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Original Research Article

Isolated tinnitus – premonitory symptom of an evolving auditory dysfunction: a retrospective analysis

Marie C. S. Stephen, Bhanuprakash P. N.*, Anju Venugopalan, Nagaraj B. Thimmasettiah

Department of ENT, MVJ Medical College and Research Hospital, Hoskote, Bengaluru, Karnataka, India

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***Correspondence:**
Dr. Bhanuprakash P. N.,
E-mail: bhanuprakashpn@gmail.com

ABSTRACT

Background: Tinnitus manifests frequently with hearing loss. Isolated tinnitus in patients with self-professed normal hearing may have underlying auditory dysfunction.
Methods: We retrospectively reviewed the audiometry record of our department from January 2019 to October 2021. Pure tone audiometry thresholds of patients with isolated tinnitus were analyzed along with the demographics, degree and type of hearing loss.
Results: Of 255 (132 males/123 females) patients, mean age 39.7±15.2 years (range: 10-80 years), tinnitus was maximum (49%) prevalent among 20-40 years group, 5.8% among the pediatric population and 8.6% amidst ≥60 years populace. Males predominated (52%) throughout except at 21-30 years age. 83% exhibited some degree of hearing loss (42% bilateral minimal loss, 11% bilateral mild hearing loss). 7% right ears (mostly >50 years age group) and 11% left ears showed greater than mild hearing loss. Bilateral tinnitus presented more (52%) followed by left tinnitus (29%) than right (19%). Mild hearing loss predominated right tinnitus presentation while minimal loss was recorded in left and bilateral tinnitus. However, greater than mild degree of hearing loss was clustered among bilateral tinnitus (14%) followed by left tinnitus (11%) than right tinnitus (6%). 18% had sensorineural deafness and all these patients had bilateral tinnitus. 30% had high frequency hearing loss and 39% among these had 4 kHz dip.
Conclusions: Isolated tinnitus may be a premonitory symptom of an underlying or an evolving auditory dysfunction. Bilateral tinnitus followed by left tinnitus presentation warrant higher index of suspicion.

Keywords: Auditory pathway, Cochlea, Hair cells, Otorhinolaryngology, Tinnitus

INTRODUCTION

Tinnitus (Latin: tinnire – to ring) is described since ancient times.[1] It is defined as the perception of sound in the absence of an external acoustic stimulus.[2] This pathologically altered hearing perception results from neuronal hyperactivity induced by changes in the audio somatosensory integration in the cochlear nucleus generated by deficits in the peripheral auditory pathway.[3]

One in five persons experiences tinnitus especially the elderly population.[4] Its world-wide prevalence is 11–30%.[1,2,5] Indian estimates report 7-14% among general population, 16% amid ≥60 years and 5% in <18 years populace.[6-8] Patients with hearing loss are more likely to suffer tinnitus.[4] However, patients with isolated complaint of tinnitus with self-professed normal hearing often disregard it. The multifaceted etiology, incompletely described pathophysiological mechanisms underlying tinnitus, besides the commonly prevailing self-resolving and subjective nature of tinnitus could prove to be factors behind this complacency.[9] However, isolated tinnitus should be regarded as a premonitory symptom of an underlying or possibly evolving auditory dysfunction.

We proposed to analyze the audiometric thresholds of patients with isolated tinnitus and no other otological symptoms.

METHODS

An observational retrospective analysis was undertaken. Institutional ethics committee (No. IEC – 40/2022) approved the study. The audiometry record maintained in the department of otorhinolaryngology at our institute was reviewed. Patients with complaint of isolated tinnitus referred for pure tone audiometry (PTA) were chosen irrespective of age from 01 January 2019 to 31 October 2021. Patients who were referred for PTA with other associated otological complaints besides tinnitus were excluded. Audiometry was performed by the senior audiologist in the standard manner following American speech-language hearing association (ASHA) guidelines (modified Hughson-Westlake method) using appropriately calibrated RMS decent audiometer. Air conduction was measured using Telephonics TDH-30 supra-aural headphones and bone conduction with B71 bone vibrator. The pure tone average for each of the ears were calculated by averaging the thresholds at frequencies 500 Hz, 1000 Hz and 2000 Hz. The audiometric record of each of these patients was retrieved from the saved database. The demographics, tinnitus laterality, pure tone thresholds for each of the ears were noted down and the average threshold were documented. The degree and type of hearing loss was thus recorded. Data were tabulated on Microsoft excel software version 2013. The results were analyzed using pivot table tool of excel and the observations were depicted using graphs and the clinical parameters were tabulated.

