

**ONE-YEAR PREVALENCE AND RISK FACTORS OF TINNITUS IN
INDIVIDUALS WITH OTOLOGICAL PROBLEMS**

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May 2014.

CERTIFICATE

This is to certify that this dissertation entitled “**One-Year Prevalence and Risk Factors of Tinnitus in Individuals with Otological Problems**” is the bonafide work submitted in part fulfillment for the Degree of Master of Science (Audiology) of the student with Registration No: 12AUD014. This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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DECLARATION

This is to certify that this Master's dissertation entitled "**One-Year Prevalence and Risk Factors of Tinnitus in Individuals with Otological Problems**" is the result of my own study under the guidance of Ms. Geetha C., Lecturer in Audiology, Department of Audiology, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier in other University for the award of any Diploma or Degree.

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CHAPTER 1

INTRODUCTION

Tinnitus is defined as a sound perceived in the ears or head unrelated to any external source. Tinnitus has been found to comprise of many negative effects (Tyler & Baker, 1983). Tinnitus in severe condition occurs with depression, concentration difficulties, insomnia, or headaches (Tyler & Baker, 1983). It can even affect the quality of life severely in some persons. In addition, tinnitus is associated with several risk factors such as hearing loss, dizziness (Gopinath et al., 2010), age, gender and noise exposure (Sidhusake et al, 2004) among others. The severity of tinnitus has been found to vary depending on the risk factors it is associated with (Sidhusake et al., 2004).

Tinnitus is a symptom associated with all types of hearing loss and, hence, the prevalence of tinnitus can be expected to be high (Axelsson & Ringdahl, 1989; Davis & Refaie, 2000; Henry & Wilson, 2001; Vernon, 1998). Several attempts have been made to find out the prevalence of tinnitus in the past in various parts of the world.

An epidemiological study of tinnitus in the United States has reported the prevalence of tinnitus in 30 million Americans and out of these; 13 million have tinnitus without hearing loss. In this study, they surveyed nearly 80,000 households by mailing tinnitus related questions. This survey mainly focused on individuals with hearing loss. The results showed that, approximately, one person out of four reported their tinnitus as louder and one person out of five reported their tinnitus as disabling or nearly disabling (Kochkin, Tyler, & Born, 2011).

In Canada, it was found that greater than 360,000 individuals have tinnitus in an annoying form. In that, 150,000 individuals reported that tinnitus affects their quality of life

(Craig, 2004). A population study in Sweden reported that 14.2% of the adults experienced tinnitus often or always (Craig, 2004).

Similarly, a study carried out in Italy showed that 14.5% of the population had significant tinnitus (Craig, 2004). Prevalence of tinnitus in the north of Shaanxi Province, China, has been found to be 7.8% among 28,000 participants as reported by Xu et al. (2011).

The above mentioned prevalence details of the other countries have consistently reported that prevalence of tinnitus in adults range from about 8 to 15 percent of the population studied, which is quite high.

In the Indian context, there is limited information available on the prevalence of tinnitus. However, there is a survey study done by Sreeraj et al. (2013). 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.

NEED FOR STUDY

These evidences on high prevalence of tinnitus in general population and the severe negative effects of tinnitus mandate the need for good intervention programs. Coles et al. (1984) have emphasized that allocation of resources for the development of intervention programs and research on any condition requires statistics on 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.

In addition, the prevalence of tinnitus in hearing loss persons have been reported to be even higher, i.e., 70-85% of the hearing impaired population reported tinnitus (Henry, Dennis,

& Schechter, 2005). According to Hall et al. (2013), 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 of tinnitus. Prevalence data are available in many countries across globe. However, in the Indian context, there is limited information available on the prevalence of tinnitus and the risk factors associated with tinnitus. Though Sreeraj et al's study provides data on prevalence of tinnitus, there is no information about the risk factors associated with tinnitus except for age and gender. In addition, there is no mention about the prevalence of tinnitus even in the results of National Sample Survey 58th round (NSSO, 2003).

Considering the high prevalence of hearing impairment in India, especially due to presence of high risks of otitis media and presence of environmental noise causing sociocusis (Garg et al., 2009), prevalence of tinnitus can also be expected to be high, more in the persons with ear and hearing related problems. Hence, the present study attempted to study the prevalence of tinnitus in individuals' with otological complaints.

AIM OF THE STUDY

The aim of this study was to estimate the prevalence and risk factors of tinnitus in the individuals 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.

OBJECTIVES OF THE STUDY

The objectives of this study were:

- 1) To estimate the prevalence of tinnitus in the individuals who reported with otological complaint to All India Institute of Speech and hearing, Mysore, between July 2012 and June 2013, using a register-based study design,
- 2) To compare the same across different age groups, gender, degree and types of hearing loss, and
- 3) To analyze other possible risk factors associated with tinnitus.

CHAPTER 2

REVIEW OF LITERATURE

The literature on tinnitus has been reviewed under following headings:

- Definition and characteristics of tinnitus
- Pathophysiology of tinnitus
- Epidemiology
- Risk factors

Definition and characteristics of tinnitus

“Tinnitus is defined as a sound perceived in the ears or head unrelated to any external source” (Tyler & Baker, 1983). According to Hallan, Rechman and Hincheliffe (1984), tinnitus has been characterized as perceiving noises, mainly originating forcefully inside the head, without any external acoustic stimuli. Vernon (1995) described tinnitus as a noise perceived by the patient when there is no external acoustic stimulus.

