

# One-year prevalence and risk factors of tinnitus in older individuals with otological problems

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## Abstract

**Objective:** The present study was carried out to estimate one year prevalence and risk factors of tinnitus in the older individuals (60 years and above) who reported with the ear and/or hearing related complaint to All India Institute of Speech and hearing, Mysore. **Methods:** The case files of those who visited the institute during the above said period were reviewed retrospectively. **Results:** The results of the study revealed that the prevalence of tinnitus was 16.81%. It was also found that 60.9% of the individuals with tinnitus were males. Further, 97.5% of the individuals with tinnitus had hearing loss. In addition, 28.53% of the individuals with tinnitus had moderate degree of hearing loss followed by moderately severe degree of hearing loss. Most of these individuals had sensorineural impairment. **Conclusion:** It can be concluded that prevalence of tinnitus is quite high in the older individuals with otological problems. The hearing loss, gender, giddiness, headache, hypertension, and diabetes were found to be major risk factors.

**Keywords:** hearing loss, prevalence, tinnitus.

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## INTRODUCTION

Tinnitus is a sound perceived in the ears or head to without any external sound. Tinnitus can be a serious condition as it has been found to comprise of many negative effects<sup>1</sup>. The severity of tinnitus has been found to vary depending on the risk factors it is associated with<sup>2</sup>. Tinnitus is associated with several risk factors such as hearing loss, dizziness<sup>3</sup>, age, gender and noise exposure<sup>2</sup>, among others. It can even affect the quality of life severely, more in the geriatric population<sup>4-6</sup>, as prevalence of the tinnitus has been reported to increase with respect to age<sup>7</sup>. The older individuals might have one or more of the conditions such as otological, neurological, cardiovascular, metabolic, orthopaedic, psychological, dental, pharmacological<sup>4</sup>, hypertension, middle ear diseases, autoimmune disorders, diabetes<sup>8,9</sup>, head injury and, side effect of many drugs. These conditions could be the causes for the tinnitus as well<sup>4,10,11</sup>.

According to the prevalence studies, the prevalence of tinnitus in the general older population was reported to be between 12% to 49%<sup>12</sup>. Below the age of 45 years, tinnitus occurrence was only 1%, however, between 60 to 69 years of age, the tinnitus was reported to be 12%, and 25 to 30% in individuals above 70 years of age<sup>13</sup>.

In addition, the prevalence of tinnitus in hearing loss persons has been reported to be even higher. Henry et al.<sup>14</sup> reported that around 80% of the impaired ears were associated with tinnitus. Clinical based retrospective study conducted by Negrila-Mezei et al.<sup>15</sup> reported an overall prevalence rate of 24.2%, prevalence rate of 49.12% in young elders (60 to 70 years) and of 28.95% in older elders (above 75 years). They found significant differences between these two groups.

Prevalence data are available in many countries across globe. However, in the Indian context, there is very limited information available on the prevalence of tinnitus and the risk factors associated with tinnitus. However, there is a survey study done by Sreeraj et al.<sup>16</sup>. They conducted a door to door survey in Mandya district of Karnataka state, India. They randomly selected 15 villages. The survey was done using a high risk register for estimating the prevalence of communication disorders. According to their results, 9.6% of the total population studied had tinnitus. They also reported that tinnitus was more prevalent in adults and females. However, there is no information about the risk factors associated with tinnitus, except for age and gender. In addition, no information is available on the prevalence of tinnitus and risk factors associated with tinnitus in geriatrics.

Considering the high prevalence of hearing loss in India and high risks associated with it such as the presence of environmental noise causing sociococcus, otitis media<sup>17</sup> and other systemic diseases, the prevalence of tinnitus can also be expected to be high. The prevalence is expected to be even higher in the geriatric population with ear and hearing related problems. These evidences on high prevalence of tinnitus and the severe negative effects of tinnitus mandate the need for good intervention programs. Coles et al.<sup>18</sup> have emphasized that allocation of resources for the development of intervention programs and research on any condition requires statistics on the prevalence of the particular condition.

Hence, it is essential to know the prevalence of tinnitus as well as the associated risk factors, as like any other condition, in order to develop appropriate infrastructure, assessment protocols and intervention strategies for tinnitus. According to Hall et al.<sup>19</sup>, in a UK based prevalence study, the risk factors associated with tinnitus give more information about target prevention campaigns. Hence, it is important to have knowledge on the prevalence and the risk factors associated with the tinnitus.