RESULTS

Of the 255 patients, 52% (132) were males and 48% (123) were females (Table 1). The mean age was 39.7±15.2 years (range 10 to 80 years) (Figure 1). Prevalence of tinnitus among the younger population 20-40 years was 49% (125/255), maximum among 26-30 years group (14%; 35/255). The curve then gradually sloped down till 55 years of age followed by a spike at 55-60 years of age. Beyond this, there was a steep downward slope with increasing age. The prevalence among >60 years of age was 8.6% (22/255 patients) and 5.8% (15/255) among the pediatric populace <18 years of age (Figure 1).

There was a slight male predominance (52%, 132/255) throughout the study population, maximum among the pediatric population (11/15) (Figure 2). However, the male to female ratio gradually decreased and reversed (11males/21 females) at 21-25 years and 26-30 years age group respectively and stabilized equal at 31-35 years. Beyond this, the trend paced towards male prevalence throughout except at 55-60 years.

17% were seen to have normal hearing. That is, 83% (211/255) had some degree of hearing loss (Figure 3). The predominant pattern was bilateral minimal loss 42% (106/255) followed by bilateral (11%) mild degree of hearing loss (15% right ear/19% left ear). That is, 7% right ears and 11% left ears had greater than mild degree of hearing loss, although, it was clustered among >50 years age groups for the right ears but was scattered across the entire adult population for the left ears (Figure 4). Among the pediatric population, of the 30 ears (15 patients), 7 right ears each had minimal and mild loss while in the left ears, 8 minimal loss and 1 had mild hearing loss.

The type of hearing was analyzed (Table 1). 65% (166/255) patients had bilateral normal hearing. 45 (18%) patients had bilateral SNHL and all had presented with bilateral tinnitus. 2 patients among the lot had bilateral conductive loss.

Table 1: Clinical parameters of patients.

Parameters (N=255)*	N$ (%)
Males	132 (52)
Females	123 (48)
Age (years) [mean (±SD)]	39.7 (±15.2)
Pediatric (<18)	15 (5.8)
Elderly (>60)	22 (8.6)
Tinnitus laterality (N=125)	
Bilateral	65 (52)
Left sided	36 (29)
Right sided	24 (19)
Bilateral normal hearing on PTA	44 (17)
Hearing loss on PTA	211 (83)
PTA threshold right ears	
Normal	68 (27)
Minimal	131 (51)
Mild	39 (15)
Moderate	8 (3)
Moderate severe	7 (3)
Severe	2 (1)
PTA threshold left ears	
Normal	48 (19)
Minimal	131 (51)
Mild	48 (19)
Moderate	16 (6)
Moderate severe	6 (2)
Severe	6 (2)
Type of hearing loss	
Right	
Normal	196 (77)
Conductive	2
Sensorineural	55 (22)
Mixed	2
Left	
Normal	176 (69)
Conductive	7
Sensorineural	68 (27)
Mixed	4

*-Total number of patients included in the study; $-number of patients as per the parameter

30% (77/255) patients showed high frequency hearing loss. Among them, 30 patients had dip at 4 kHz (12

bilateral; 14 right, 4 left sided) possibly indicating noise exposure and 47 patients showed sloping HL at 4, 6 and 8 KHz. Of the 255 patients, however, data on tinnitus laterality was available in the record for only 125 patients. Of the 125 patients, bilateral tinnitus was slightly common (52%).

In unilateral tinnitus, left (29%) predominated over right (19%) (Table 1). The predominant pattern among patients with isolated right tinnitus was mild hearing loss while patients with left tinnitus showed minimal followed by mild hearing loss. Bilateral tinnitus presentation showed more minimal loss. (Figures 5-7).