Tinnitus has been reported as a condition not a disease and tinnitus has been found to result from many causes such as ear infections, cerumen, exposure of loud sounds, multiple sclerosis, and oxidative stress, and foreign bodies in the ear (Pall & Bedient, 2007). Tinnitus may occur with conductive hearing loss or sensorineural hearing loss; tinnitus may also result from certain medications. However, the noise induced hearing loss is reported to be the major cause for tinnitus (Pall & Bedient, 2007). In its more severe form, tinnitus can be together with depression, headaches, concentration difficulties, or insomnia (Tyler & Baker, 1983).

Tinnitus is ranged from a quiet situation to noisy situation by the persons with tinnitus that is audible over loud external sounds. Tinnitus is mainly divided into two types: subjective and objective.

Subjective tinnitus is the perception of a sound whose origin is inside the head. It is audible only to the individual who has the tinnitus and is referred to as "head noise" to distinguish it from sounds produced by external sources (Fowler, 1939). Because an external noise explained in terms of spectral magnitude and location, efforts have been put to explain the tinnitus similarly (e.g., Bailey, 1979; Goodwin & Johnson, 1980a, 1980b; Graham & Newby, 1962; Josephon, 1931; Reed, 1960; Vernon, 1976). Objective tinnitus is audible to others as a sound coming from the ear canal (Dobie, 2004). Subjective tinnitus is the most common experienced by clients (Hendry, Zaugg & Myers, 2010).

Irrespective of the type of tinnitus, the tinnitus is considered to be of concern, when it bothers people, affects their life, and causes them frequently to seek professional help and become patients. This is termed as significant tinnitus. Survey reports have found that four percentage of people reported clinically significant tinnitus, in the United States approximately 10 to 12 million people reported significant tinnitus (Snow, 2004).

In addition, left-sided localization of tinnitus is found to be commoner than right-sided in clinical populations, according to Taylor-Walsh (1984). Erlandsson, Hallberg and Axelsson (1992) noticed that patients with considerable low levels of mood more often had tinnitus located to the left ear. The right hemisphere is dominant regarding emotional experiences, and qualitative differences in the capacity of integrating and discriminating sensory input were mentioned by the authors as some of the causes of the commoner left sided localization of tinnitus.

According to Roderik Mrena et al. (2002), 42% of the individuals report of tinnitus in the left ear, 19% of them in the right ear and 25% of them having tinnitus in both ears either to an equal extent or with one ear dominating. Based on Edge theory, edge area spontaneous activity is increased and it cause tinnitus (Kiang, Moxon, & Levine, 1970).

Pathophysiology of tinnitus

It has been found that 85% of persons with tinnitus have hearing loss and most of the time in the cases where cochlea is damaged by leisure and occupational noise (Axelsson, & Prasher, 2000).

Causes of tinnitus are mainly associated with ototoxic drugs, systemic disorders, head and neck injuries, autoimmune disorders, temporomandibular joint disorders, vascular and cerebrovascular diseases, ear conditions, and infectious disease (Vernon & Moller, 1995).

Several theories, mechanisms and models have been proposed. Some researchers believe that the origin of tinnitus is cochlea. They proposed discordant damage of inner and outer hair cells systems in tinnitus generation and the involvement of an abnormal increase of gain within the auditory system (Jastreboff & Hazel, 1993). Some more authors have proposed different mechanisms and they attribute the source of tinnitus to: central auditory system (Henry, Dannis, & Schechter, 2005); altered spontaneous activity in the cochlear nucleus (Kaltenbach et al., 2000); increased spontaneous activity in extra lemniscal pathway (Moller et al., 1992); and more spontaneous activity in external nucleus of inferior colliculus (Jastreboff, 1995; Manabe et al., 1997). In the neurophysiologic model, Jastreboff (1996) reported that there is involvement of reactive, emotional system, and auditory perceptual systems in tinnitus generation.

Recent research explains that the tinnitus occurs because of changes in the neural activity, however, knowledge about the accurate neural substrates of tinnitus is still limited. This is because of the difficulties to separate the changes that have been induced by hearing loss from that are specifically associated with tinnitus (Eggermont, & Roberts, 2004; Moller, 2007).

Epidemiology

Tinnitus is a common issue (Davis & Rafeie, 2000), and can be a serious one (Andersson, 2009). There are many epidemiological reports available on the prevalence of tinnitus carried out in the past, across different countries.

Epidemiology of tinnitus in abroad

An epidemiological study in the United States found 30 million individuals have tinnitus. Of these, 13 million individuals reported tinnitus without any hearing problems. Approximately, one out of four individual have their tinnitus as louder and one individual out of five have tinnitus as disabling or nearly disabling (Kochkin, Tyler, & Born, 2011).

A canadian study has reported a prevalence of tinnitus in more than 360,000 with an annoying form. Of these, 150,000 persons reported that tinnitus impairs their quality of life (Craig, 2004). In a study done in Sweden, estimated prevalence of tinnitus for adults was around 14.2% (Craig, 2004).

Similarly, in Italy, an epidemiological study of tinnitus was conducted in five cities and they have found that 14.5% of individuals have tinnitus and their tinnitus was prolonged, spontaneous tinnitus (Craig, 2004). In the north of Shaanxi Province, China, study reported 7.8% among 28,000 of the population have tinnitus as reported by Xu et al. (2011). These reports show that the prevalence of tinnitus in adults range from 8 to 15 percent of the population studied.