Hence, the present study attempted to study the prevalence of tinnitus in individuals' with otological complaints and who were 60 years and above. The objectives of this study were to estimate the prevalence and risk factors of tinnitus in the geriatrics who reported with the ear and/or hearing related complaint to All India Institute of Speech and hearing, Mysore, between July 2012 and June 2013 and to compare the same across different gender, degree and types of hearing loss, and analyze other possible risk factors associated with tinnitus.

## METHOD

In order to arrive at the prevalence of the tinnitus in older individuals with otological complaints, the case files of the individuals, in the age range of 60 years and above, who reported to the All India Institute of Speech and Hearing, Mysore, were reviewed. Retrospective evaluation of the case files was done for the duration of one-year between July 2012 and June 2013.

The OPD register was used for the retrospective analysis. The total number, the age and gender of individuals who visited the institute during the above said period and the number of individuals who presented with the complaint of tinnitus were noted down. The case numbers of individuals with the complaint of tinnitus were taken down and their case files were retrieved. The primary and secondary complaints, the type of tinnitus, the age and gender of the Individuals, the occupation of the individuals, and the medical history of the individuals were obtained from the case files.

All the above details were obtained from the case history. Individuals with tinnitus who had visited the department of Audiology had been evaluated for hearing sensitivity. In the department of Audiology, standard procedures and testing conditions are followed for evaluating hearing abilities of those who visit the department. These include the sound treated double room set for carrying out the entire evaluation. Calibrated diagnostic audiometer and middle ear analyzers are used for routine hearing evaluation. Routine hearing evaluation includes pure tone audiometry, speech audiometry and Immittance evaluation. The standard procedures include obtaining pure tone thresholds using the modified version of the Hughson and Westlake procedure in the audiometric frequencies<sup>20</sup>.

Speech audiometry includes tracing the Speech Recognition Thresholds and Speech identification testing using live voice. These are done with standardized speech materials in the listeners' mother tongue. Tympanometry and acoustic reflex thresholds are done as a part of Immittance evaluation. These are done using a 226 Hz probe tone. The interpretation of the results of the above tests and the provisional diagnosis based on that had been made by qualified audiologists. The type of hearing loss and degree of hearing loss were noted down from the provisional diagnosis, if the individual was found to have hearing loss.

## RESULTS

The study involved a retrospective analysis of the OPD registers and case files of the geriatric population who visited the All India Institute of Speech and Hearing, Mysore, between July 2012 and June 2013. The review of OPD registers revealed that a total of 2,758 clients had visited the Institute in the age range of 60 years and above. In these 2,758, case files of 2,695 clients were reviewed as 63 case files were not available for review.

### Prevalence of tinnitus

Of these 2,695 clients, 453 individuals had reported with the symptom of tinnitus. Hence, the prevalence of tinnitus in geriatrics with otological problems, according to the present study, is 16.81%.

### Gender-wise analysis of tinnitus

The assessment of the prevalence of tinnitus with respect to gender revealed that, among the 453 individuals with tinnitus, 276 (60.9%) were males and 177 (39.1%) was females. This is represented in the Figure 1.

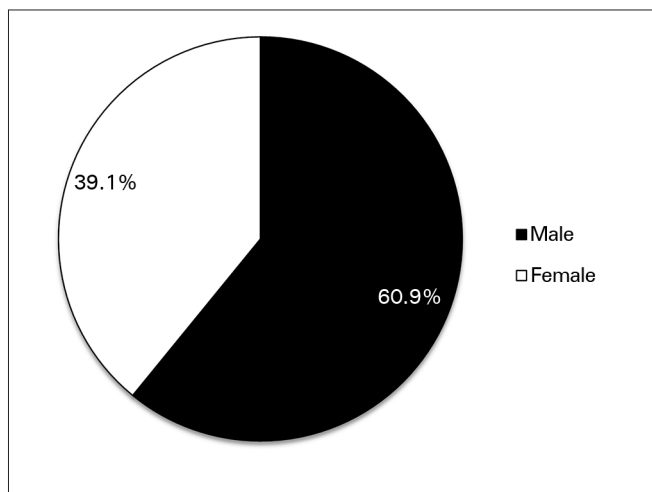


Figure 1. Percentage of tinnitus in males and females.

The gender-wise analysis revealed that more number of individuals with tinnitus were males. Test for equality of proportions was done to observe if these differences in prevalence between males and females were statistically significant or not. The results revealed that between male and female individuals, there was a statistically significant difference ( $|Z| = 6.58$ ,  $|Z| > 1.96$ ).