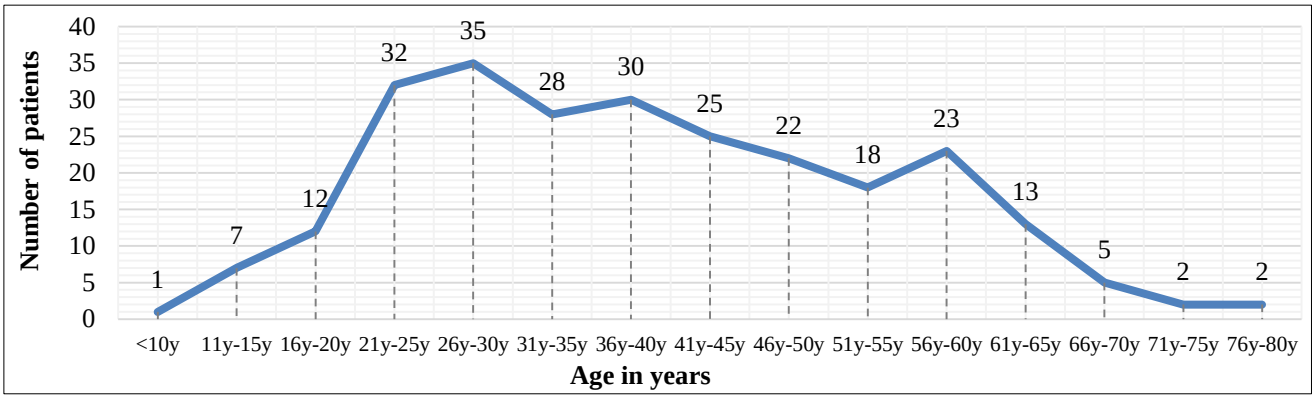


Figure 1: Age stratified prevalence of tinnitus.