Epidemiology of tinnitus in india

Information on prevalence of tinnitus in india is very limited. To our knowledge, there is only one published epidemiological study that was conducted in Mandya district of Karnataka state, India, by Sreeraj et al. (2013). It was a door to door survey as a part of a camp in 15 randomly chosen villages of Mandya district. Survey of different communication disorders was done using a high risk register on a total of 15, 441 individuals. They have

reported that prevalence of hearing loss was 76.45% and prevalence of tinnitus was 9.6%. They have found that tinnitus was more prevalent in females than males and that tinnitus was more prevalent in age range of 15 to 50 yrs. Apart from these, other risk factors have not been reported in the present study.

Risk factors

There are many factors that have been found to be associated with tinnitus. Hearing loss has been found to be a major risk factor associated with tinnitus (Chung et al., 1984; Sindhusake et al., 2003, 2004). However, some individuals with tinnitus have normal audiograms. This could be because of presence of small amount of cochlear damage that is not reflected in the audiogram (Shiomi et al., 1997; Weisz et al., 2005) or because of presence of hearing loss in high frequencies beyond 8 kHz that it is not identified by routine audiometry testing (Roberts et al., 2006).

The perception of the tinnitus and hearing loss are related to each other. Most of the times individuals with tinnitus match their pitch of the tinnitus to the pure tone in the frequency range where they have hearing loss (Henry et al., 1999; Norena et al., 2002). In animals, hearing loss due to cochlear damage resulted in reduced firing rate of spontaneous fibers (Liberman and Dodds, 1984). Because of this reduction, there is discontinuity of spontaneous activity in the auditory pathway. Studies suggest that this kind of discontinuity could be redundant by homeostatic changes (Schaette and Kempster, 2006) and lateral inhibition (Gerken, 1996) leading to activity which is consistent with a tone-like tinnitus.

Age is another risk factor associated with tinnitus. Prevalence of tinnitus increases with hearing loss and age (Moller, 1981; Spoor, 1967). According to Coles (1984), 16 to 19 percentages of the adults reported of tinnitus of more than 5 minutes duration. The age of the

individuals who reported of tinnitus was 17 years or more. In another study, 9.7 percentages of the adults reported tinnitus (Davis, 1989).

Klein et al. (1991) reported that the prevalence of tinnitus increases with age till the age of 60 or 65 years, and between the age range of 70 and 79 years, the prevalence of tinnitus remains constant. Along with tinnitus there are other changes that occur with aging. The changes are retirement, changes in mood due to decreased social activity, illness, depression, loss of friends or spouse, loss of function, and anxiety. These changes in the life events have the chance to increase the loudness of tinnitus perception or to increase the tinnitus reactions (Henry & Wilson, 2001). This may be the reason for age to be the major risk factor associated with tinnitus. Other than hearing loss and age, exposure to noise and ototoxic drugs have also been found to be important risk factors associated with tinnitus (Moller, 1981).

Noise exposure is another factor associated with tinnitus. According to Shargorodsky et al. (2010), the association between the perception of tinnitus and noise exposure depends on the hearing status. Especially, the occupational noise exposure has been found to have strong relationship between tinnitus as well as hearing loss (Rubak et al., 2008). This could be because of the damage in outer hair cells, inner hair cells and acoustic nerves by occupational noise (Nordmann, 2000). There are several other factors also associated with tinnitus such as ear infections/inflammation, otosclerosis, presbycusis, sudden deafness otological problems, head and neck injuries, systemic disorders, infections, autoimmune disorders and cerebrovascular diseases (Chiossoine et al., 2000; Grist Wood & Venables, 2003; Martin & Snashall, 1994; Perry & Gantz, 2000; Podoshin, Ben-David & Teszler, 1997; Rosenhall & Karlsson, 1991; Vernon & Moller, 1995).

Apart from these, higher body mass index, cigarette smoking, lower income, reduced general health status, (Hoffman & Red, 2004). Depressive moods, educational level, knee

point pain and past/current history of coronary heart disease (Takehiro Michikawa, 2010) also considered as risk factors. Further, there is significant relationship between tinnitus and hypertension as reported by Shargorodsky et al. (2010).

Based on the review of literature, it can be said that there is quite a high prevalence of tinnitus in individuals with hearing loss, and the risk factors associated with tinnitus also provide important information concerning the prevention and management. However, in India, only limited information about the prevalence of tinnitus available and, to our knowledge, there is no study which analyses all the risk factors associated with tinnitus.

CHAPTER 3

METHOD

The present study was conducted at All India Institute of Speech and Hearing, Mysore. The aim of the study was to estimate the prevalence and risk factors of tinnitus in the individuals with otological problems. A register based study design was used to find out the prevalence of tinnitus. A retrospective case analysis was carried out by reviewing the case files of those who visited the institute presenting complaints related to ear and/or hearing in between July 2012 and June 2013.

The OPD register was used to the retrospective analysis. The total number, the age and gender of individuals 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 following details were obtained from the case files:

- The primary and secondary complaints,
- Type of tinnitus,
- Age and gender of the Individuals,
- Occupation of the individuals, and
- Medical history of the individuals

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. The standard procedures include obtaining puretone thresholds using modified version of the Hughson and Westlake procedure (Carhart, & Jerger, 1959) in the audiometric frequencies. Speech audiometry includes tracing the Speech Recognition Thresholds and Speech identification testing. These are done with standardized speech materials in the listeners' mother tongue. The puretone audiometry and speech audiometry had been tested with calibrated diagnostic audiometers. Speech identification testing had been done with live voice presentation of phonetically balanced monosyllables at 40 dB SL (re: SRT) or at the maximum comfortable level. Immittance evaluation includes assessment of tympanometry and acoustic reflex threshold testing for a 226 Hz probe tone with calibrated middle ear analysers.

