.0	24.5	23.3
50-59	26.4	25.2	33.3	38.6
60-69	29.7	31.2	44.8	39.1

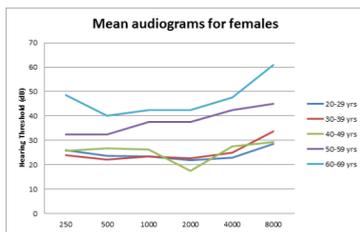
**Table 3: Age & Gender verses Mean Hearing Threshold levels in study subjects.**

Age & Gender Vs Hearing Threshold levels		Males	Females	Mean hearing threshold
Young adults (18-35 yrs)	Right ear	21.5	23.0	22.4
	Left ear	21.2	22.3	21.9
	Mean hearing threshold	21.4	22.7	
Middle age (36-55 yrs)	Right ear	24.2	24.1	24.2
	Left ear	23.1	24.8	23.4
	Mean hearing threshold	23.7	24.5	
Older adults (55 yrs & above)	Right ear	28.1	44.8	31.4
	Left ear	27.8	39.1	30.0
	Mean hearing threshold	27.9	41.9	

In Figure 3 & 4, the graph represents, mean threshold levels of males and females have increased with age.



**Fig 3: Line diagram showing mean audiograms for males Vs Age group**



**Fig 4: Line diagram showing mean audiograms for females Vs Age group**

**DISCUSSION:**

Irrespective of the sample size, there was a significant affect of age on hearing thresholds with reduced auditory sensitivity and increased thresholds at all frequencies in the older groups. Although clinically classified as normal the analysis separated younger and older individuals by indicating different thresholds for each. Sensitivity assessments at higher frequencies showing increased thresholds in parallel with increasing age.<sup>7,8</sup> In the present study, age associated hearing loss initially affected higher frequencies which coincided with other studies.<sup>7,9,10,11,12</sup> Mean hearing threshold level in each group in decibels at different frequencies in men and women and in right and left ears was also evaluated and findings show that with advancing age there was decrease in hearing acuity between 41 to 60 yrs and further decrease above 60 yrs which was coinciding with previous studies.<sup>13,14,15,16,17,18</sup>

The present study shows older group adults had high pure tone threshold sensitivity compared to younger adults which is similar to other studies. In the present study woman had higher thresholds compared to men which are contrary to previous studies.<sup>19,20,21</sup>

As per WHO, a speech frequency pure tone average (PTA 0.5-2-4) of greater than 25 dB hearing loss is the initiation of communication impairment in daily life.<sup>22</sup> Various researchers used PTA for three to four frequencies in the conversational frequency scales. However, PTA 0.5-1-2-4 has been widely

used.<sup>23, 24</sup> The result of this study indicates that there is a significant relationship between age and average hearing threshold. However, this is not noise induced hearing loss, because in NIHL, the hearing threshold frequencies 500, 1000, 2000 Hz is better than hearing threshold at 4000 Hz frequency, accompanied by improvement in frequency at 8000 Hz.<sup>25, 26</sup> This notch is not present in our study. However, in older patients, it is difficult to distinguish between the effects of noise and age related effects without seeing the previous audiogram.<sup>27</sup>

**Conclusion & recommendations:**

It is very common among general population for hearing to get worse as they get older. About 25-40% of people over the age of 65 are affected. Half of all people above the age of 75, and 80% of 80 yr old are hard of hearing. This usually affects their ability to understand what people are saying more than the range of tones they can hear and they can hear low frequencies better than high frequencies. That's why people with age related hearing loss find it particularly difficult to follow conversations in noisy environments. The exact causes of age related hearing loss are not known. Changes in the inner ear and brain are thought to play a role. Nowadays, there are various sound amplifying hearing aids which improve hearing in those individuals and help them understand conversation. All of these hearing aids filter out background noise.<sup>28</sup>

So, the present study recommends that after 40 yrs of age, every individual must undergo regular audiometric examination annually. In regular health check-up policies pure tone audiometry must be included along with other routine investigations.

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