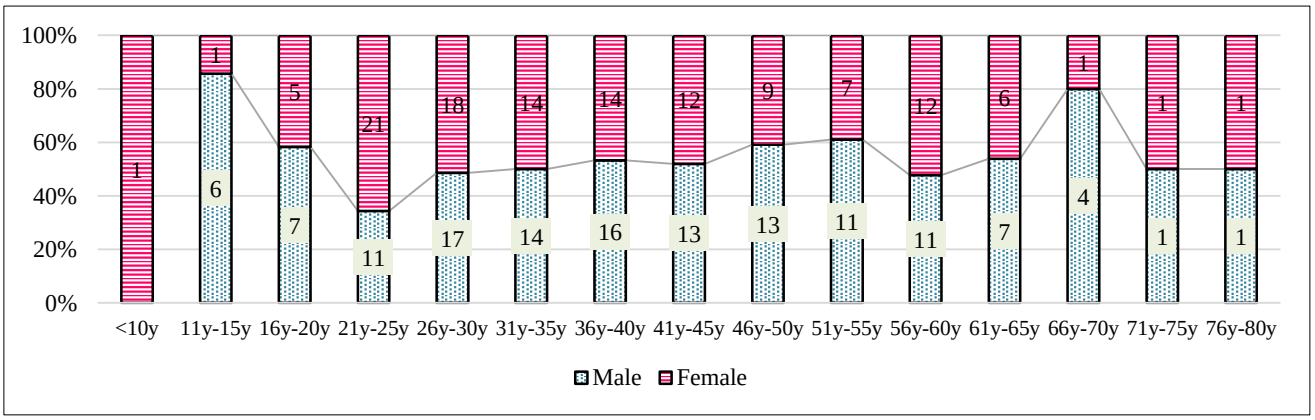
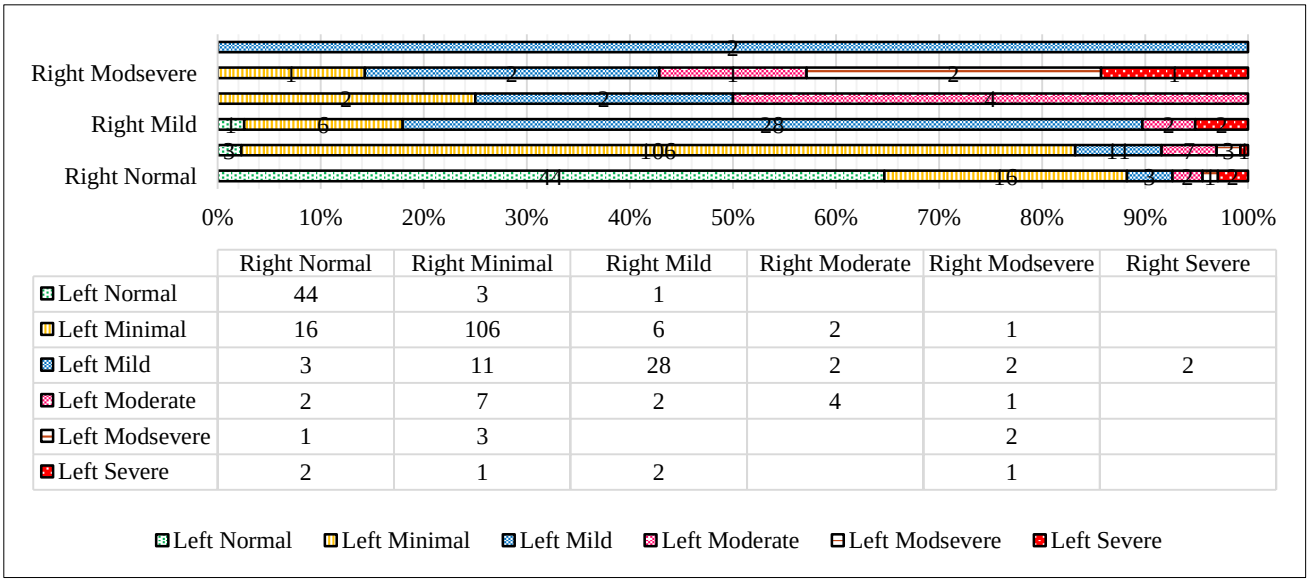