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.

CHAPTER 4

RESULTS

The study involved retrospective analysis of the OPD registers and case files of individuals 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 12,656 clients had visited the Institute. Of these 12,656, case files of 12,325 clients were reviewed as 331 case files were not available for review.

Prevalence of tinnitus

Of these 12,325 clients, 1,766 individuals had reported with the symptom of tinnitus. Hence, the prevalence of tinnitus in individuals with otological problems, according to the present study, is 14.33%. Of these 1,766 clients, 349 individuals had reported tinnitus as a primary complaint and 1,417 clients had reported tinnitus as a secondary complaint.

Tinnitus in different age groups

The age-wise analysis of percentage of tinnitus is presented in the Figure 1. The analysis of results revealed that, among the 1,766 individuals with tinnitus, 59 (3.3%) were children, 102 (5.8%) were adolescents, 1152 (65.2%) were adults and 453 (25.7%) were geriatrics. That is, more number of individuals with tinnitus were adults followed by geriatric, adolescent and children, in the decreasing order of percentage.

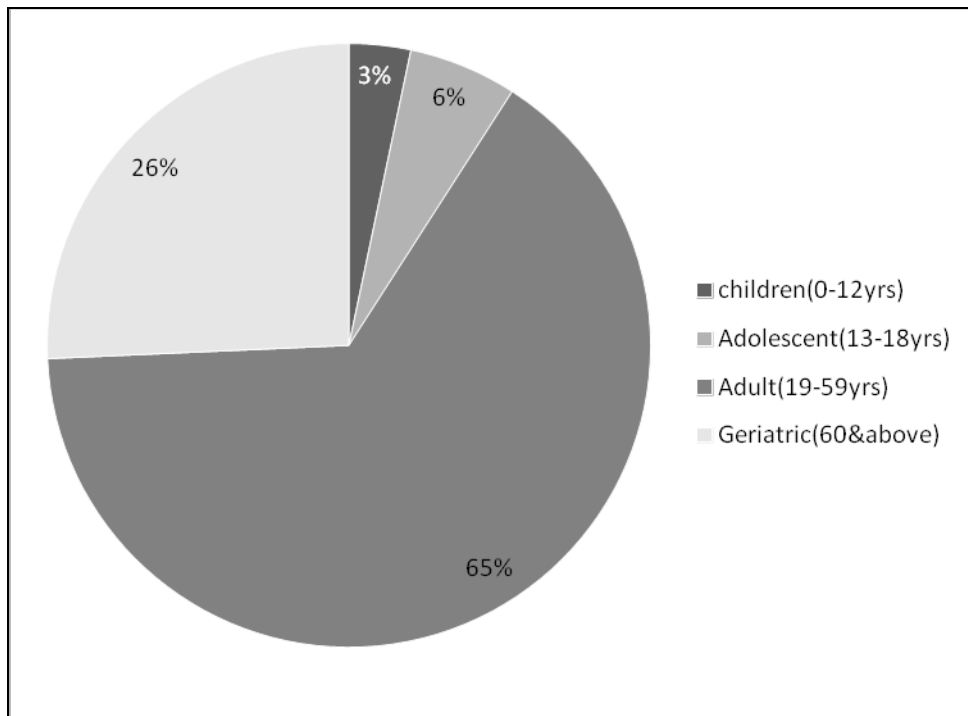


Figure 1: Percentage of individuals with tinnitus in different age groups (in years).

In order to see if these differences seen among the different age groups were statistically significant or not, Test for equality of proportions was performed. The results are presented in Table 1. The results revealed a statistically significant difference among all the age groups ($|Z| > 1.96$).

Table 1

Results of test for equality of proportions for age-wise analysis of percentage of individuals with tinnitus.

Age Group	Z value
Children (0-12 yrs) and Adolescent (13-18 yrs)	3.47 *
Adult (19-59 yrs) and Children (0-12yrs)	38.74 *
Geriatric (60 & above) and Children (0-12 yrs)	18.83 *
Adult (19-59 yrs) and Adolescent (13-18 yrs)	36.92 *
Adolescent (13-18 yrs) and Geriatric (60 & above)	16.23 *
Geriatric (60 & above) and Adult (19-59 yrs)	23.62 *

*|Z| > 1.96

Gender-wise analysis of tinnitus

The assessment of prevalence of tinnitus with respect to gender revealed that, among the 1,766 individuals with tinnitus, 1006 (57%) were males and 760 (43%) were females. This is represented in the Figure 2.