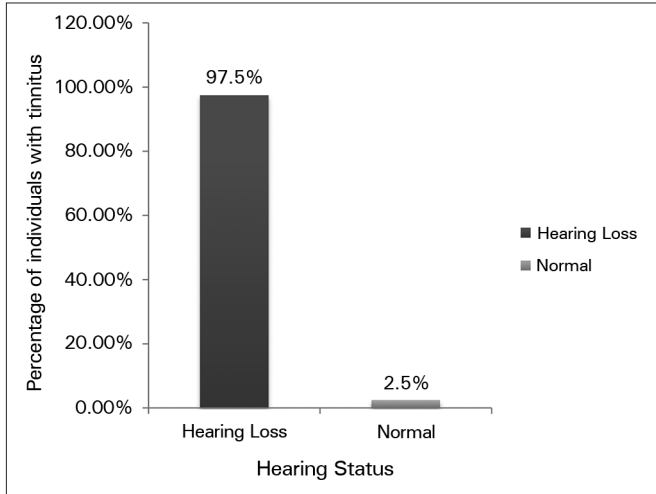
### Analysis of risk factors associated with tinnitus

#### *Tinnitus in individuals with normal hearing sensitivity vs. hearing impairment*

In these 453 individuals with tinnitus, only 392 individuals had visited the department of Audiology and, hence, had been evaluated for hearing sensitivity. The hearing sensitivity of these 392 individuals was analyzed.

For the analysis of tinnitus in normal hearing sensitivity *versus* hearing loss, different types and degrees of hearing loss, the data is presented in terms of number of ears rather than number of individuals as some individuals had reported tinnitus as bilateral and some individuals had reported tinnitus as unilateral. In the present study, totally 590 ears with tinnitus underwent audiological evaluation. Of these 590 ears, 15 (2.5%) were found to have normal hearing sensitivity and 575 (97.5%) had some degree of hearing loss. The result of this is given in the Figure 2.

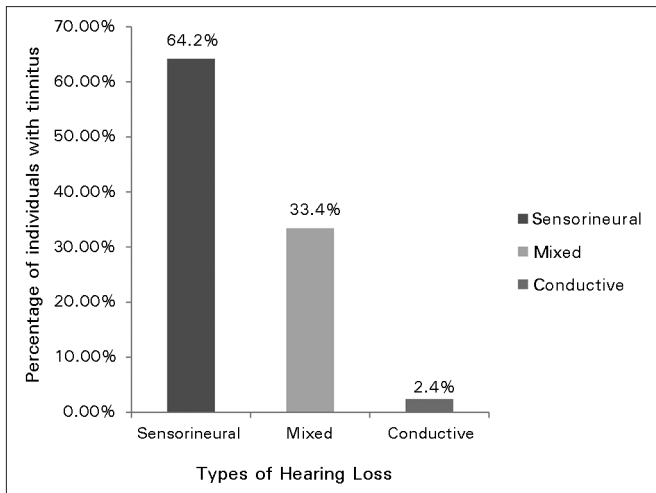
The normal hearing sensitivity *versus* hearing loss analysis of tinnitus revealed that most of the ears with tinnitus had some degree of hearing loss. Test for equality of proportions was done to observe if these differences between ears with normal hearing sensitivity and ears with hearing loss were statistically significant or not. The results revealed a statistically significant difference ( $|Z| = 32.60$ ,  $|Z| > 1.96$ ).



**Figure 2.** Percentage of ears with tinnitus in normal hearing sensitivity and hearing loss.

### Tinnitus in different types of hearing loss

Analysis of prevalence of tinnitus in different types of hearing loss is presented in the Figure 3. Of these 575 ears with tinnitus, 369 (64.2%) were found to have sensorineural type of hearing loss, 192 (33.4%) were mixed and 14 (2.4%) were conductive type of hearing loss. This indicates that the majority of older individuals with tinnitus had the sensorineural type of hearing loss followed by mixed and conductive type of hearing loss, in the decreasing order of prevalence.



**Figure 3.** Percentage of ears with tinnitus in different types of hearing loss.

In order to see if these differences seen among the type of hearing loss were statistically significant or not, Test for equality of proportions was carried out. The results are provided in Table 1. The results revealed a statistically significant difference among three types of hearing loss ( $|Z| > 1.96$ ).