Figure 2: Age stratified sex distribution of tinnitus patients.



	Right Normal	Right Minimal	Right Mild	Right Moderate	Right Modsevere	Right Severe
Left Normal	44	3	1			
Left Minimal	16	106	6	2	1	
Left Mild	3	11	28	2	2	2
Left Moderate	2	7	2	4	1	
Left Modsevere	1	3			2	
Left Severe	2	1	2		1	

Left Normal Left Minimal Left Mild Left Moderate Left Modsevere Left Severe

Figure 3: Degree of hearing loss in tinnitus patients in right ear and left ear.

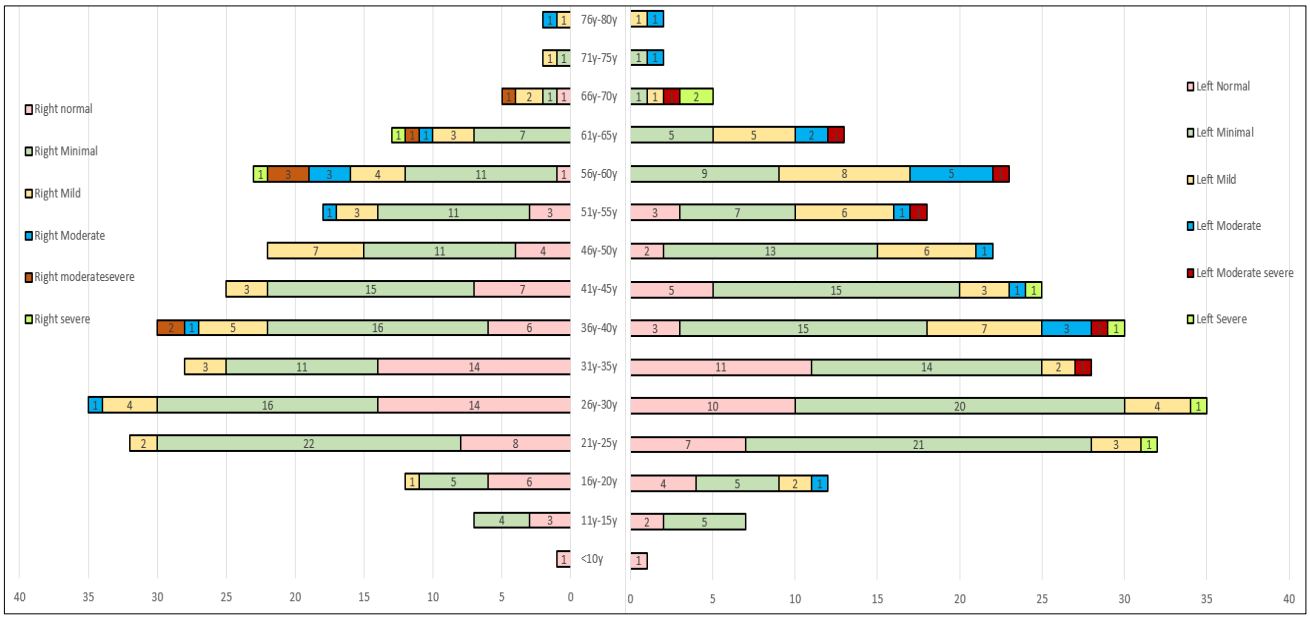


Figure 4: Age stratified degree of hearing loss among right ears versus left ears.

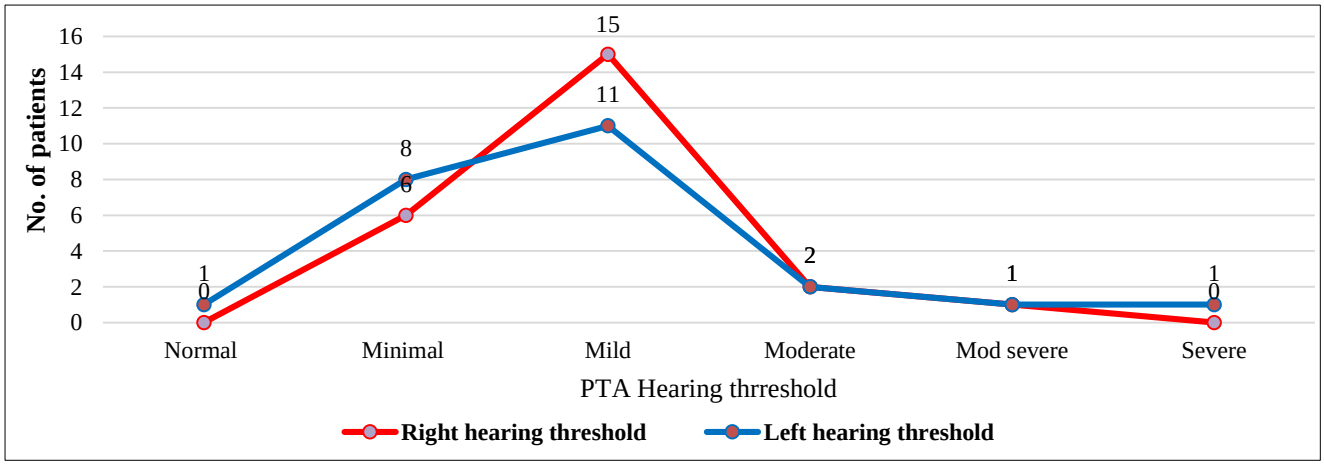


Figure 5: Pure tone audiometry (PTA) thresholds in patients with right tinnitus.