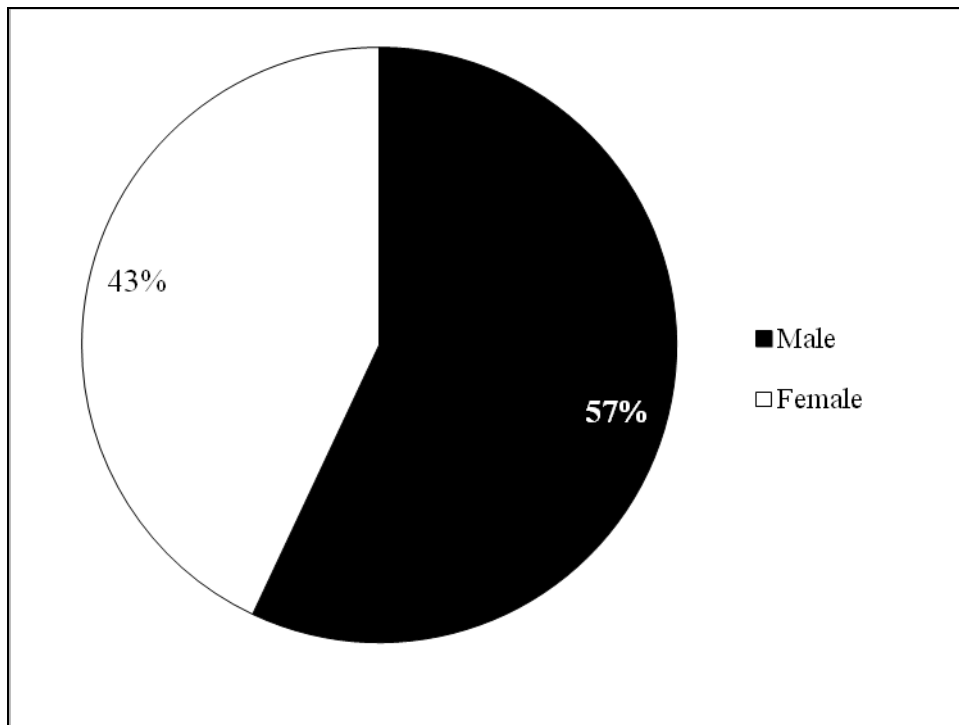


Figure 2: Percentage of tinnitus in males and females.

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 ($|Z| = 8.28, |Z| > 1.96$).

Analysis of risk factors associated with tinnitus

Tinnitus in individuals with normal hearing sensitivity vs hearing impairment

Of these 1,766 individuals with tinnitus, only 1,250 individuals had visited the department of Audiology and, hence, had been evaluated for hearing sensitivity. The hearing sensitivity of these 1,250 individuals was analyzed.

Of these 1,250 individuals with tinnitus, 220 (17.6%) were found to have normal hearing sensitivity and 1030 (82.4%) had some degree of hearing loss. The result of this is given in the Figure 3.

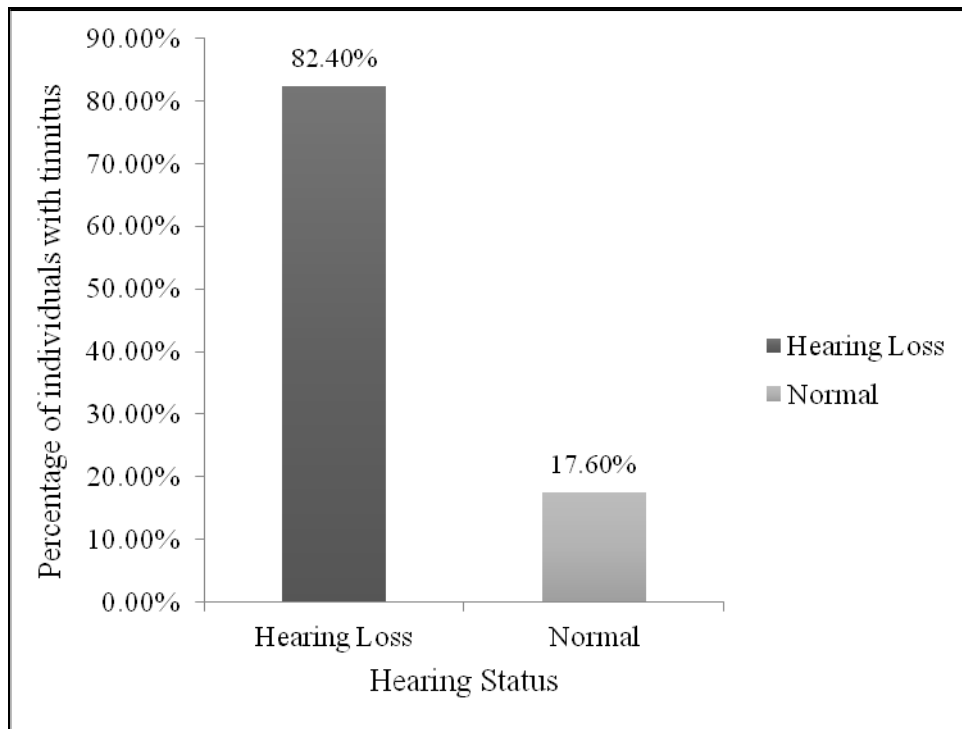


Figure 3: Percentage of individuals with tinnitus with normal hearing sensitivity and hearing loss.

The normal hearing sensitivity versus hearing loss analysis of tinnitus revealed that most of the individuals with tinnitus had some degree of hearing loss. Test for equality of proportions was done to observe if these differences between individuals with normal hearing sensitivity and individuals with hearing loss were statistically significant or not. The results revealed a statistically significant difference ($|Z| = 32.40$, $|Z| > 1.96$).

Tinnitus in different types of hearing loss

For the analysis of tinnitus in 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 bilateral hearing loss. In the present study, totally 1,751 ears with tinnitus underwent

audiological evaluation. Out of these 1,751 ears, 1,531 ears with tinnitus had some degree of hearing loss. Of these 1,531 ears with tinnitus, 798 (52.12%) were found to have sensorineural type of hearing loss, 408 (26.65%) were mixed and 325 (21.23%) were conductive type of hearing loss. This indicates that majority of individuals with tinnitus had sensorineural type of hearing loss followed by mixed and conductive type of hearing loss, in the decreasing order of prevalence. This is represented in the Figure 4.