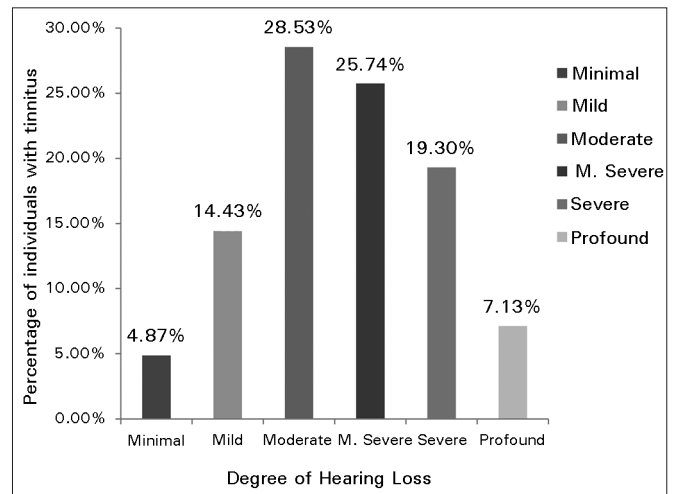
**Table 1.** Results of test for equality of proportions for analysis of tinnitus in different types of hearing loss.

Types of Hearing Loss	$ Z $ value
Sensorineural and Conductive	22.21*
Conductive and Mixed	13.69*
Mixed and Sensorineural	10.44*

\*  $|Z| > 1.96$ .

### Tinnitus in different degrees of hearing loss

Analysis of prevalence of tinnitus in different degrees of hearing loss is presented in the Figure 4. The analysis of results revealed that, among the 575 ears with tinnitus, 28 (4.87%) had minimal hearing loss, 83 (14.43%) had mild hearing loss, 164 (28.53%) had moderate, 148 (25.74%) had moderately severe, 111 (19.30%) had severe, and 41 (7.13%) had profound hearing loss. That is, tinnitus was more prevalent in moderate hearing loss followed by moderately severe, severe, mild, profound and minimal hearing loss, in the lessening order of percentage.



**Figure 4.** Percentage of ears with tinnitus in different degrees of hearing loss.

In order to see if these differences in prevalence among the degree of hearing loss were statistically significant or not, Test for equality of proportions was performed. The results are presented in Table 2. The results revealed other than minimal-profound and moderate-moderately severe group rests of them were statistically significant difference between the degrees of hearing loss groups ( $|Z| > 1.96$ ).

### Other risk factors

The analysis of other symptoms that were present in the 453 older individuals with tinnitus revealed that 93 (20.5%) individuals had headache, 110 (24.3%) had

**Table 2.** Results of test for equality of proportions for analysis tinnitus in different degrees of hearing loss.

Degree of Hearing Loss	Z  value
Minimal and Mild	5.49*
Moderate and Minimal	10.75*
Minimal and Moderately Severe	9.83*
Severe and Minimal	5.99*
Profound and Minimal	1.61
Mild and Moderate	5.81*
Moderately Severe and Mild	4.78*
Mild and Severe	2.20*
Profound and Mild	3.99*
Moderately Severe and Moderate	1.06
Moderate and Severe	3.66*
Profound and Moderate	9.48*
Moderately Severe and Severe	2.61*
Profound and Moderately Severe	8.51*
Severe and Profound	6.09*

\* |Z| > 1.96.

giddiness, 133 (29.4%) individuals had hypertension and 62 (13.7%) individuals had diabetes. Hence, after hearing loss, hypertension, giddiness, headache and diabetes can also be considered as major factors associated with tinnitus. The results of Test for equality of proportions revealed a statistical significant difference ( $|Z| > 1.96$ ) among the risk factors listed above. The results of this are given in Table 3.

**Table 3.** Results of test for equality of proportions for analysis of other risk factors.

Risk Factors	Z  value
Headache and Giddiness	1.35
Headache and Hypertension	3.07*
Headache and Diabetes	2.73*
Giddiness and Hypertension	1.72
Giddiness and Diabetes	4.06*
Hypertension and Diabetes	5.74*

\* |Z| > 1.96.

Hence, hypertension and giddiness are high risk factors for the occurrence of tinnitus. These are followed by headache and diabetes.

## DISCUSSION

### Prevalence of tinnitus

The present study was done to establish the prevalence of tinnitus in geriatrics with otological problems, who visited AIISH between July, 2012 and June 2013. The prevalence of tinnitus in geriatrics in the age range of 60

years and above with otological problems was found to be 16.81%. This result is closer to that was reported by Negrila-Mezei et al.<sup>15</sup> and Melo et al.<sup>21</sup>.

Negrila-Mezei et al.<sup>15</sup> reported a prevalence of 24.2%. Whereas, Melo et al.<sup>21</sup> reported a prevalence of 13.54%. The reason for the difference between the results among the studies could be because of the number of samples included. The present study included more than 2000 samples, whereas Negrila-Mezei et al.<sup>15</sup> included 471 samples.