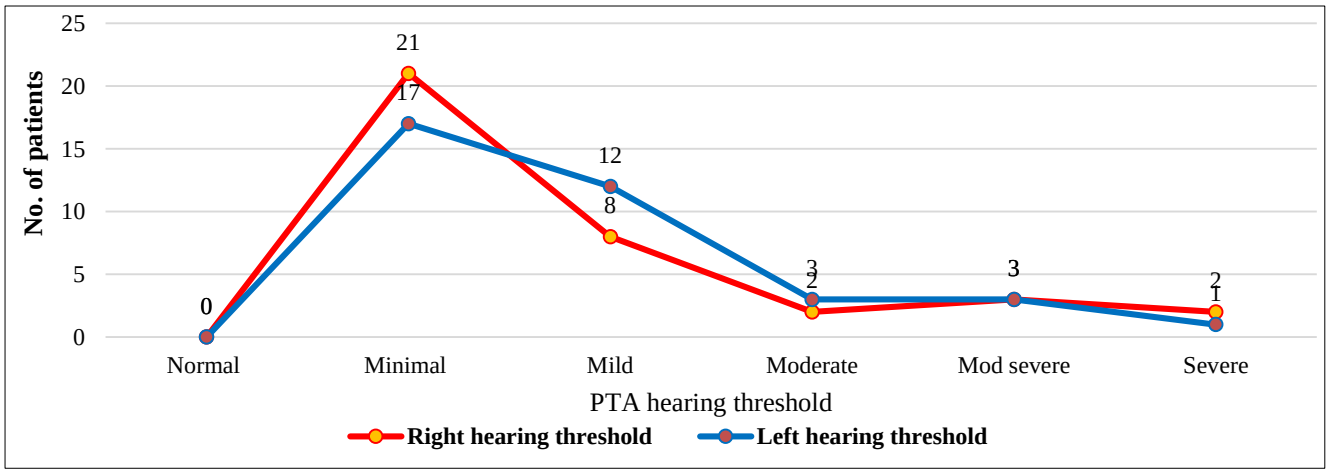


Figure 6: Pure tone audiometry (PTA) thresholds in patients with left tinnitus.

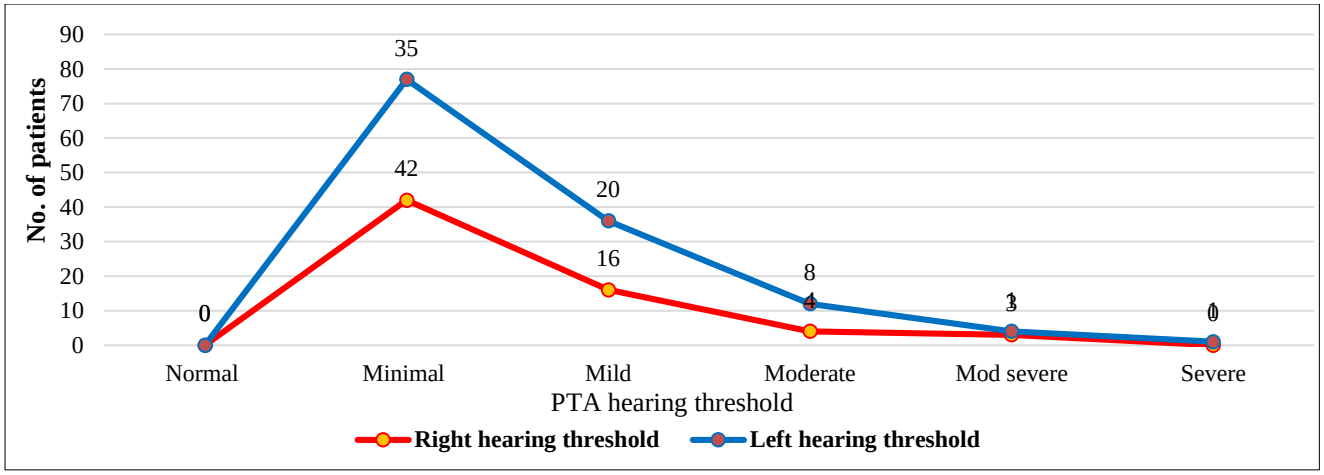


Figure 7: Pure tone audiometry (PTA) thresholds in patients with bilateral tinnitus.

DISCUSSION

The results of our study found the maximum prevalence of tinnitus among the younger population 20-40 years age group with gradual downward slope beyond. This was in contrast to many studies which showed higher prevalence with increasing age.[5,7,10-13] The possible reason could be the increasing exposure of the younger age group to occupation and leisure related noise exposure.[12] Excessive head phone usage, extensive involvement in social media and gaming related activities need mention here. Especially, with the recent pandemic induced lockdowns, many in an effort to escape boredom resort to indefinite hours of head phones usage. In addition, with the ever booming IT revolution, there seems to be an increasing number employed in the IT sector, wherein the long hours of office calls pose a bigger threat to the already exhausted ears. However, no significant age or gender related prevalence for tinnitus was noticed in the Blue Mountains hearing study.[14]

The prevalence among the elderly >60 years of age was 8.6%. Studies have shown a higher prevalence at 16.8%, 21% and 30% with major risk factors like diabetes, hypertension, associated hearing loss and vertigo.[4,7,14] The early diagnosis and apt control of these comorbid conditions and the fewer visits to hospitals in view of the recent lockdowns could have resulted in lower prevalence among the elderly in our study. The prevalence among pediatric populace <18 years of age was 5.8%. This was in accordance with a systematic review on pediatric prevalence of tinnitus from 4.7% to 46%.[8,15]