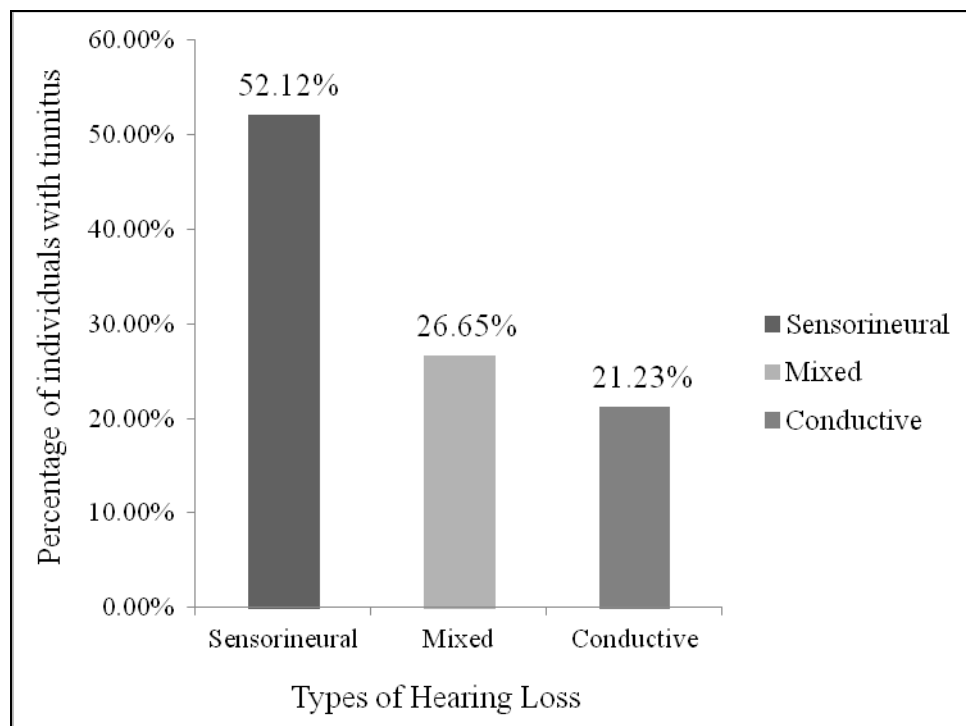


Figure 4: Percentage of individuals with tinnitus in different types of hearing loss.

Table 2

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	17.74 *
Conductive and Mixed	3.52 *
Mixed and Sensorineural	14.42 *

*|Z| > 1.96

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 2. The results revealed a statistically significant difference among three types of hearing loss ($|Z| > 1.96$).

Tinnitus in different degrees of hearing loss

Analysis of prevalence of tinnitus in different degrees of hearing loss is presented in the Figure 5. The analysis of results revealed that, among the 1,531 ears with tinnitus, 210 (13.72%) had minimal hearing loss, 320 (20.90%) had mild hearing loss, 380 (24.82%) had moderate, 303 (19.79%) had moderately severe, 234 (15.28%) had severe, and 84 (5.49%) had profound hearing loss. That is, tinnitus is more prevalent in moderate hearing loss followed by mild, moderately severe, severe, minimal, and profound hearing loss, in the lessening order of percentage.

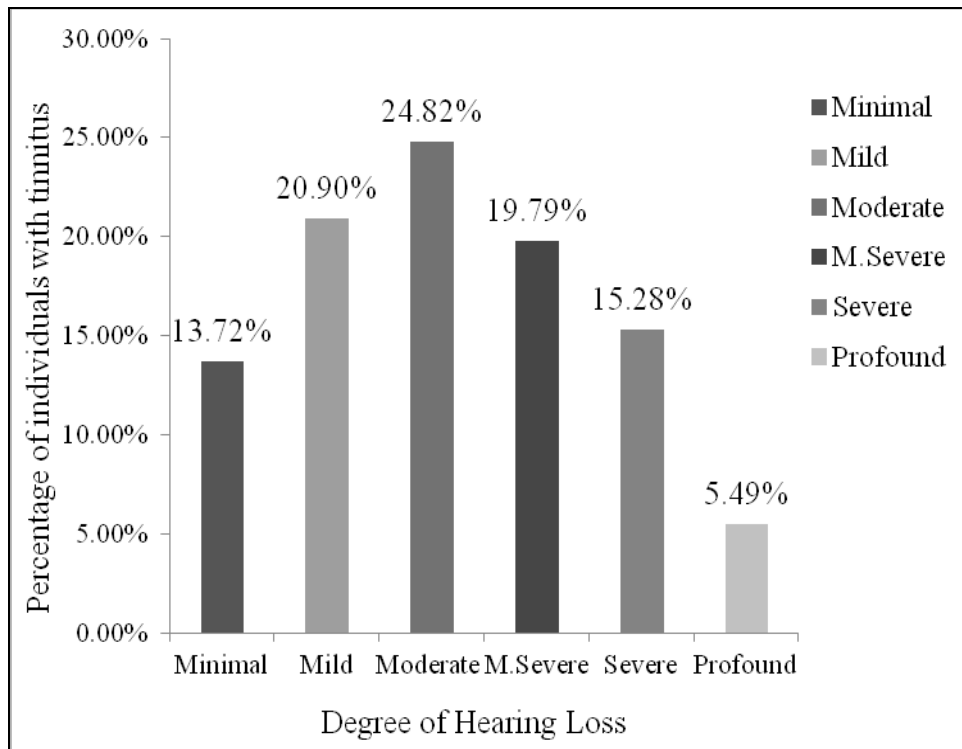


Figure 5: Percentage of individuals with tinnitus in different degrees of hearing loss.