### Gender-wise analysis of tinnitus

In the present study, tinnitus was more in males than females. This result is disagreeing with that given by Negrila-Mezei et al.<sup>15</sup> and Rosenhall & Karlsson<sup>22</sup>. Earlier studies have reported no significant difference between male and female individuals, whereas in the present study, there was a statistically significant difference among gender. The reason could be that occupation related and social activity related exposure to noise is more in males. In addition, males have more hearing loss than females with respect to exposure of occupational noise leading to a greater number of males with tinnitus than females.

### Analysis of risk factors associated with tinnitus

#### *Tinnitus in individuals with normal hearing sensitivity vs. hearing impairment*

Analysis of the risk factors of tinnitus revealed that hearing loss is one of the major risk factors, i.e., 97.5% of geriatrics with tinnitus have some amount of hearing loss. These results are comparable with the study done by Henry et al.<sup>14</sup> who found that 70 to 85% of the hearing impaired population reported tinnitus. Vernon & Meikle<sup>23</sup> also reported that 70 to 80% of the tinnitus patients had hearing difficulty. Hence, deprivation of auditory stimulation to the auditory system is a major cause of tinnitus.

Further, normal hearing sensitivity in the routine audiometric frequencies can also be associated with the tinnitus. In the present study, 2.5% of the tinnitus individuals had normal hearing sensitivity. This result is lesser than Stouffer & Tyler's<sup>24</sup> study (18%), the reason for this difference could be that the earlier study had included normal hearing range at less than or equal to 25 dB, whereas in the present study, the range taken was less than or equal to 15 dB.

It could also be that the routine testing was not sensitive to detect the little changes in the auditory system that might have caused tinnitus in these cases. The hypothesis is that these individuals with normal hearing sensitivity with tinnitus may have an impairment at frequencies above the 8 KHz as reported by Weisz et al.<sup>25</sup>.



### **Tinnitus in different types of hearing loss**

Type of hearing loss was found to be another factor that could influence the prevalence of tinnitus. Sensorineural hearing loss was associated with tinnitus the most. This result is supported by Baguley et al.<sup>26</sup>, Chung et al.<sup>27</sup>, and Ahmad & Seidman<sup>28</sup>. Many of the causes related to tinnitus are related to the inner ear, and inner ear problems lead to sensorineural hearing loss.

### **Tinnitus in different degrees of hearing loss**

It was also found that more number of individuals with moderate degree of hearing loss had tinnitus followed by moderately-severe degree of hearing loss. Lesser percentage of minimal hearing loss and profound degree of hearing loss geriatrics had tinnitus. This result is not in agreement with that of the study done by Kochkin<sup>29</sup>. They reported that, in individuals with mild degree of hearing loss, tinnitus is more troublesome in day to day life than the hearing loss. Most often they do not report of communication problems. However, in the present study, tinnitus was more prevalent in moderate degree of hearing loss. The reason could be that the number of individuals with moderate hearing loss who visited the Institute might have been more due to the communication problems faced by them. They might have been more concerned and sought help which might not have happened with the minimal and mild degree of hearing loss. However, the data on the total number of individuals with moderate hearing loss who visited the Institute is not available to support the above view.

Even though it has been reported that tinnitus is a common symptom in profound hearing loss<sup>30</sup>, the percentage of tinnitus in profound hearing loss cases is much lesser in the present study.

### **Other risk factors**

Analysis of other risk factors of tinnitus other than hearing loss revealed that hypertension is found to be one of the major risk factors of individuals with tinnitus. Dehmel et al.<sup>31</sup>, also found similar results. Further, Cook-Huvnh<sup>32</sup> has indicated that there is an increasing prevalence of hypertension and diabetes mellitus in the adults and geriatrics. Conditions that cause changes in the blood flow such as the high blood pressure have been reported to increase risk of tinnitus<sup>13</sup>.

The symptom hypertension was followed by giddiness, headache, and diabetes. Gopinath et al.<sup>3</sup> reported that giddiness is a major risk factor in individuals with tinnitus because of the proximity of the vestibular system and cochlea. Further, according to Bartsch & Goadsby<sup>33</sup> and Dehmel et al.<sup>31</sup>, an enlargement of the somatosensory area could lead to headache as well as tinnitus.

## **CONCLUSION**

The present study throws light on the prevalence of tinnitus in older individuals with otological problems. It can be concluded that the prevalence of tinnitus is quite high in older individuals with otological problems; however, information on the significance of tinnitus and severity of tinnitus was not available. The hearing loss, gender are major risk factors, along with giddiness, headache, hypertension, and diabetes.

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