There was a slight male predominance in our study, maximum among the pediatric population. However, Thirunavukkarasu et al found no gender difference.[8] Like most of the studies, the male predominance could possibly be associated with outdoor, occupational and leisure time noise exposures.[5,7,10-14] However, there was a reversal of pattern at 21-30 years which equaled at 31-35 years. The female predominance in this age group could possibly be due to increasing working women likely exposed to industrial noises especially in rural settings, premature marriages and domestic violence, early child birth with resultant prolonged noise exposures during child care and tantrums. Increased stress leading to lower tinnitus annoyance have also been factors for higher female prevalence.[13,16]

83% in our study had manifested some degree of hearing loss, predominantly minimal and mild. Studies have shown frequent association of tinnitus with auditory deficits.[2,4,7,11,14,17] Although, mechanisms behind this synergy are still ambiguous, the characteristics of hearing loss may not be related to the tinnitus percept.[2,17,18] Also there is no direct influence of hearing loss on the impact of tinnitus.[19] 7% right ears and 11% left ears in our study showed greater than mild degree of hearing loss; 18% had sensorineural hearing loss. The severity of tinnitus was significantly worse in those with hearing loss compared to those with normal hearing thresholds.[10,19,20] Thirunavukkarasu et al showed 28% affected with moderate and moderately severe hearing loss with most being sensorineural deafness.[7]

17% in our study presented a normal audiogram. Guest et al described ~8% tinnitus patients with normal audiogram.[21] Cochlear synaptopathy is a subclinical or hidden hearing loss characterized by macroscopically intact cochlear hair cells, but signify a synaptic loss between the inner hair cells and spiral ganglion neurons possibly due to aging or noise exposure resulting in (near) normal audiometric thresholds.[21-23] This kind of primary de-afferentation exhibits preferential loss of neurons at high thresholds.[21] The presence or absence of hearing loss clinically determined by PTA in the octave frequencies 125Hz to 8kHz does not detect possible hearing loss at extended high frequencies.[2,24]

Also, PTA assesses only sensitivity and not capture deficits in supra threshold processing.[2] Tinnitus thus potentially points to being an initial symptom of an underlying or evolving auditory pathology before any measurable audiometric changes.[17]

30% showed high frequency hearing loss and 39% among them showed 4 kHz dip suggestive of noise exposure. Tinnitus is more common in high-frequency steeply sloping audiometric configurations than flat audiogram.[11] Occupational or recreational loud noise exposure have consistently been associated with tinnitus.[12]

Bilateral tinnitus presentation (52%) was slightly commoner than unilateral tinnitus. Similar presentation was reported by Reiss et al.[25] Bilateral tinnitus development has been associated with hyperactivity at the level of cochlear nucleus while unilateral tinnitus results from higher order cortical involvement.[26] Patients with bilateral tinnitus had frequent noise exposure, longer tinnitus duration with a higher pitch and hypersensitivity to sound compared to their unilateral counterparts.[26]

Left sided tinnitus (29%) presented more than the right (19%) in our study. Left lateralization was shown by many studies especially when bilateral presentation was split for ease of statistical analysis.[10,14,27] Left sided tinnitus have been linked to the biological effectiveness of right efferent auditory pathway compared to the left.[10]

In our study, majority of the patients with right tinnitus showed mild hearing loss while minimal loss was predominant in left sided or bilateral tinnitus. Although, greater than mild degree of hearing loss was clustered among those who had bilateral and left tinnitus more than right tinnitus. This was in accordance with studies which described right sided tinnitus frequently had normal hearing as compared to left tinnitus which was associated more with hearing impairment.[10]

Limitations

Data on tinnitus laterality could be retrieved only for less than half of the study population and the results were accordingly truncated. Data on potential confounders like comorbidities and noise exposure were not available. Data on impedance audiometry if was available would have generated further valuable outcome.

CONCLUSION

There was a greater proportion of patients with tinnitus and self-professed normal hearing who showed elevated audiometric thresholds. Though minimal to mild hearing loss predominated most of these ears, irrespective of tinnitus laterality, the smaller proportion of patients with greater than mild hearing loss cannot be disregarded. Bilateral tinnitus followed by left tinnitus warrant higher index of suspicion in view of their increased risk for greater than mild degree of hearing loss. Tinnitus thus may be a premonitory symptom of an underlying or evolving auditory dysfunction.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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