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 3. The results revealed a statistically significant difference among all the types of hearing loss groups ($|Z| > 1.96$).

Table 3

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	5.25 *
Moderate and Minimal	7.79 *
Minimal and Moderately Severe	4.50 *
Severe and Minimal	1.23
Profound and Minimal	7.73 *
Mild and Moderate	2.58 *
Moderately Severe and Mild	0.76
Mild and Severe	4.03 *
Profound and Mild	12.60 *
Moderately Severe and Moderate	3.34 *
Moderate and Severe	6.59 *
Profound and Moderate	14.92 *
Moderately Severe and Severe	3.28 *
Profound and Moderately Severe	11.91 *
Severe and Profound	8.88 *

*|Z| > 1.96

Other risk factors

The analysis of other symptoms that were present in the 1,766 individuals with tinnitus revealed that 415 (23.5%) individuals had headache, 392 (22.2%) had giddiness, 223 (12.6%) individuals had hypertension and 106 (6%) individuals had diabetes. Hence, after hearing loss, hypertension, headache, diabetes and giddiness can also be considered as major factors associated with tinnitus. This can be viewed in Figure 6. 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 4.

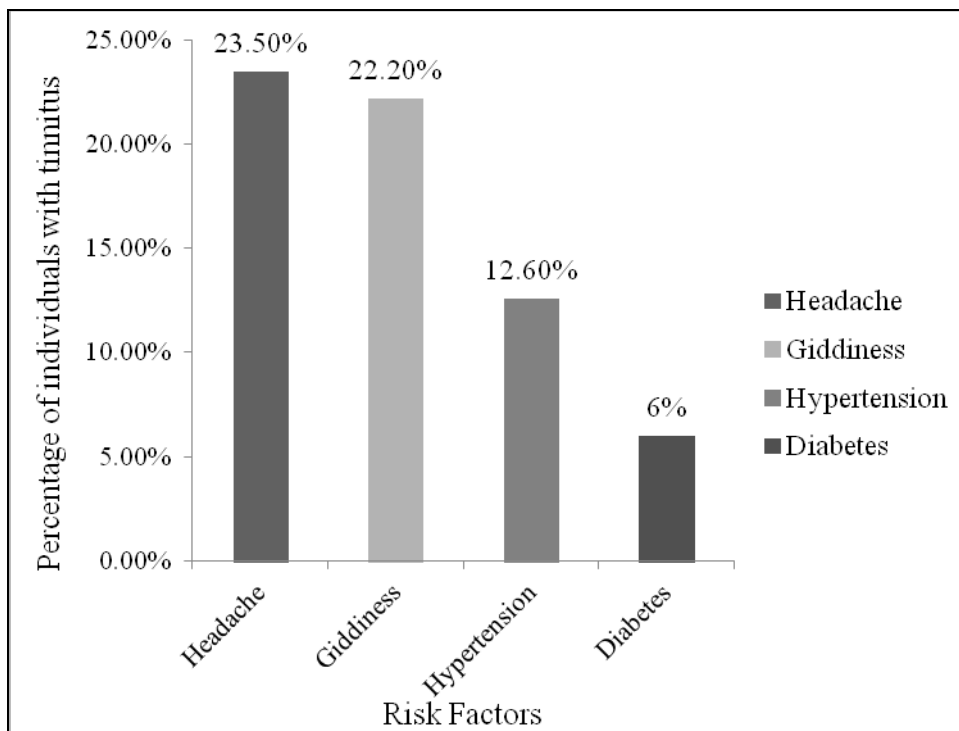


Figure 6: Percentage of individuals with headache, giddiness, hypertension, and diabetes with tinnitus.

Table 4:

Results of test for equality of proportions for analysis of other risk factors.

Risk Factors	Z value
Headache and Giddiness	0.92
Headache and Hypertension	8.39 *
Headache and Diabetes	14.66 *
Giddiness and Hypertension	7.49 *
Giddiness and Diabetes	13.83 *
Hypertension and Diabetes	6.77 *

Hence, headache and giddiness are high risk factors for the occurrence of tinnitus.

These are followed by hypertension and diabetes.

CHAPTER 5

DISCUSSION

Prevalence of tinnitus

The present study was done to establish the prevalence of tinnitus in individuals with otological problems, who visited AIISH between July, 2012 and June 2013. The prevalence of tinnitus in individuals with otological problems was found to be 14.33%. These results are similar to that was reported by Quaranta et al. (1996) and higher than that was reported by Xu et al. (2011) and Sreeraj et al. (2013).

Xu et al. (2011) reported a prevalence of 7.8% and Sreeraj et al. (2013) reported a prevalence of 9.6%. The reason for the difference between the present study and the earlier studies could be that the earlier studies have reported the prevalence in the general population, where as in the present study, only the individuals with otological problems have been included. Further, in the present study, the individuals who reported the tinnitus as a primary complaint is much lesser and the information on the exact prevalence of clinically significant tinnitus and the severity of tinnitus are not known in the present study as this is a retrospective study. Where as Quaranta et al. reported the prevalence of tinnitus only in the hearing loss population which might have led to similar results.

Tinnitus in different age groups

In the present study, most individuals with tinnitus were adults followed by geriatrics. Children had the least percentage of tinnitus. A Swedish study reported by Axelsson and Ringdahl, (1989) found that 14.2% of adults suffer from tinnitus and Hoffman and Red (2004) found that 10 to 15% of adults suffer from tinnitus. These figures are much lower than that is reported in the present study. The reason for the disagreement in results could be the population that was studied. The earlier study included general population. Further, the

prevalence is expected to be more in the geriatric population, however, in the present study, adults are found to be more prone to tinnitus. It could be that the total number of adults who visited the OPD is double in number that of geriatrics which might have led to such results.

Tinnitus was least prevalent in children in the present study. These results support the results of Shulman et al. (1991). Shulman et al. attributed this to the reason that children may consider tinnitus as an usual event and that children are incapable of differentiating emotional impact of the tinnitus from its remedial significance.

Gender-wise analysis of tinnitus

In the present study, tinnitus was more in males than females. This result is in agreement with that given by Adegbenro, Amusa, Ijadunola and Adeyemo (2013). The reason could be that occupation related and social activity related exposure to noise is more in males. The reason could be that males have more hearing loss than females with respect to exposure of occupational noise and because of this, greater number of males have more tinnitus than females.

Nevertheless, Sreeraj et al's study reported that tinnitus was more prevalent in females than in males, however, the reason for this not explained in their study. Further, there is no statistical data to indicate if the difference was statistically significant or not.

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., 82.40% of individuals with tinnitus have some degree of hearing loss. These results are comparable with the study done by Henry, Dennis, and Schechter (2005) who found that 70 to 85% of the hearing impaired population reported tinnitus. Vernon and Meikle (2000) also reported that 70 to 80% of the tinnitus patients had hearing difficulty. Hence, deprivation of auditory stimulation to the auditory system can be 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, 17.60% of the tinnitus individuals had normal hearing sensitivity. This result is correlated with that of Stouffer and Tyler (1990) and Schaette and McAlpine (2011). It could be that the routine testing was not sensitive to detect the changes that have happened to the auditory system in these cases. The hypothesis is that these individuals with normal hearing sensitivity with tinnitus may have impairment at frequencies above the 8 KHz as reported by Weisz et al. (2006).

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. (2013), Chung et al. (1984), Coles (1984) and Ahmad and Seidman (2004). The reason for this, by analyzing the possible causes of tinnitus, is that many of the causes related to tinnitus are related to the inner ear, and inner ear problems lead to sensorineural hearing loss. Sensorineural hearing loss was followed by mixed, and conductive hearing loss was least in individuals with tinnitus.

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 mild degree of hearing loss. Lesser percentage of minimal hearing loss and profound degree of hearing loss individuals had tinnitus. This result is dissimilar to the results of the study done by Kochkin (2007). 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 (Baguley & Atlas, 2007), the percentage of tinnitus in profound hearing loss cases is much lesser in the present study. This could be because of the reason that, majority of the individuals with profound hearing loss who visit the institute is children. Children, as discussed above, do not report of the symptom even though it may be present.

Other risk factors

Analysis of other risk factors of tinnitus other than hearing loss revealed that headache is found to be one of the major risk factors of individuals with tinnitus. Bartsch and Goadsby (2003) and Dehmel et al. (2008) also found similar results. According to the authors, the reason could be that, in both headaches and tinnitus, an enlargement of the somatosensory area might play a major role.

The symptom headache was followed by giddiness, hypertension, and diabetes. Gopinath et al. (2010) reported that giddiness is a major risk factor in individuals with tinnitus because of the proximity of the vestibular system and cochlea.

Further, Cook-Huvnh (2012) has indicated that there is an increasing prevalence of hypertension and diabetes mellitus in the adults. Conditions that cause changes in the blood flow such as the high blood pressure have been reported to increase risk of tinnitus (Shargorodsky, Curhan, & Farwell, 2010). In the present study, majority of the individuals were adults and geriatrics, which could have led to the results.

CHAPTER 6

SUMMARY AND CONCLUSIONS

The prevalence studies in different countries have reported quite a high prevalence rate of tinnitus, especially in hearing loss individuals (Craig, 2004; Henry, Dennis, & Schechter, 2005; Kochkin, Tyler, & Born, 2011). It is emphasized that in order to develop proper infrastructure, assessment protocols and intervention strategies for any condition it is necessary to know the prevalence of tinnitus as well as the associated risk factors, as like any other condition (Coles et al., 1984).

Hence, the present study was carried out to estimate the prevalence and risk factors of tinnitus in the individuals who reported with the ear or hearing related complaint to All India Institute of Speech and hearing, Mysore, between July 2012 and June 2013. A retrospective case analysis was carried out by reviewing the case files of those who visited the institute during the above period. The details regarding the presence of tinnitus, the primary and secondary complaints, type of tinnitus, age and gender of the Individuals, occupation of the individuals, medical history of the individuals, the type of hearing loss and degree of hearing loss were collected.

The results of the data obtained revealed that:

- The prevalence of tinnitus was 14.33%. It was assumed that all individuals with tinnitus had significant tinnitus.
- Of these 14.33%, majority was adults, followed by geriatrics, adolescent and children in the decreasing order of prevalence. There was a statistically significant difference among these groups.

- It was also found that majority of the individuals with tinnitus were males. The reason could be the work related noise exposure being more for males than females.
- Further, majority of the individuals with tinnitus had hearing loss (82.4%). Hence, hearing loss is one of the major risk factors.
- In addition, majority of the individuals with tinnitus had moderate degree of hearing loss followed by mild degree of hearing loss. Most of these individuals had sensorineural impairment (52.12%).
- Giddiness, headache, hypertension and diabetes were also found to be the significant risk factors.

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

Implications

- The results of the present study can be helpful to have the knowledge on prevalence and risk factors of tinnitus in individuals with ear and hearing related problems in the Indian context.
- It can be used to develop proper infrastructure, assessment protocols and intervention strategies for tinnitus.

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